Organic Vegetable Insect Management

Organic Vegetable Production Conference, February 2, 2018

Madison, WI

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http://labs.russell.wisc.edu/vegento/

Vegetable IPM Resources

- Vegetable Insect Mgmt Web-page

http://labs.russell.wisc.edu/vegento/

- Vegetable Disease Mgmt Web-page

http://www.plantpath.wisc.edu/wivegdis

http://www.plantpath.wisc.edu/wivegdis/contents_pages/veg_crop_updates.html

- ATTRA

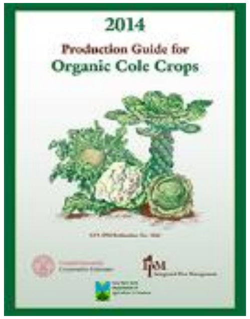
NCAT ATTRA NATIONAL SUSTAINABLE AGRICULTURE INFORMATION SERVICE

https://attra.ncat.org/publication.html

- Wisconsin Pest Bulletin

http://datcpservices.wisconsin.gov/pb/index.jsp

Vegetable IPM Resources



- Cornell University, Organic Guide for Vegetables

  http://nysipm.cornell.edu/organic_guide/veg_org_guide.asp

- Organic Materials Review Institute Web-page

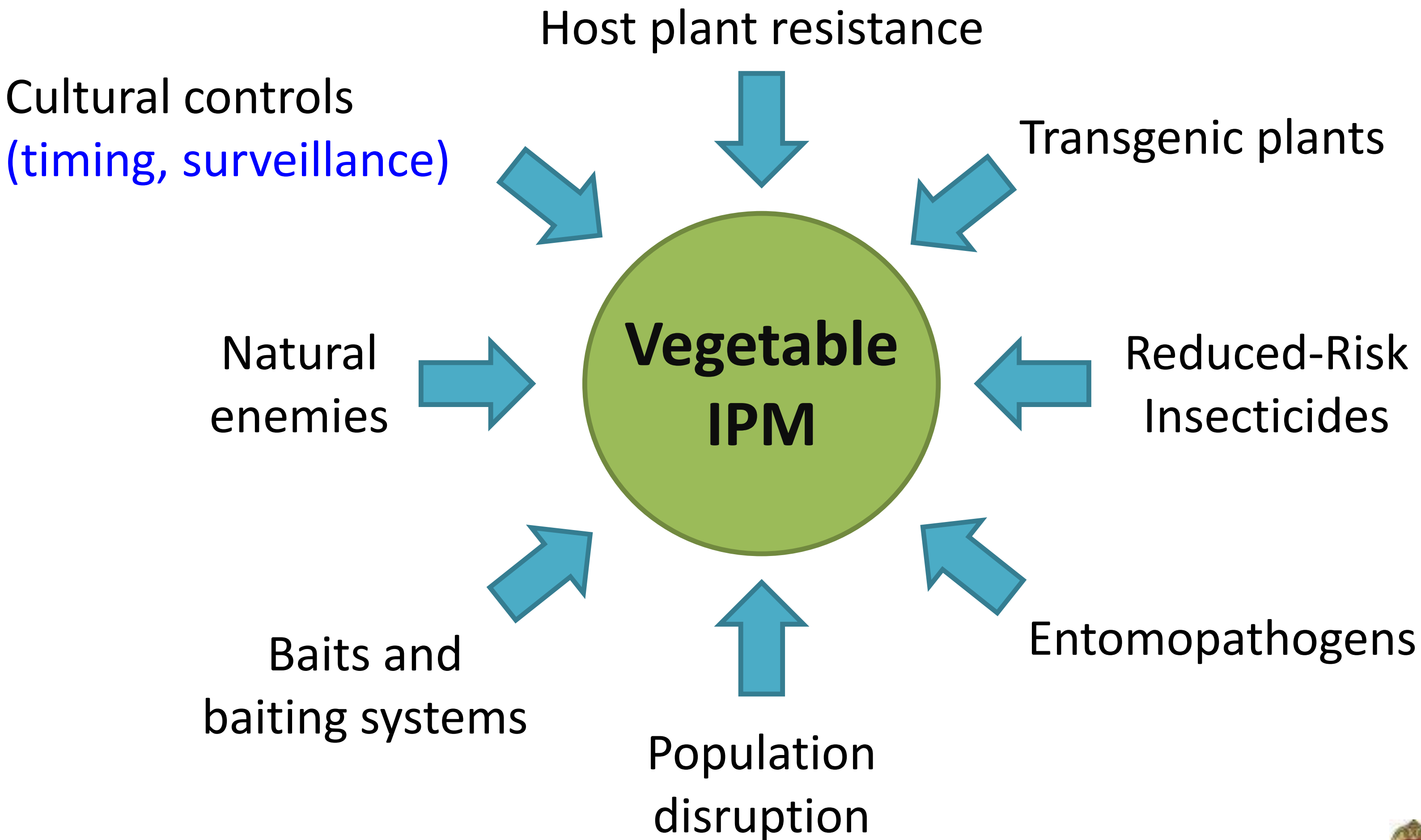
  http://www.omri.org/omri-lists/download

- UWEX Learning Store

  http://learningstore.uwex.edu/

Organic pest management tactics for vegetables

Use all available tools to manage pest damage in the most economic, socially, and environmentally sound way



Process of an IPM program

decision flow

Component	Process
monitoring and sampling	inspect crop
pest identification	what pest(s)?
decision-making	what action(s)?
Intervention	take action(s)
follow-up	re-inspect crop
record-keeping	write it down
education	review and learn

- For all farm sizes and *any* management approach (e.g. conventional, agro-ecological, or organic)

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Presentation Outline

- Cucurbit pests – cucumbers, melons, squash, pumpkins
  (seed maggots, cucumber beetle, squash vine borer)

  - avoidance in time (rotation, planting dates, phenology, and DD)
  - avoidance in space (rotation, trap crops)
  - varietal selection

- Brassica pests – cabbage, cauliflower, broccoli, mustard greens
  (caterpillar pests, cabbage maggot, flea beetles, thrips)

  - biocontrol and natural enemies

- Potato leafhopper, onion thrips

  - anticipating a problem

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Cold and warm blooded animals

- A **poikilotherm** is an organism whose internal temperature varies considerably.



- A **homeotherm** is an organism whose internal temperature remains constant.


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Calculating Degree Days

- **Temperature controls the developmental rate of poikilotherms (plants, invertebrates).**

- **The amount of heat required to complete a given organism's development does not vary—the combination of temperature (between thresholds) and time remains constant and is expressed and approximated in units called degree-days (DD).**

- **Different insects have different developmental minimums and maxima**

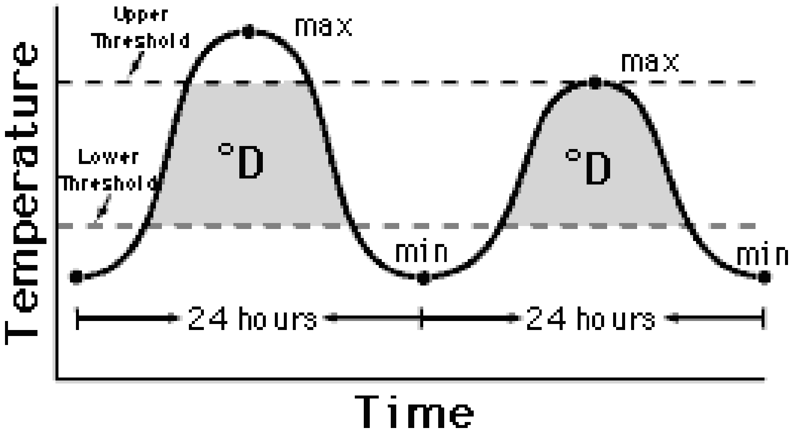

University of Wisconsin Garden Facts

Extension

Provided to you by:

Degree Days for Common Fruit and Vegetable Insect Pests

COMMON VEGETABLE INSECTS THAT CAN BE MONITORED USING DEGREE DAYS OR INDICATOR PLANTS



http://fyi.uwex.edu/hort/files/2014/11/Degree-Daysfor-Common-Fruit-and-Vegetable-Insect-Pests.pdf

Example Insects & Associated Degree Day Calculations

Colorado potato beetle, (1st generation only)
Base temperature = 50°F
Biofix - Begin counting when first eggs appear
- 1st instar larva at 185 DD_{50}
- 2nd instar larva at 240 DD_{50}
- 3rd instar larva at 300 DD_{50}
- 4th instar larva at 400 DD_{50}
- Pupa at 675 DD_{50}

Fleabeetles
Base temperature = 50°F
Biofix – January 1: 150-200 DD_{50}
(Norway maple, Amelanchier, redbud early bloom)

Seed corn maggots
Base temperature = 39°F
Biofix – January 1050, 1950, 3230 DD_{39} for 2^{nd}, 3^{rd} & 4^{th} generation flies
1st generation eggs laid 230-280 DD_{39} (Lilac bloom)

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Key insect pests of cucurbits

