New Tools and Products for Insect Control on Vegetable Crops

January 31, 2023

2023 Wisconsin Fresh Fruit & Vegetable Conference

January 29-31, 2023 | Wisconsin Dells, WI

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

Russell L. Groves

Department of Entomology

University of Wisconsin

College of Agricultural & Life Sciences
UNIVERSITY OF WISCONSIN-MADISON

Extension
UNIVERSITY OF WISCONSIN-MADISON

Personnel and Program - Research

Wisconsin Vegetable Entomology | Research | Extension | Crops & Insects | IPM | Lab Members

Quick Links

- Field Trials
- Pest Factsheets
- Crop Information
- Research Projects
- Extension Publications
- Publications
- Lab Members

Off-site Resources

Related sites:

- Entomology Department
- Plant Pathology Department
- Horticulture Department
- Insect Diagnostic Lab
- Plant disease diagnostic clinic

Newsletters:

- UW-IPCM vegetable crop update newsletter
- WI-DATCP pest bulletin

Degree-day modeling:

- USPest DD models
- USPest DD map maker
- UC IPM DD concepts
- Wisconsin Vegetable Disease & Insect Forecasting Network (VDIFN) Maps
- National Phenology Network Maps & Models

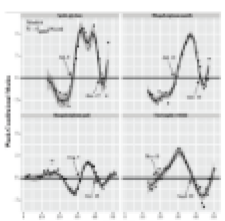
Research Projects

Research in our lab integrates basic studies on the biology, ecology and behavior of vegetable insect pests and pathogens with applied studies utilizing both novel and traditional pest management approaches. Please contact us if you are interested in collaborating on any of our ongoing projects.

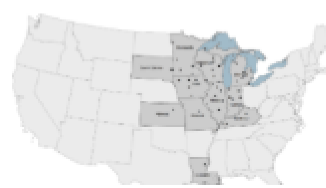
Current Research Projects

Phenology of Aphid Vectors of Potato Virus Y (PVY)

Potato virus Y (PVY) is the most important disease issue facing the seed potato industry and it is having an impact on the commercial industry. PVY impacts negatively yield and tuber quality, but more importantly, PVY reduces farm income because seed lots cannot meet virus tolerance limits, and because the emergence of necrotic strains reduce trade market opportunities. Effective on farm PVY management has been realized through our efforts to reduce the potential for aphids to inoculate plants. Aphid populations have also increased, especially with the introduction and establishment of the soybean aphid (*Aphis glycines*) to the U.S. in the early 2000s. Publicly held, regional and national databases have recently become available to provide information about which aphid species are moving into susceptible seed potato.



Data were compiled from the North Central Region Aphid Suction Trap Network from over a span of 8 years (2005-2013) and 45 locations comprising over 200 species of aphids and nearly 785K individual captures in the upper Midwestern US. The suction trap information available was initially standardized for each year, location, and week using a random effects modeling approach. Generalized additive models (GAMM) were then fit to the resulting conditional modes of the random effects model, representing the de-seasonalized count data, and have been very effectively used to predict the phenology of each unique aphid species.



The North Central Regional Aphid Suction Trap Network is an ongoing effort aimed at collecting and characterizing aphid species occurrences across the central and upper Midwest from 2005-present. The suction trap network currently has 30 active sites in 11 states, but 49 unique sites have at some point been active. Aphid samples are collected weekly from active suction traps and counts are generated for each species present.

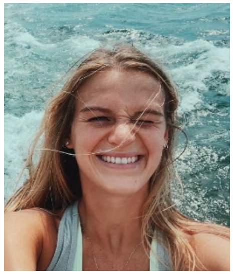
https://vegento.russell.wisc.edu/current-projects/