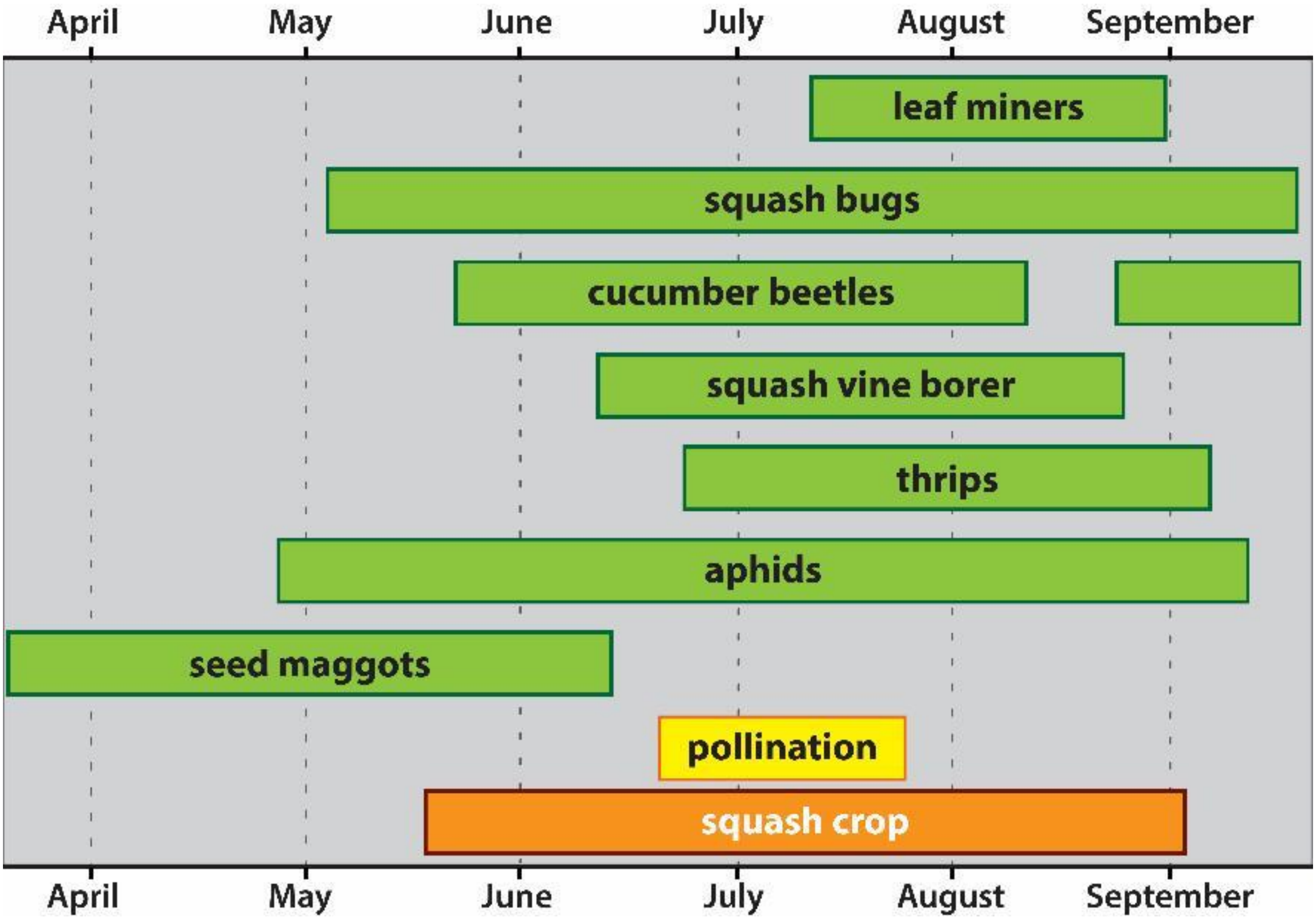
Squash bug
(*Anasa tristis*)

Squash vine borer
(*Melittia cucurbitae*)

Seed maggots
(*Delia spp.*)

Striped cucumber beetle
(*Acalymma vittatum*)

Insect pests of cucurbits



Seed corn maggot, *Delia platura*

Adult
- Small grey/black fly
- Similar to housefly

Eggs
- Small, white
- Laid in soil at base of plants

Larvae
- White, legless maggots
- 4 instars; up to 1/4”
- 3-4 weeks per generation
- 3-5 generations per year

Pupa
- Brown, oval shaped
- In soil

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Seed corn maggot: Seedling damage

Occurrence

- Overwinter in soil as pupa
- Adults emerge in spring
- 4-5 generations/year. 2nd adult peak in May/June is usually most serious

Damage

- Larvae hatch and tunnel germinating seeds
- Larvae feed in seed and developing plant and prevent emergence or severely distort plant.
- Moderate feeding may injure 1st leaves only giving crop a ragged appearance
- Cool weather, which delays plant emergence increases severity of damage

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Seed corn maggot: Management

Cultural

- Prevent egg laying with row cover
- Speed up germination: pre-sprout, mulch, warm soil
- Avoid green manure

Biological

- Predacious soil beetles
- Fungal epidemics

Chemical

- In-furrow, insecticides (neonicotinoids)
- Commercial seed treatments (Entrust)

Avoidance in Time - Thermal models for Wisconsin insects - SCM

UW Extension Ag Weather

Weather | Sun/Water | Thermal Models | About Us

Thermal Models

We're sorry to note that these products were defunded in April of 2015; they continued working for over a year, but as of Mid-June the old servers finally gave up. The team at agweather.cals.wisc.edu is working to restore as many of them as they can, but their funding is limited too. Check back on their site to see what they've got working. It has been a pleasure serving you.

Degree days totalize the amount of heat available above a threshold temperature since a given day. The number of degree days accumulated over some period of time is often related to the phenological development of plants and insects, and so can be used to estimate when pests will be at a life stage vulnerable to control. The base, or lower threshold temperature is that below which the organism does not grow or develop. The cap, or upper threshold is the maximum temperature at which organismal development occurs. Some specific examples can be found at our European Corn Borer and Alfalfa weevil web pages.

For more information, see:

Degree Day Concepts (UC-Davis)
Weather and Modeling (UC-Davis) (has videos on how to use DD).
Cullen Field Crop Entomology Lab (UW-Madison)

Note: These parameters are usually specific for a particular crop and pest. Make sure you are using the right ones for your particular situation. Some values for common pests in our area are listed below.

Pest	Method	Base Temp	Upper Temp	Biofix
Apple Scab	Simple	32F	None	Bud break
Alfalfa Weevil (DD Map)	Sine	48F	86F	January 1
Black Cutworm	Sine	50.7F	86.0F	
Cabbage Maggot	Simple	43F	None	January 1
Colorado Potato Beetle	Simple	52F	None	When eggs are first scouted
Common Asparagus Beetle	Simple	50F	None	January 1
Corn plant development (DD Map)	Modified	50F	86F	Emergence
Corn Rootworm Adults	Simple	50F	None	January 1
Cranberry plant development DD Map	Modified	45F	86F	Ice off
European Corn Borer (DD Map) (Sweet corn, Field corn)	Modified	50F	86F	January 1
Seedcorn Maggot (DD Map)	Sine	39F	84F	January 1
Fleabeetles (Beet, Cole crops, Potato)	Simple	50F	None	January 1
Imported Cabbageworm	Simple	50F	None	January 1
Onion Maggot	Simple	40F	None	January 1
Squash Vine Borer	Simple	50F	None	January 1
Stalk Borer (DD Map) (Sweet Corn, Field Corn, Potato, Snap Bean)	Sine	41F	86F	January 1
Tree and shrub pests (DD Map)	Modified	50F	86F	January 1
Western Bean Cutworm (More information)	Simple	50F		May 1

42.0 Latitude -98.0 West longitude

- Simple
- Modified
- Sine

http://agwx.soils.wisc.edu/uwex_agwx/thermal_models/degree_days

2016 January 1 Biofix (start) date
2016 June 10 End date
39 Lower threshold temperature (Degrees F):
84 Upper threshold (F)
Report only last 7 days of accumulated values
View in browser / Download as CSV / Download as JSON
Get Data Series

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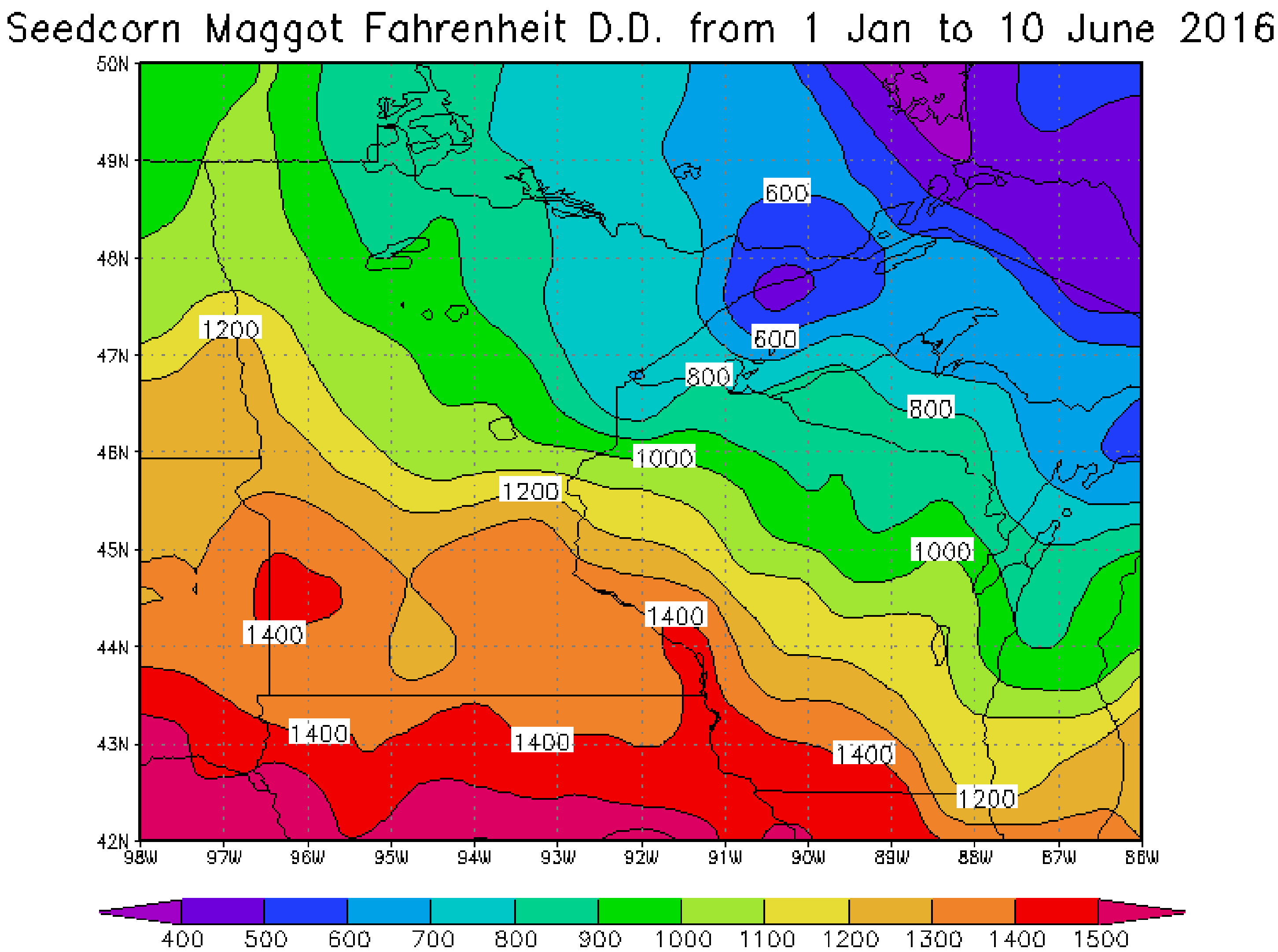
Seed corn maggot: DD_{39} Calculations



http://agwx.soils.wisc.edu/uwex_agwx/thermal_models/degree_days

US Degree Day Mapping Calculator

http://uspest.org/cgi-bin/usmapmaker.pl

US degree-day mapping calculator

Calculator Options: Thresholds: ° F. lower: 39 upper: 86 calc. type: simple average/growing dds start date: Jan 1 end date: May 30 data from: last year - 2016

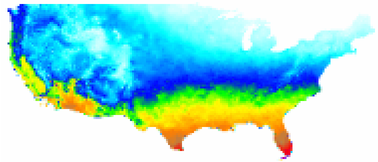
Mapping Options: Region: Wisconsin Subregion-(not New Eng states): entire Mapsize: med. Image type: jpg Legend: heat ramp Resolution: original Network Selection:

Overlay: none

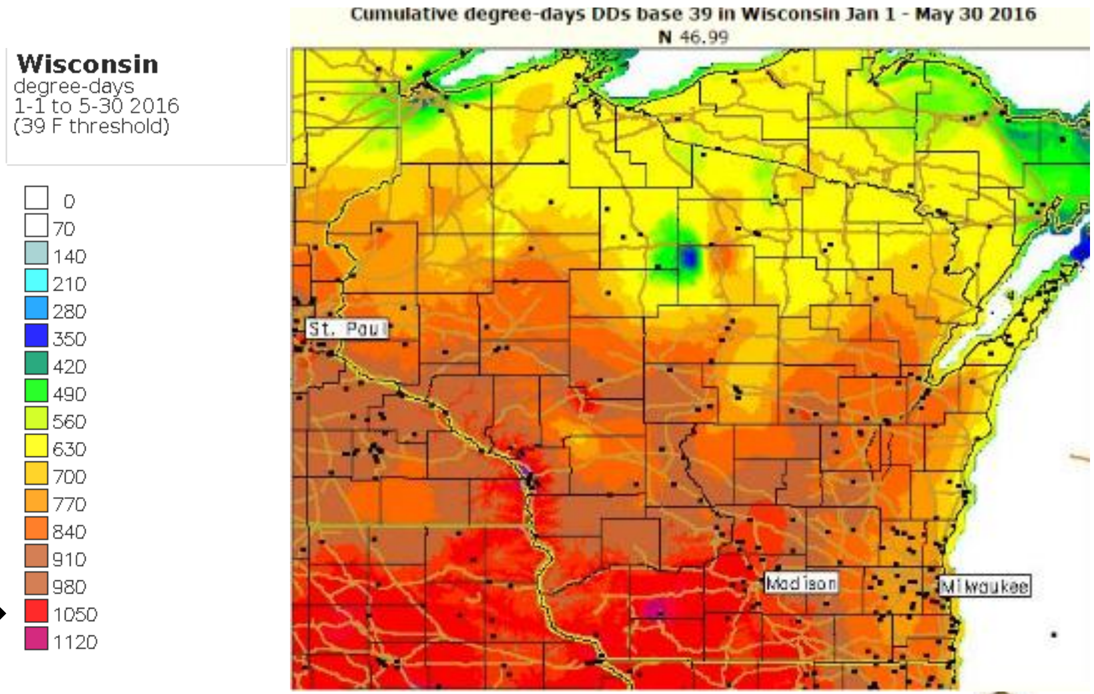
MAKE MAP: 30+ seconds for states | Defaults

Degree-day maps are under construction... major steps include:

6. Add heat ramp color table



Approximately 30 seconds needed for map computation...



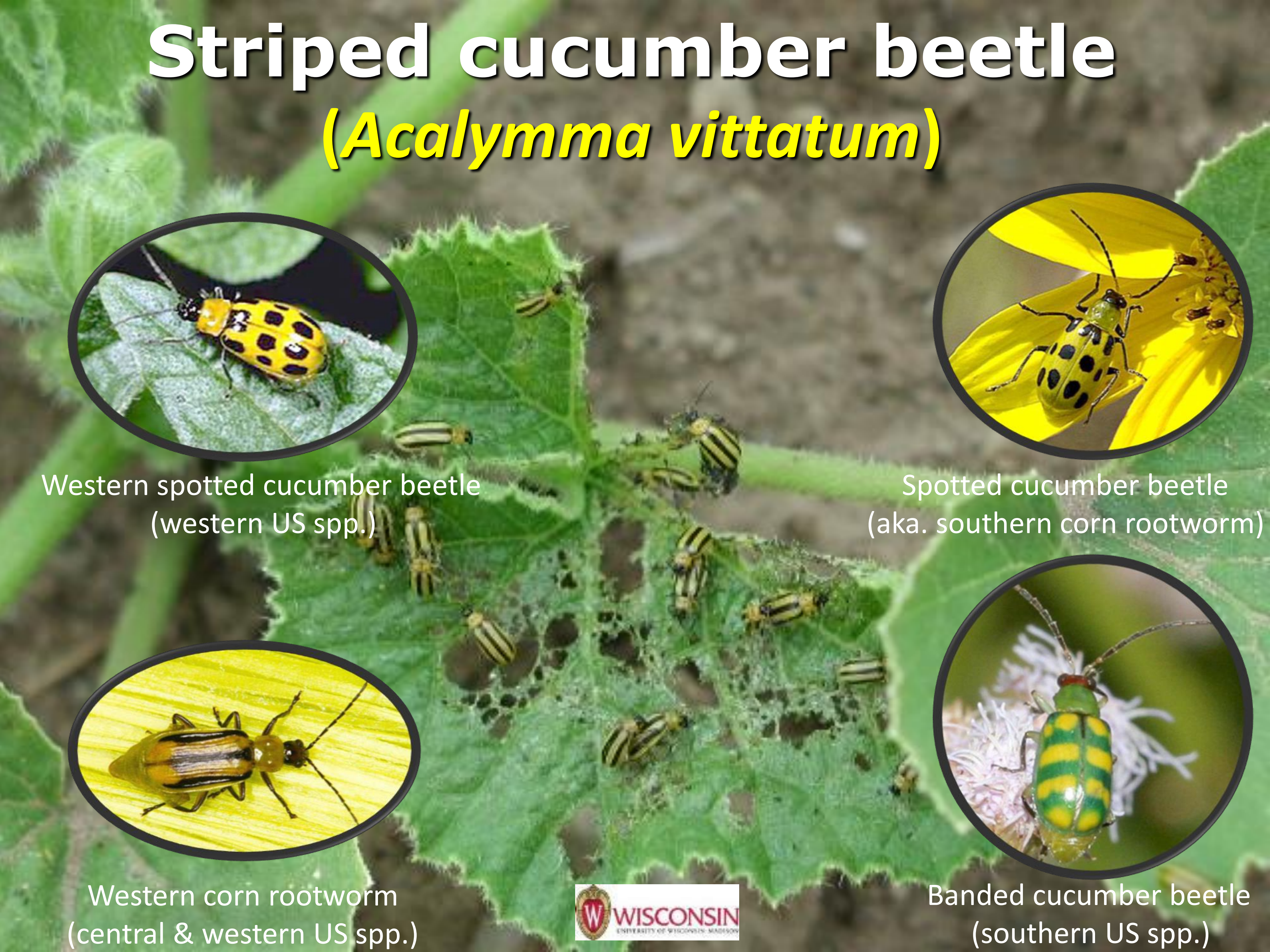
Seed corn maggots

Base temperature = 39°F

Biofix – January 1

1st generation eggs laid 230-280 DD_{39}

1050, 1950, 3230 DD_{39} for 2^{nd}, 3^{rd} & 4^{th} generation flies


Striped cucumber beetle
(*Acalymma vittatum*)
Western spotted cucumber beetle
(western US spp.)
Spotted cucumber beetle
(aka. southern corn rootworm)
Western corn rootworm
(central & western US spp.)
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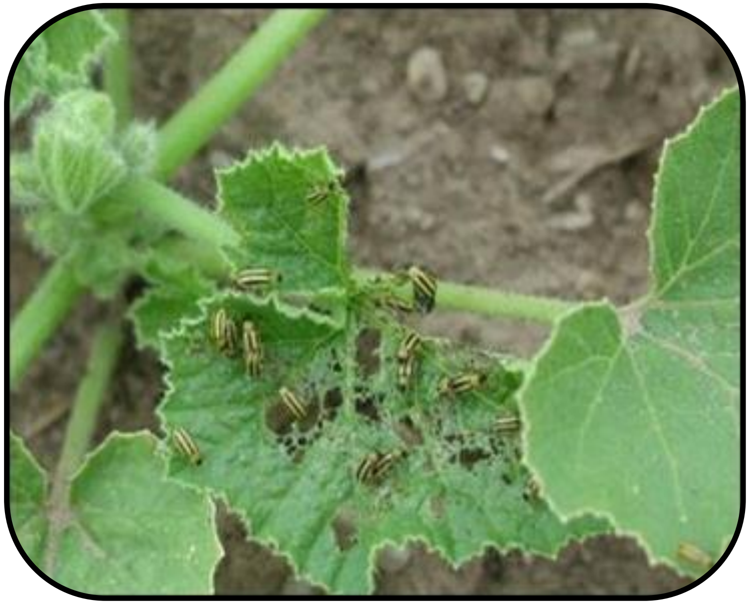
Banded cucumber beetle
(southern US spp.)

Striped cucumber beetle – Lifecycle



- Overwinters as an adult in protected non-crop areas & colonizes in early spring
- Adults feed on plants and mate
- Lays eggs at base of host plant
- Become active when 'surrounding' air temp > 55^o F.
- Micro-climatic variation influences timing of adult emergence (recall the DD_{50} calculations for Colorado potato beetle).
- Nothing supplements field scouting!!!