Personnel and Program

UNIVERSITY OF WISCONSIN MADISON
Department of Entomology

Ms. Victoria Lason – PhD
HEBP – insect interactions
vlason@wisc.edu

Mr. Chris Blume – PhD
IRM - Diabrotica
chris.blume@wisc.edu



Ms. Emma Terris – MS
CPB resistance mechanisms
eterris@wisc.edu

Dr. Scott Chapman – Researcher
scott.chapman@wisc.edu

Mr. Ben Bradford– Associate Researcher
bbradford@wisc.edu

Personnel and Program

Plant Pathology
at the University of Wisconsin-Madison

Matthew Pereyra – PhD
Data science and risk predictions
pereyra@wisc.edu

Shannon Piper – PhD
Aster yellows phytoplasma – microbes
sbpiper@wisc.edu

AGROECOLOGY
Cultivating a Beneficient Agriculture

Ariana Abbrescia – MS
"Organic disease management"
abbrescia@wisc.edu

2023 Vegetable Resources – By Crop

https://vegento.russell.wisc.edu/

2023 Vegetable Resources – By Crop

Wisconsin Vegetable Entomology

Research ▾ Extension ▾ Crops & Insects ▾ IPM ▾ Lab Members

Pumpkin and Squash

Cucurbita (Latin for gourd) is a genus of herbaceous vines in the gourd family, Cucurbitaceae, also known as cucurbits, native to the Andes and Mesoamerica. Five species are grown worldwide for their edible fruit, variously known as squash, pumpkin, or gourd depending on species, variety, and local parlance, and for their seeds. First cultivated in the Americas before being brought to Europe by returning explorers after their discovery of the New World, plants in the genus *Cucurbita* are important sources of human food and oil. Wikipedia

image source

Major pests »

- Cucumber beetles
- Cutworm (see black cutworm)
- Loopers
- Seedcorn maggot
- Squash bug
- Squash vine borer

Minor pests »

- Melon aphid
- Spider mite

Pest management »

- Pumpkin and squash production in WI – Excerpt from UW-Extension Publication A3422

Cultivation in Wisconsin »

Most commercial growers start pumpkin and squash from seed. Delay planting until danger of frost is past and soils have warmed to at least 60°F. Planting generally begins around May 10 in southern Wisconsin and June 1 in northern Wisconsin. Pumpkin and squash are sensitive to transplanting. Plants are typically started in individual containers 3–4 weeks before transplanting in the field—May 20 in southern Wisconsin and June 1 in northern counties. Using too small a container or allowing the plants to grow too large before transplanting can impair root growth in the field.

Pumpkins and squash have male and female flowers that are pollinated by insects, typically bees. To protect pollinators, insecticide applications should not be made during the day while they are active.

Resources »

- Pumpkin and squash production in WI – Excerpt from UW-Extension Publication A3422
- Growing pumpkins and other vine crops in Wisconsin: a guide for fresh-market growers–UW-Extension publication

- General information
- Major Pests
- Minor Pests
- Management
- WI Cultivation Tips
- Resource Links

https://vegento.russell.wisc.edu/

2023 Vegetable Resources – By Pest

https://vegento.russell.wisc.edu/

2023 Vegetable Resources – By Pest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Vegetable Crop Entomology

Extension and Research

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Degree-day modeling
- What is degree-day modeling?
- Wisconsin Vegetable Disease & Insect Forecasting Network (VDIFN)
- UC IPM DD concepts
- USPest DD models
- USPest DD map maker
- USA National Phenology Network
- PRISM Climate Data Portal

Other Resources

Related sites:
- Entomology Department
- Plant Pathology Department
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- Insect Diagnostic Lab
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- CALS AgWeather

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Squash Bug

Order **Hemiptera** (true bugs, cicadas, hoppers, aphids)
Family **Coreidae** (leaf-footed bugs)
Species ***Anasa tristis***

Squash bugs are an emerging problem in Wisconsin. In recent years, these insects have become more prevalent, causing damage to vine crops in commercial fields and home gardens alike. The key to management is early detection. Squash bugs feed on all vine crops, but pumpkins and squash are the preferred hosts with gourds and melons favored next.

Squash bug (*Anasa tristis*)
Photo: Jeffrey Hahn, Univ. of Minnesota

Appearance

Adults are about ½ -3/4-inch long, brownish-black, flat, shield-shaped bugs. They are sometimes mistaken for stink bugs. Adults congregate and emit a strong odor when crushed. Immature squash bugs initially have red heads and legs with whitish-green bodies, but later have black heads and legs with gray bodies. Eggs are 1/16-inch, reddish orange to brown-colored and are laid in clusters on the undersides of leaves along the center vein.

Squash bug nymphs
Photo: 'Pollinator' on Wikipedia

Symptoms and effects

Squash bugs are a major pest of squash and pumpkins. Nymphs and adults feed on plant juices and release toxins into leaves. Feeding causes wilting, and leaves become dry and brown or black along the edges. This wilting may appear similar to bacterial wilt, but bacterial wilt is spread by the cucumber beetle. Early symptoms of infestation include yellow spotting on the leaves. Later in the season, adults will also feed on fruit, which can cease development and begin to rot. Young plants are more susceptible to severe damage.

Squash bug eggs
Photo: 'Pollinator' on Wikipedia

Life cycle

Unmated adults overwinter in Wisconsin in protected areas. Eggs are laid in late June and early July when cucurbit vines begin to develop. Eggs hatch in about 10 days. The nymphal stage lasts 4-6 weeks. Nymphs undergo 5 molts before reaching maturity. Adults appear in late July and early August. There is one generation per year. The female lays eggs over an extended period of time, and all life stages may appear at once on the plant.