Cucumber beetle – Sampling and thresholds (foliar)

Sampling

- Yellow sticky cards
- Plant counts
- Colonization times critical

Action thresholds

- 1 beetle/plant for melons, cucumbers, and young pumpkins
- 5 beetles/plant for watermelon, squash, and older pumpkins

Cucumber beetle damage (4 types)


Defoliation


Pollination interference


Feeding scars

Rindworms

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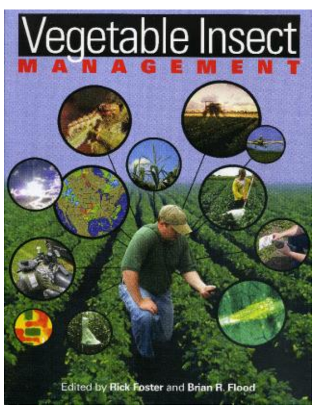
Cucumber beetle – Bacterial wilt (most impt type)

- Most damage is from bacterial wilt, *Erwinia tracheiphila*
- Closely associated with the beetle, vectored via posterior-station
- No cure for bacteria, control through vector
- Susceptibility:



Vegetable Insect Management with Emphasis on the Midwest **(Foster et al., 1995) lists susceptibility, from greatest to least as:**

1. Cucumber
2. Cantaloupe
3. Honeydew
4. Casaba melon
5. Winter squash
6. Pumpkins
7. Summer squash
8. Watermelon

American Vegetable Grower
[(www.meisterpro.com)](http://www.meisterpro.com)

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Cucumber beetle – management

Cultural

- Later planting (second week of June)
- Transplants
- Early border trap crops
  (transplant Blue Hubbard)

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Cucumber beetle – variety preference

Table 1. Ranking of cucurbits by cucumber beetle feeding preference (Jarvis, 1994).

Higher ranking numbers indicate more preferred varieties by cucumber beetles. Rankings: 1 to 14 means not preferred, greater than 45 means highly preferred.

Summer squash		Winter squash	
Variety	**Ranking**	**Variety**	**Ranking**
Yellow		*Acorn*	
Sunbar	1	Table Ace	6
Slender Gold	2	Carnival	7
Early Prolific Straightneck	20	Table King (bush)	12
Goldie Hybrid	32	Tay Belle (bush)	14
Sundance	33	*Butternut*	
Straightneck		Zenith	13
Seneca Prolific	4	Butternut Supreme	16
Goldbar	5	Early Butternut	25
Multipik	37	Waltham	28
Crookneck		*Buttercup*	
Yellow Crookneck	8	Honey Delight	43
Sundance	34	Buttercup Burgess	44
Scallop		Ambercup	55
Peter Pan	9	*Pumpkins*	
Zucchini		Baby Pam	10
Gold Rush	39	Munchkin	11
Zucchini Select	40	Seneca Harvest Moon	15
Ambassador	41	Jack-Be-Little	17
President	45	Jackpot	18
Black Jack	46	Tom Fox	19
Green Eclipse	50	Baby Bear	21
Seneca Zucchini	51	Howden	22
Senator	52	Spirit	23
Super Select	54	Wizard	24
Dark Green Zucchini	56	Ghost Rider	26
Embassy Dark Green Zucchini	57	Big Autumn	27
Other summer squash		Autumn Gold	29
Scallop	3	Jack-of-All Trades	30
Cocozelle	48	Rocket	31
Caserta	58	Frosty	35
Melon		Spookie	36
Classic	59	Connecticut Field	38
		Happy Jack	42
		Big Max	47
		Baby Boo	53

ATTRA

Cucumber Beetles: Organic and Biorational Integrated Pest Management

A Publication of ATTRA—National Sustainable Agriculture Information Service • 1-800-346-9140 • www.attra.ncat.org

https://attra.ncat.org/attra-pub/viewhtml.php?id=133

Some varieties of a cucurbit species are more attractive to cucumber beetles than others. For example, cucumber beetles preferentially feed on muskmelon varieties in the following order, from greatest to least (Foster et al., 1995):

1. Makdimon	6. Galia
2. Rocky Sweet	7. Pulsar
3. Cordele	8. Passport
4. Legend	9. Super Star
5. Caravelle	10. Rising Star

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Cucumber beetle – management

Cultural

- Eliminate weeds, weedy edges (non-crop sanitation)
- Crop rotation
- Early season row cover

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…cultural control trade-offs

Cultural control drawbacks

Non-crop sanitation may eliminate alternate floral resources – impacts on pollinators?

- Row cover is only effective until plants begin to bloom – pollinator access

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Cucumber beetle – insecticides

- kaolin clay (Surround WP)
- broadcast foliar applications:
  - pyrethrum (Pyganic 1.4 and 5.0 EC)

PyGanic

  - pyrethrum + azadirachtin

azera

  - heat-killed Burkholderia (Venerate XC)

VENERATE XC BIOINSECTICIDE

  - *Bacillus thuringiensis* subsp. tenebrionis (Trident) - ??

CERTIS USA The Biopesticide Company

- Foliar sprays (thresholds) – "caution with pollinators"!!

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Insecticides registered in Wisconsin

Seed treatments

Commercially applied to most varieties

Thiamethoxam – FarMore F1400

FarMore Technology

At-plant applications

Applied as at-plant, in-furrow, banded applications to seed furrows or transplant row or as a soil drench, side dress applications, or drip

imidacloprid – AdmirePro® (7-10.5 fl oz/acre)
thiamethoxam – Platinum 75SG (3.67 oz/acre)
clothianadin – Belay (12.0 fl oz/acre)

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Squash vine borer, *Melittia cucurbitae*

Occurrence

- Daylight and dusk -flying clearwing moth
- Adults have rusty brown abdomens
- Wingspan ~ 1-1.5 inches
- Females can lay 150-200 eggs
- Larvae ¾ - 1 inch in length
- Appear around 900 growing degree days (base 50^{o}F)
- One generation per year

US Degree Day Mapping Calculator

http://uspest.org/cgi-bin/usmapmaker.pl

US degree-day mapping calculator

Calculator Options: Thresholds: °F. lower: 50 upper: 130 calc. type: single sine start date: Jan 1 end date: Jul 1 data from: last year - 2016

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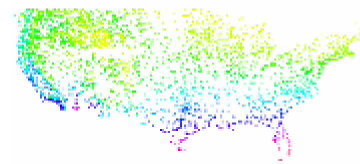
3. Station-based degree-days



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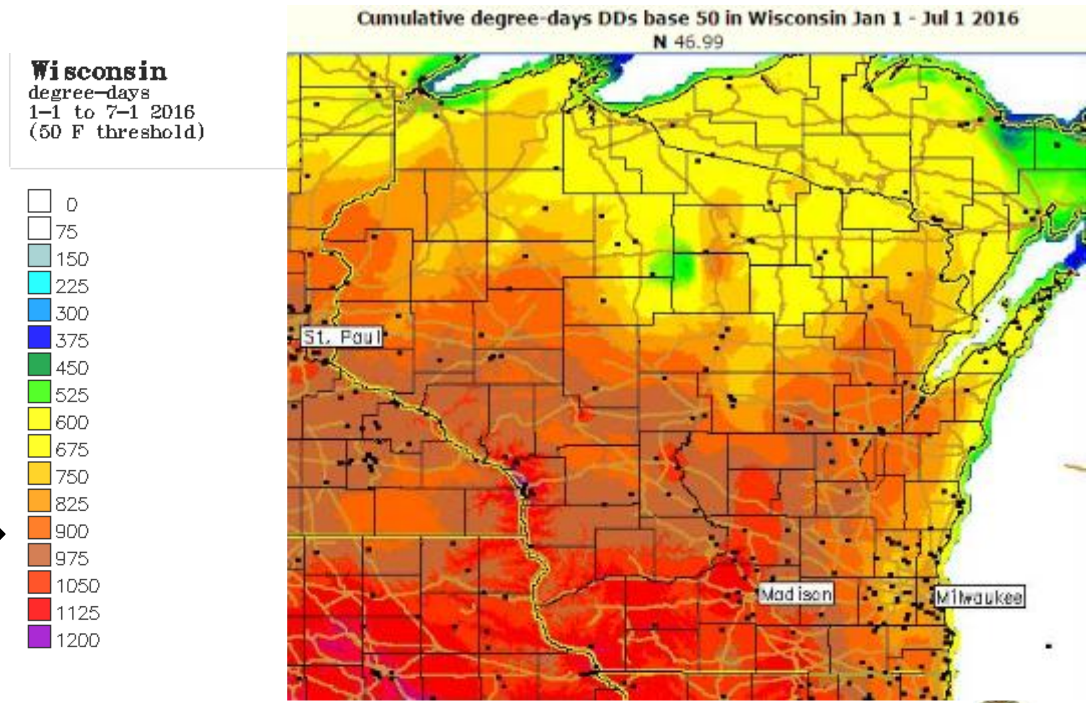


Squash vine borer

Base temperature = 50°F

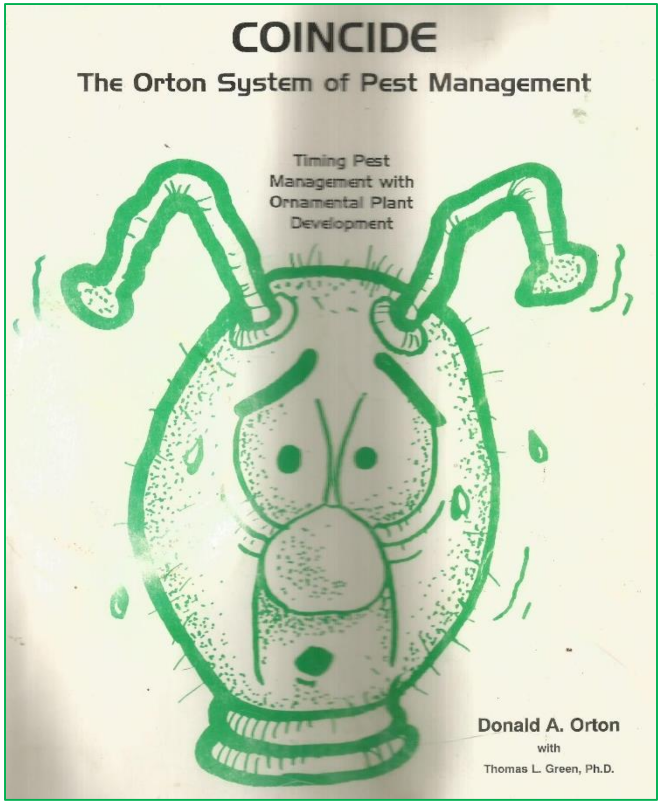
Biofix – January 1

1st generation adult emergence DD_{50}

900 for 1st generation moths

Squash Vine Borer:
phenological relationships with plants

Note: directed application to the first 12-16" of vine;
'post-chicory bloom'



https://www.amazon.com/Coincide-Orton-system-pest-management/dp/B00071TVU2

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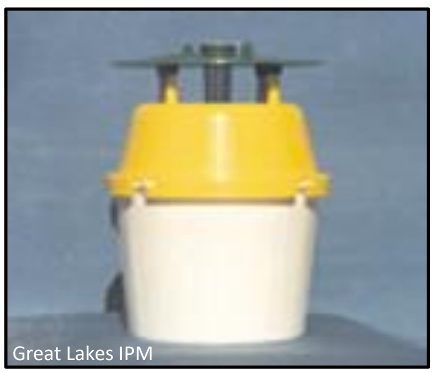
Squash vine borer - management

Damage

- Single eggs laid at plant base
- Frass and entry hole very apparent
- Advanced damage may look like bacterial wilt

Squash vine borer - management

Pheromone trap



Monitoring

- Scout crop around 950 DD_{50} threshold
- Water pans for adults in crop
- Pheromone lures available through Great Lakes IPM

Control

- Rarely an issue in commercial production. Serious garden pest
- Insecticides often difficult to time & apply properly
- *Bacillus thuringiensis* subsp. *kurstaki*
- Pyrethrins & pyrethroids

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Squash bug, *Anasa tristis*

Occurrence

- Adults are large brownish/black
- Bugs aggregate in high numbers
- Adults prefer larger, more mature plants
- Round eggs laid in neat rows
- Nymphs are white/grey (5 instars)
- One generation per year

Squash bug - Damage


MO Botanical Garden

- Phytotoxic saliva causes wilting
- Cucurbit yellow vine decline
  - Now identified in MA & VA
  - Bacterium overwinters in adult bugs
  - Hubbard and winter affected
  - Brown phloem ring

Squash bug – management thresholds

Wilting on pumpkin

Seedling stage

- Treat if wilting and squash bugs are observed

Flowering stage

- Treat if >1 egg mass is found per plant

Squash bug egg mass

Control

- Often difficult to kill
- Pyrethrum-based products
- Foliar pyrethrum
- Destroy crop residue
- ***Non-crop sanitation***

PyGanic®

Squash bug – overwintering habitats

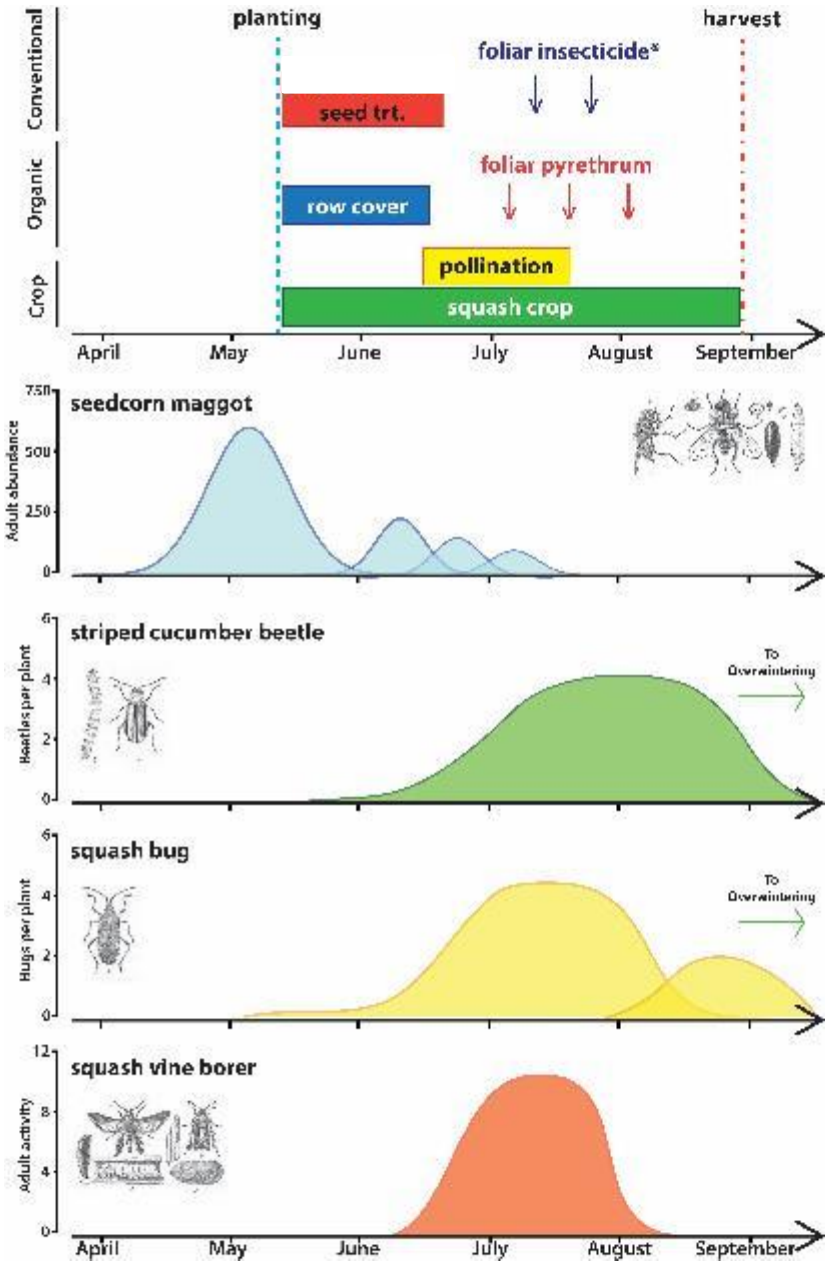
Damage

less → **more**

- Clean cultivation
- Crop rotation common
- Less overwintering habitat

- Crop debris and old fruit harbor adults into autumn
- Many sheltered areas
- Small scale annual production builds populations

Season long management plans



- Early season control with seed treatment or cultural methods
- Timing of foliars dependent on flowering stage of the crop
- Scouting for pests will save money and reduce extra sprays
- Read labels and active ingredients

How does pest management fit into the broader sustainability picture?

Balancing trade-offs, improving sustainability

Pest control and pollination services

- Insecticides remain an important component of cucurbit production
- Exposure of several pollinator guilds to agro-chemicals are thought to reduce beneficial insect health

Growers can adjust management to reduce exposure

- Avoid applying to crops in bloom or blooming
- Apply late in the day/evening
- Choose short residual products
- Insecticide formulations are not equal:

EC > WP, WSP, D

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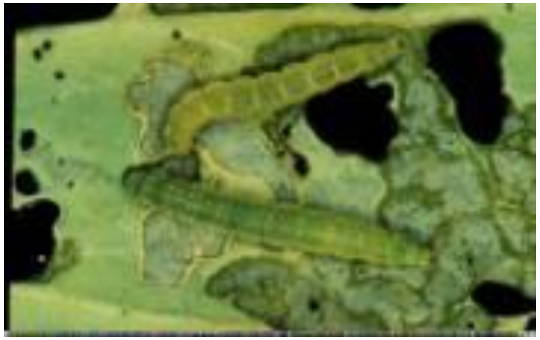
Cole Crops – Key Pests

Diamond back moth



Imported cabbage worm

Cabbage looper

Managing Key Pests on Cole Crops

**Excellent example of potential for biological control (NCR Regional pub. 471)

(https://learningstore.uwex.edu/Biological-Control-of-Insect-Pests-of-Cabbage-and-Other-Crucifers-P569.aspx)

History of problem

- Direct damage to marketable product by key pests
  - Worms on heads

- Multiple insecticide applications used
- Resistance developed as threat to production

Solution

- IPM implementation based on biological control of key pests
- Pesticides switched to specific, ‘soft’ materials to preserve natural control

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Pest Specific Insecticides for Key Pests @ Threshold

- Control caterpillar pests at thresholds when needed
- Conserve beneficial organisms
- *Bacillus thuringiensis* subsp. *kurstaki* or spinosad

Crop	Growth stage	Threshold (% infestation)
Cabbage	Seed bed	10%
	Transplant-cupping	30%
	Cupping-early head	20%
	Mature head	10%
Broccoli/cauliflower	Seed bed	10%
	Transplant-first curd	50%
	Curd present	10%

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Pest Specific Insecticides – Key Pests

Reduced-Risk Products

Bacillus thuringiensis (*kurstaki*; Btk, or *azaiwi*; Bta)

- many registered (e.g. Dipel, Xentari, Biobit, Cutlass, etc.)

spinosad (SpinTor 2SC & Entrust 2SC)

azadirachtin (Aza-Direct, AzaGuard, Azatin)

Chromobacterium subtsugae strain PRAA4-1^{T} (Grandevo)

Burkholderia spp, strain A396 (Venerate XC)

<u>**Note:</u> Avoid Broad Spectrum Insecticides!!

pyrethrum

- Multiple applications
- Resistance can be a problem
- Eliminate biological controls

Pest Specific Insecticides – Key Pests

Cultural

- Use clean transplants

Biological

- Good complex of parasites
  - Diamondback moth: (70-90%)
  - Imported Cabbage worm: (30-60%)
  - Cabbage looper: (10-30%)
- Multiple species

Diadegma insulare

Cotesia glomerata

Pteromalus puparium

Trichogramma

Copidosoma floridanum

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Cole Crops – Sporadic Pests

Cabbage maggot

Flea beetle

Onion thrips

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Cabbage Maggot Lifecycle

Adult
- Small grey/black fly
- Similar to housefly

Eggs
- Small, white
- Laid in soil at base of plants

Larvae
- White, legless maggots
- 4 instars; up to 1/4”
- 3-4 weeks per generation
- 3 generations per year

Pupa
- Brown, oval shaped
- In or close to the roots

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Cabbage maggot host range

- Moderate host range
- Can develop on organic matter
- Prevalent where brassicas reoccur

Crop Susceptibility

High	Moderate	Low
Brassica roots (cabbage, broccoli, cauliflower) Brassica weeds	Peas (soy, kidney) Brassica roots (radish, turnip)	Corn

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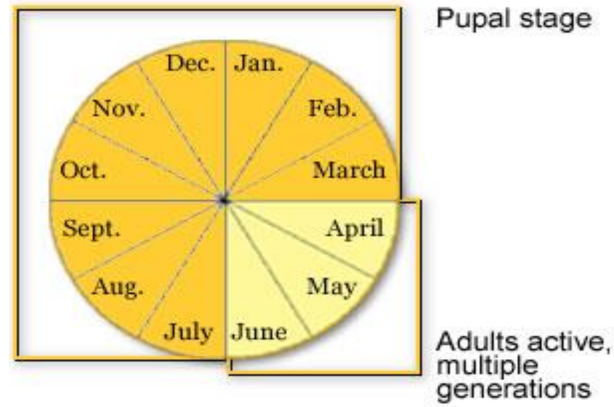
Cabbage maggot: prevalence and damage

Prevalence

- Overwinter in soil as pupa
- Adults emerge in spring
- 4-5 generations/year. 2nd adult peak in May is usually most serious