- General information
- Appearance
- Symptoms/effects
- Life cycle
- Management
- Resource Links
    - UW-Extension fact sheets
    - UW-Extension publications
    - Additional useful websites

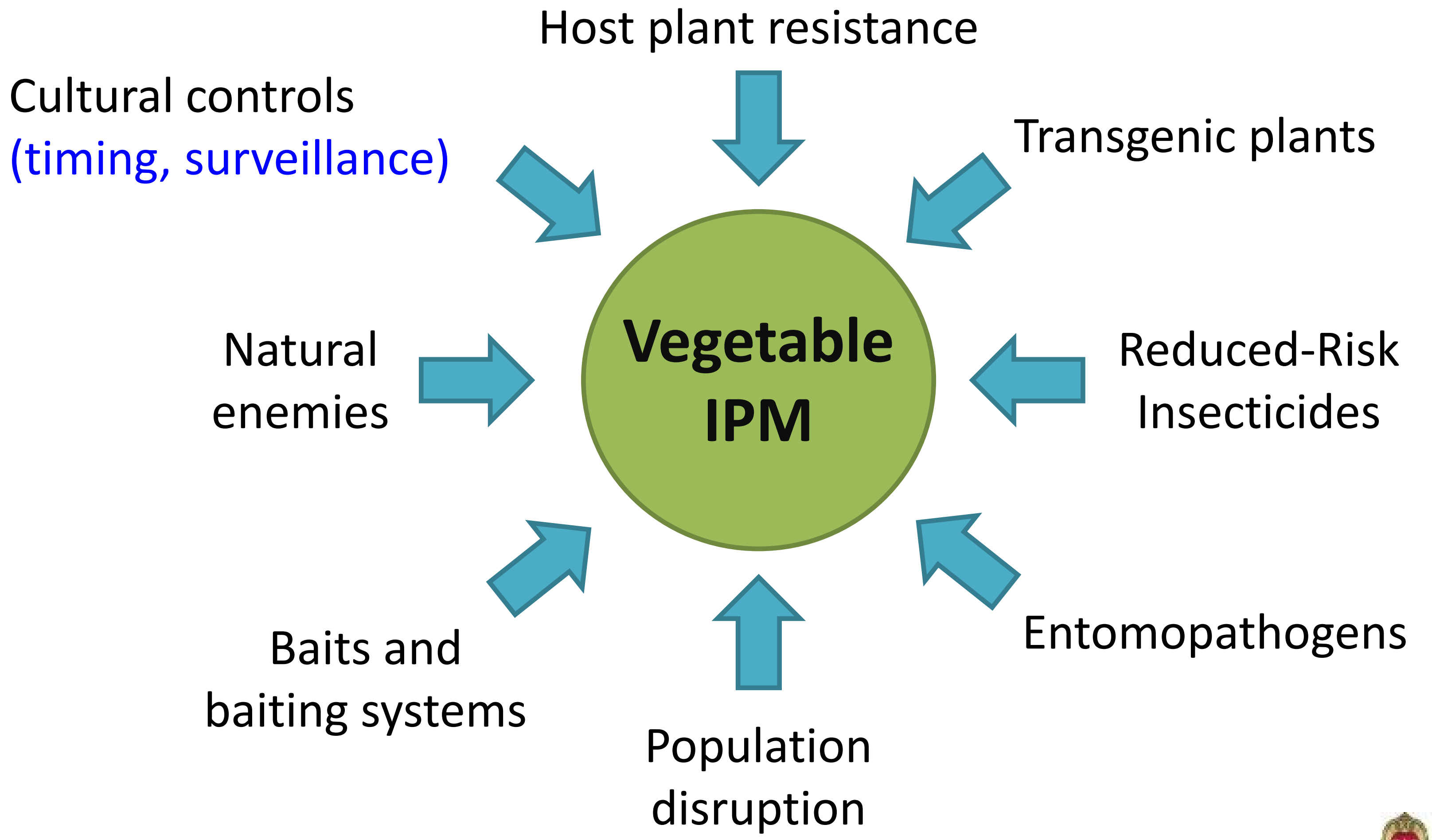
https://vegento.russell.wisc.edu/

2023 Vegetable IPM

https://vegento.russell.wisc.edu/

Insect pest management tactics for vegetables

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



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 2nd, 3rd & 4th generation flies
1st generation eggs laid 230-280 DD_{39} (Lilac bloom)

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Seed corn maggot: Pest Prediction