Wisconsin Damage Calendar



Damage

- Tunnel into transplants
- Severely stunt plants, plants wilt.
- Cool weather, delays plant emergence increases severity


Healthy vs infested broccoli

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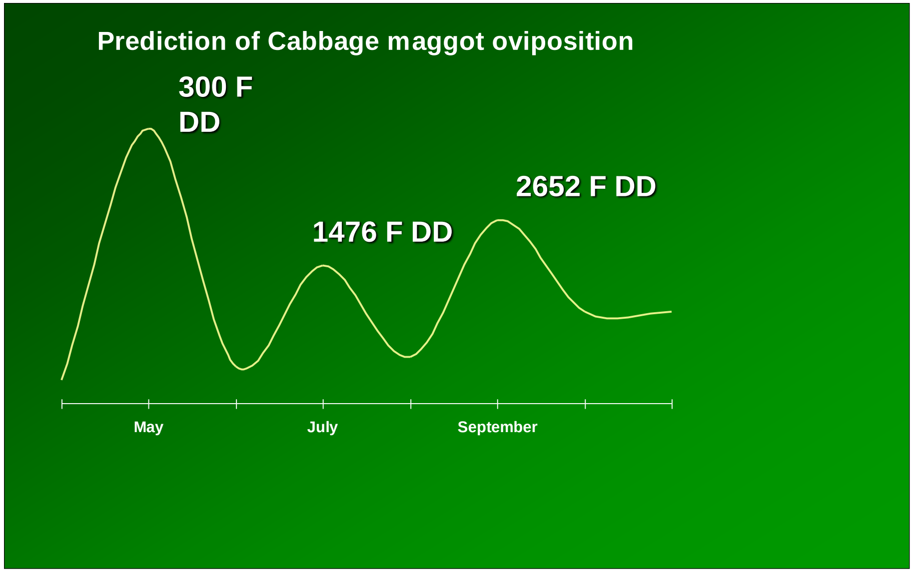
Cabbage Maggot Life Cycle



Timing of Occurrence

- Overwinters in soil as pupa
- Adults emerge in spring
- 3 flight peaks
- First peak is most serious and occurs at 300 heat units or when lilacs bloom (May)

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Cabbage Maggot Management

Cultural

- Rotate crop away from overwintering site (1/4-1/2 mile)
- Prevent egg laying with barrier, row cover
- Predict egg laying with heat units (300 DD_{43} ˚F base)
- Plant early or late to avoid eggs = fly free periods

Biological

- Some egg predation by beetles

Chemical

- At-plant drench, banded & transplant water applications
- Broadcast applications in seedbed applications

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Flea beetles

Crucifer flea beetle – *Phyllotreta cruciferae*
Potato flea beetle – *Epitrix cucumeris*
Corn flea beetle - *Chaetocnema ectypa*
Eggplant flea beetle – *E. fuscula*

- Flea beetles are small shiny and black and can cause serious damage to seedlings.
- They usually feed on the undersides of leaves leaving numerous small round or irregularly shaped holes.
- Because the beetle is small and active, it usually does not feed much in one spot.
- It is especially active during hot and sunny days.

Flea Beetle Management

Cultural

- Attract adults to alternate trap crop (Indian mustard, Chinese giant mustard, glossy-leaf collards) – perimeter trap crops
- Delay planting to allow trap crops to emerge first
- Crop rotation, avoid Brassicas in similar sites year to year
- Sanitation of Brassica weeds
- Row cover to protect from colonization

Biological

- Few effective controls

Chemical

- Repeat applications of pyrethroids, neonicotinoids or spinosad necessary (recolonization)
- DO NOT disrupt biological controls for caterpillar pests

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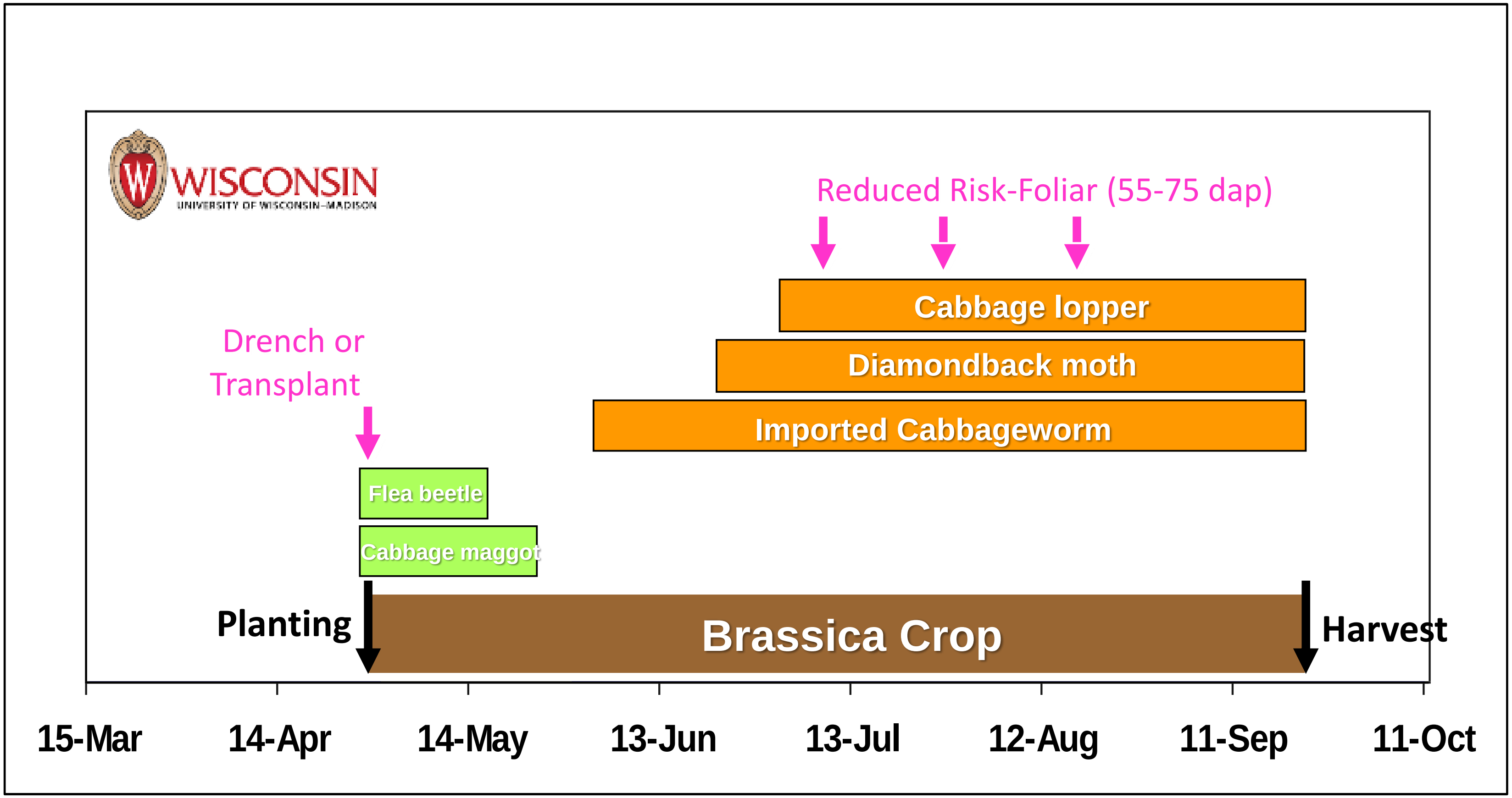
Cabbage Pest Management
Early and Mid-Season Pests

- Need to protect crop early from flea beetle and maggot (14-21 days) – do not be disruptive
- Manage mid-season caterpillar pests based upon thresholds with RR-materials



Major Thrips Pests of Onion, *Allium cepa* L., in North America

- **Onion thrips**
(*Thrips tabaci* Lindeman)

- **Western flower thrips**
(*Frankliniella occidentalis* [Pergande])

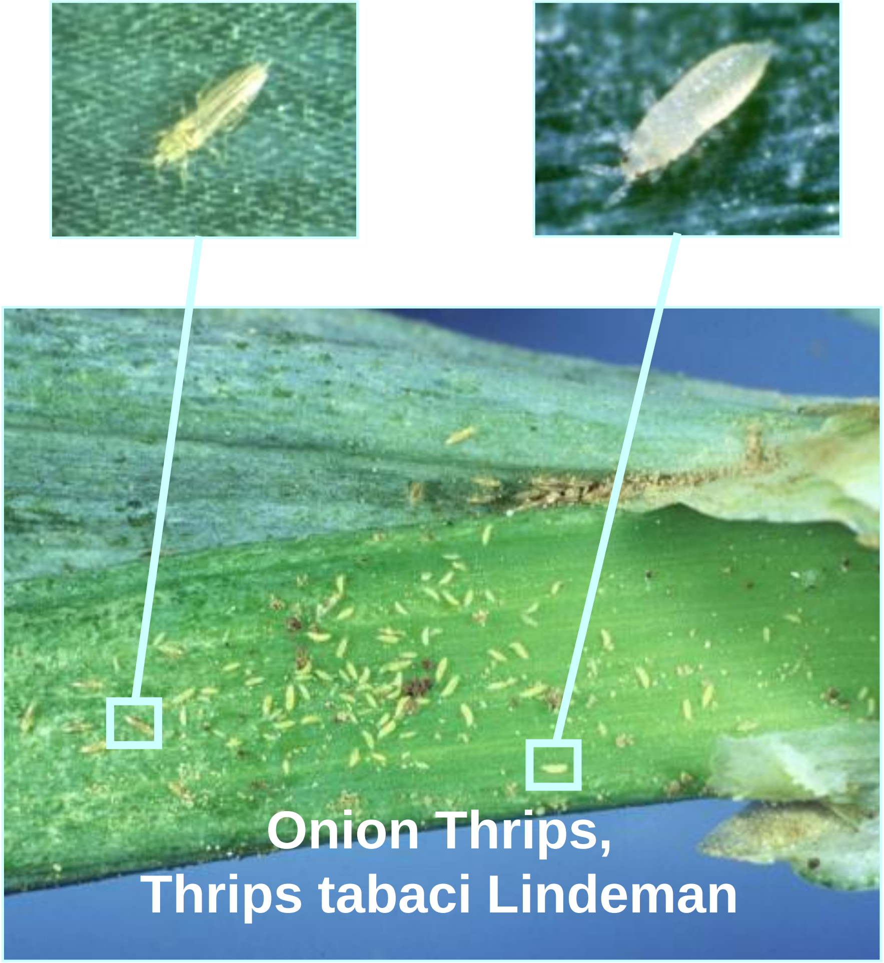
- **Tobacco thrips**
(*Frankliniella fusca* [Hinds])

The insect pest and the crop…

Damage from onion thrips

Adult

Larva



Onion Thrips, *Thrips tabaci* Lindeman

Adult

Larva

Environmental Conditions

Hot and Dry Conditions, 2012

Biological attributes that make onion thrips a pest

- Short developmental time
- Parthenogenic (do not need to find a mate)
- Highly mobile
- Wide host range
- Overwinter adjacent to onion
- Capability of developing resistance to insecticides

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Onion thrips: Management

Cultural

- Crop rotation
- Overhead irrigation
- Sanitation (culls & field borders)
- Reflective mulch

Biological

- Predacious thrips
- Minute pirate bugs

Chemical

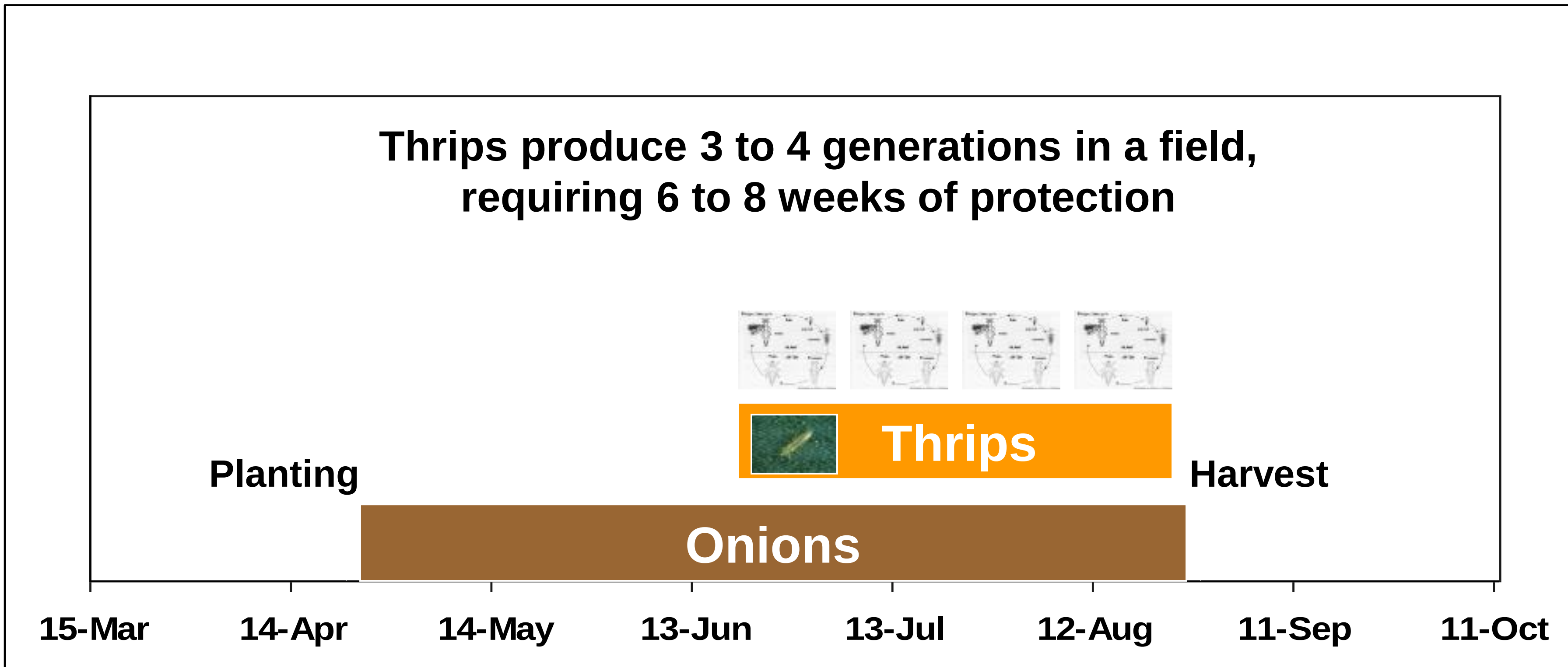
- Foliar sprays (Entrust – Aza-Direct) - organic
- Foliar sprays (Movento, Radiant) – RR conv
- Commercial seed treatments (none effective)

Leptothrips

Minute pirate bug

Example of Onion Thrips Occurrence in a Single Onion Field

Example from Wisconsin



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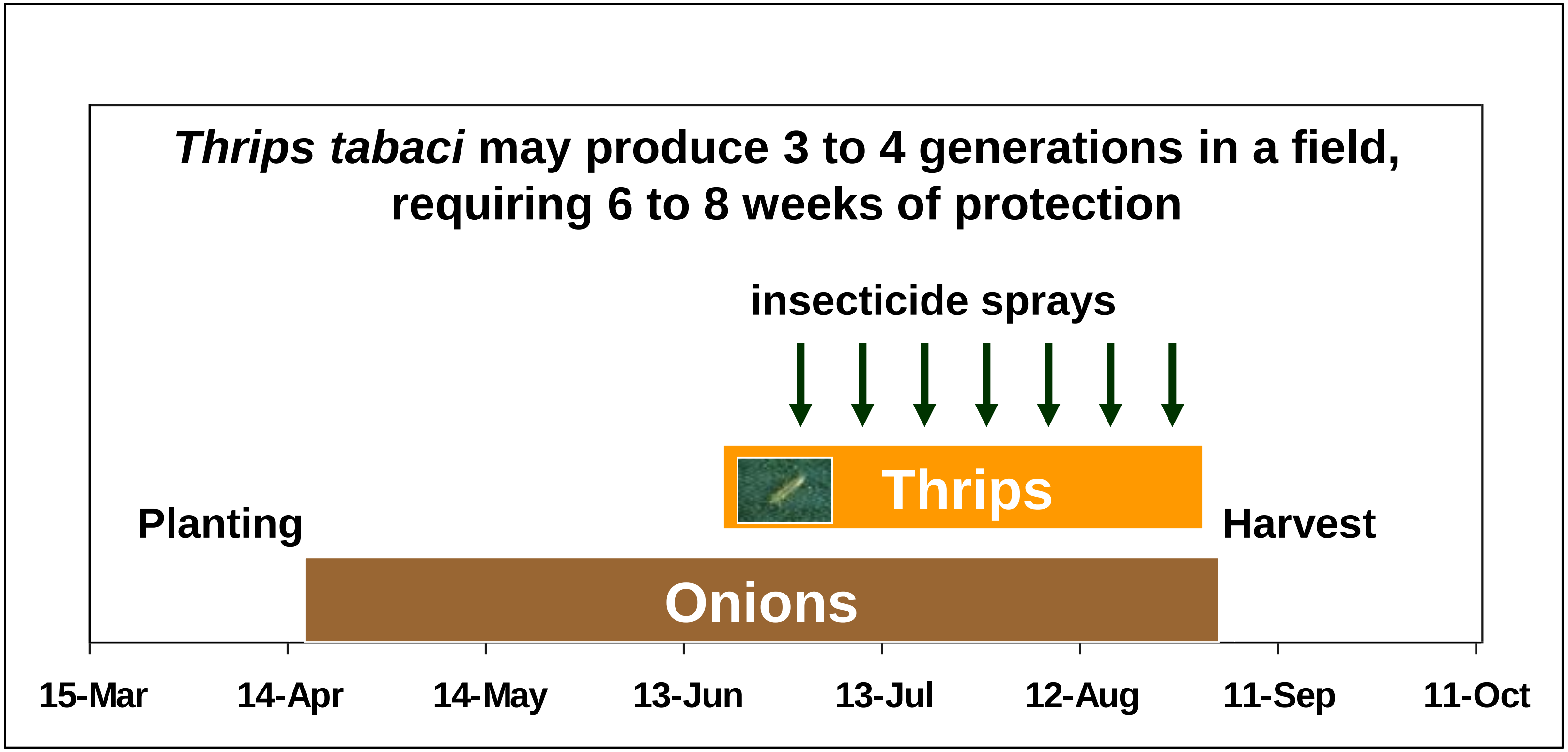
Insecticidal Treatment Approach for Managing Onion Thrips in Onion

Example from Wisconsin



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Reduced-Risk Foliar Organic Options

Entrust® SC (spinosad)

- Macrocyclic lactone (spinosad: MoA group 5)
  - Use rate 1.25 - 2 oz / A
  - Control of onion thrips
- 7-10 days persistence
- Very low impact on beneficials
- Low mammalian toxicity

Dow AgroSciences
Entrust® SC
Naturalyte® Insect Control

Aza-Guard®

- Azadirachtin (MoA group 30 - unknown)
  - Use rate 10-16 fl oz / A (immature onion thrips)
- 1-3 days persistence (photostability)
- Medium impact on beneficials
- Low mammalian toxicity

AzaGuard®

Reduced-Risk Foliar Organic Options

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- PFR-97® 20 WDG *Isaria fumosorosea* Apopka Strain 97
  - Microbial insecticide (MoA group 11)
    - Use rate 1.0 – 2.0 lbs / A
    - Control of immature onion thrips
  - 5-7 day persistence (photostability)
  - Very low impact on beneficials
  - Low mammalian toxicity

PFR-97™
MICROBIAL INSECTICIDE

- Grandevo® *Chromobacterium subtsugae* strain PRAA4-1
  - Microbial insecticide (MoA group 11)
    - Use rate 2-3 lb / A (immature onion thrips)
  - 3-5 days persistence (photostability)
  - Low impact on beneficials, low mammalian toxicity

GRANDEVO®
BIOINSECTICIDE

Reduced-Risk Foliar Organic Options

- Venerate XC® *Burkholderia* spp. strain A396

- Microbial insecticide (MoA group 11)
  - Use rate 2.0 – 4.0 qts / A
  - Control of immature onion thrips
  - 5-7 day persistence (photostability)
  - Low impact on beneficials
  - Low mammalian toxicity

VENERATE® XC BIOINSECTICIDE

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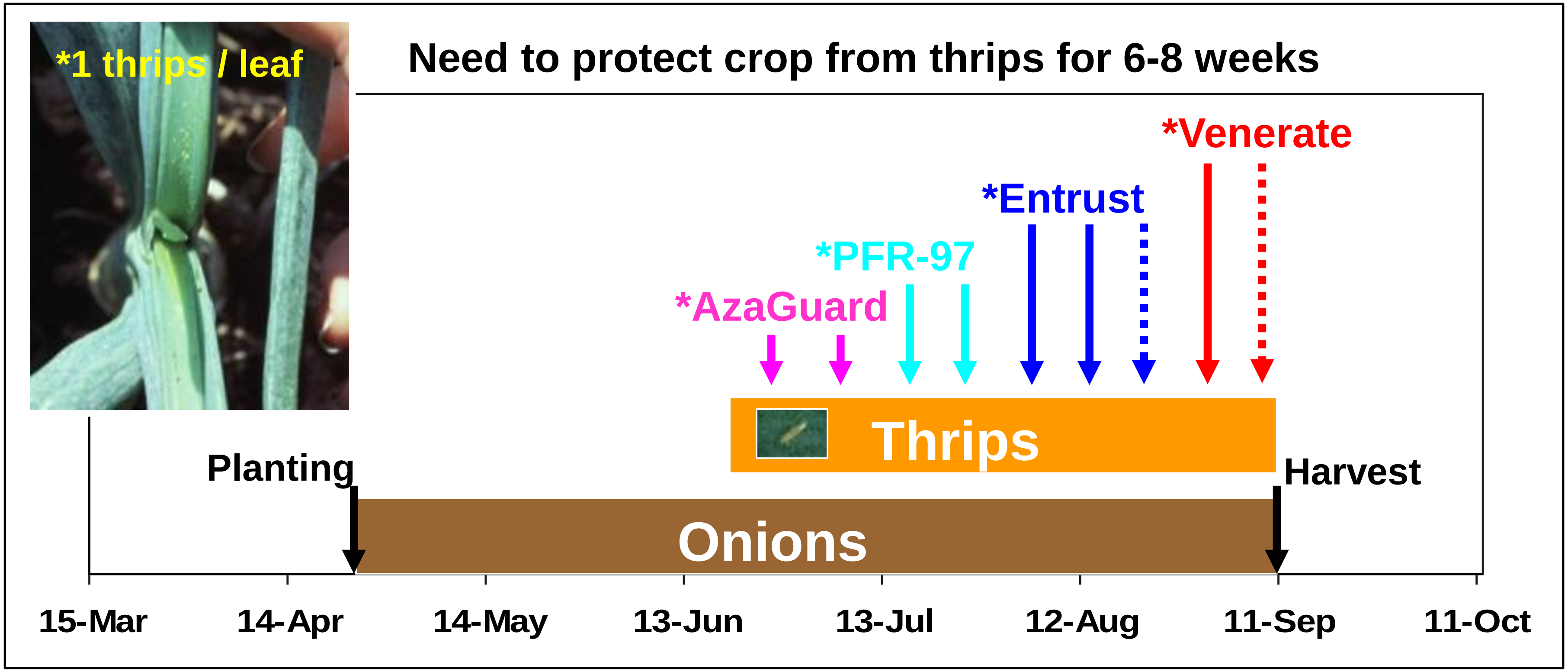
Combining Insecticide Sequences and Action Thresholds



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Insecticide Control Options

- Rotate insecticides (classes if possible)

  (e.g., spinosad, azadirachtin, Isaria, Chromobacterium, Burholderia)

- Two successive applications of one product to control a generation
- Time applications based on most appropriate threshold (1-3 immature thrips / leaf)
- Avoid tank mixing insecticides

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Key insect pests in WI potato

Potato leafhopper
(*Empoasca fabae*)

Colorado potato beetle
(*Leptinotarsa decemlineata*)

Colonizing Aphids
(*Myzus persicae* &
Macrosiphium euphorbiae)

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Potato leafhopper

Appearance

- ❖ Adults, small (1/8”) wedge-shaped, bright green
- ❖ Rapid movement
- ❖ Nymphs, yellow-green, lack wings

Occurrence

- ❖ Does not overwinter in Wisconsin
- ❖ Adults migrate from gulf states
- ❖ Arrive June, 2-3 generations/year
- ❖ Very broad host range includes potatoes, beans, alfalfa
- ❖ Can infest quickly

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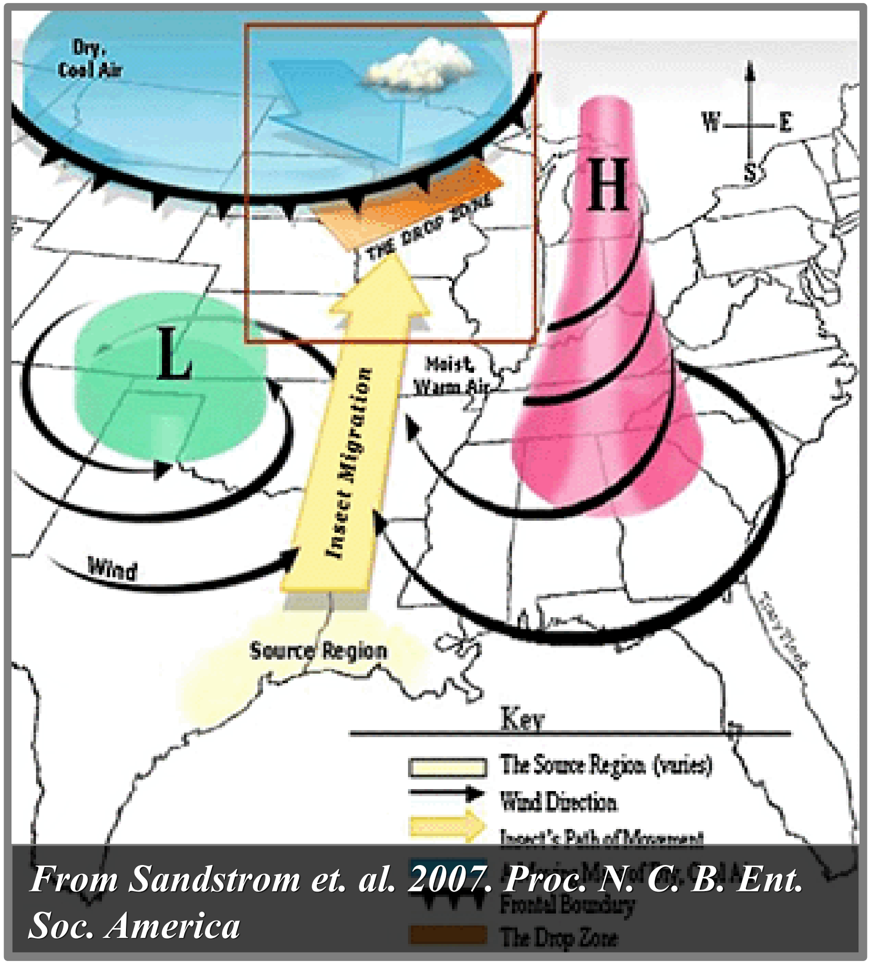
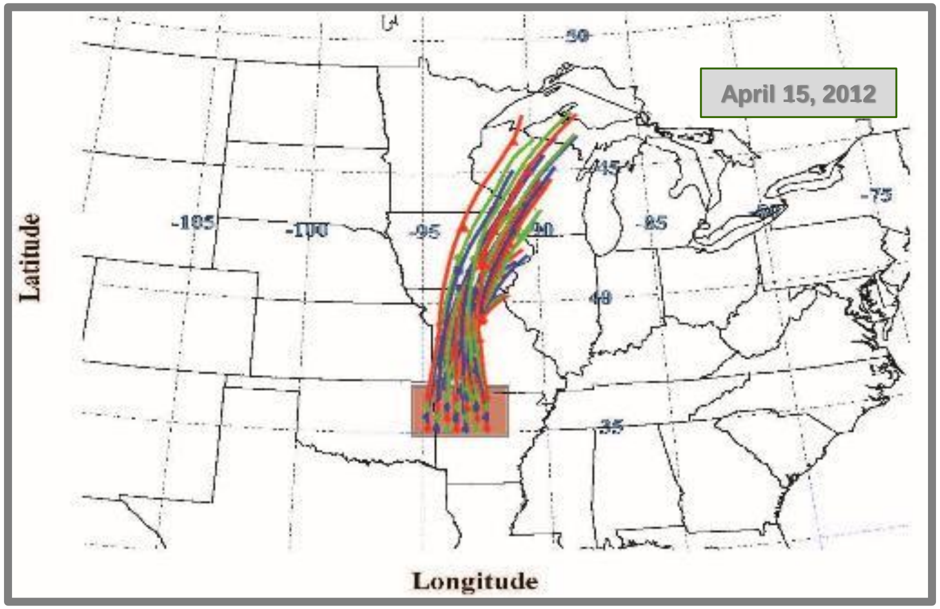
Potato leafhopper: long distance migration



From Sandstrom et. al. 2007. Proc. N. C. B. Ent. Soc. America



HYSPLIT air parcel trajectory model

Simulated transport and deposition of PLH "particles"

Transported by bulk air flow from regions where winged PLH may be present

Potato Leafhopper – damage in potato

Potato leafhopper – damage in snap beans

- Both adults and nymphs feed
- Sucking mouthparts
- Saliva clogs plant, causes yellowing, leaf necrosis
- Can kill young plants quickly
- May only cause stunting

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Potato leafhopper – Varietal Susceptibility

Whites < Reds < Russet < Yellow

	Average Yield (lbs./ 40 row ft.)			
Clone	Untreated	Treated	% Reduction	Prob > T*
All Blue	8.4	24.1	65.1	0.0008
Carola	16.6	35.3	53.0	0.006
Kennebec	23.9	38.8	38.4	0.02
Red Norland	21.1	34.2	38.3	0.09
Butte	29.3	46.3	36.7	0.03
French Fingerling	20.8	32.8	36.6	0.08
Russian Banana	35	44	20.5	0.25
Elba	31.4	38.3	18.0	0.33
Yukon Gold	36.1	40.6	11.1	0.44
Prince Hairy	44.8	49.9	10.2	0.5
All Red	49.3	54.3	9.2	0.43
NY 131	36.1	35.9	-0.6	0.95

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Potato leafhopper – Varietal Susceptibility

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Potato leafhopper management

Cultural

- Plant early to avoid

Biological

- Few effective biologicals

Chemical

- Monitor often (June 1)
- Treat only when threshold exceeded (1 / sweep)
- Tolerant varieties (1-2 / sweep)

- Do not let nymphs build up

- Control is effective if needed:
  pyrethrins = Evergreen, Pyganic

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Questions?