Degree Day Models: The Basics

Different insect species have different developmental min, max, and biofix

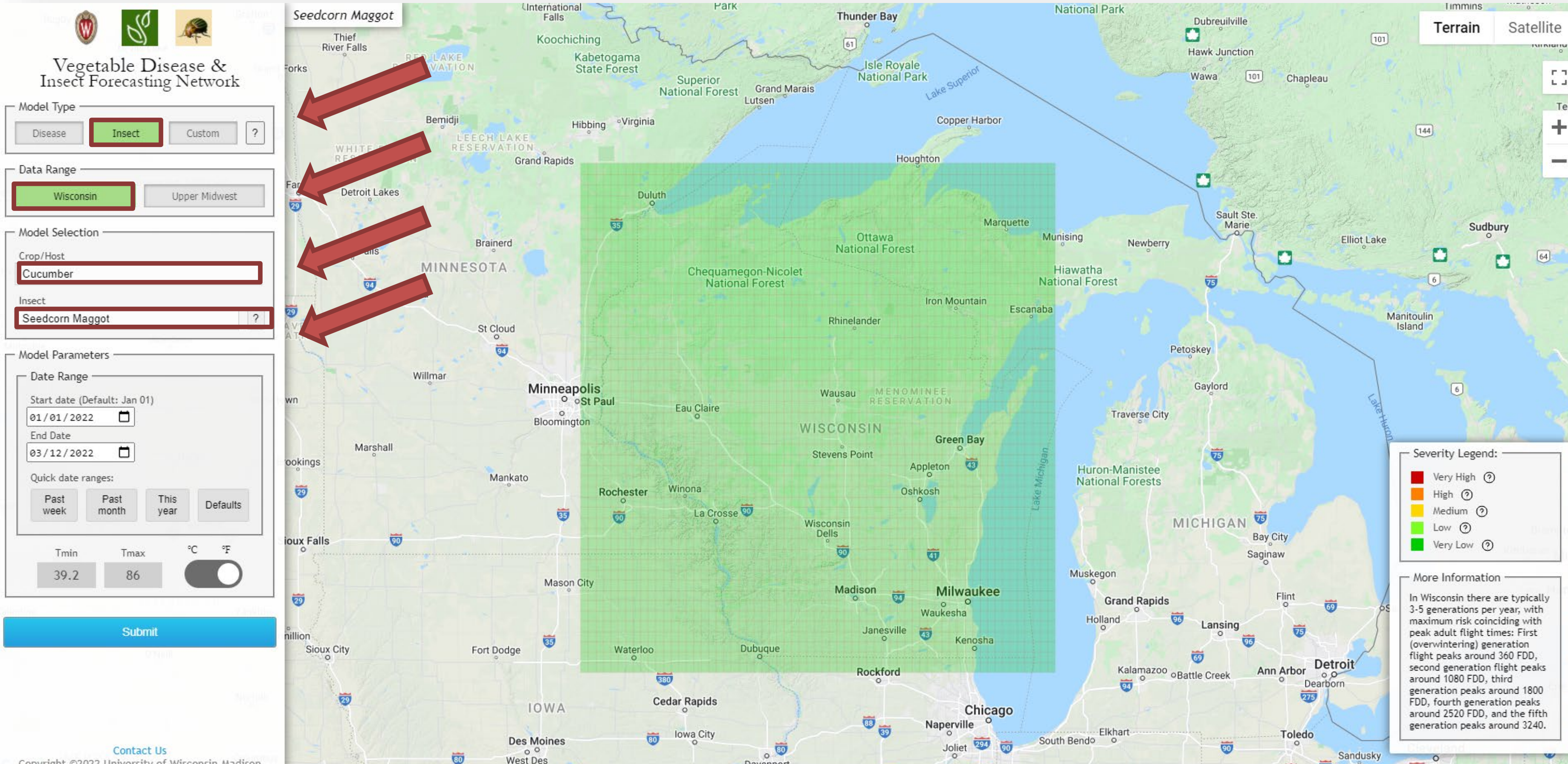
List of degree-day models for insect pests of vegetable crops in Wisconsin

Search:

COMMON NAME	BINOMIAL NAME	TMIN F	TMAX F	BIOFIX
Alfalfa weevil	Hypera postica	48	none	Jan 1
Asparagus beetle (common)	Crioceris asparagi	50	86	Jan 1
Black cutworm	Agrotis ipsilon	50	86	May 15*
Brown marmorated stink bug	Halyomorpha halys	54	92	Jan 1
Cabbage looper	Trichoplusia ni	50	90	May 15*
Cabbage maggot	Delia radicum	42.8	86	Jan 1
Colorado potato beetle	Leptinotarsa decemlineata	52	none	May 1*

** Note: Models with biofix dates other than Jan 1 are probably less reliable and the biofix may need to be adjusted to match an observed event such as the appearance of egg masses.*

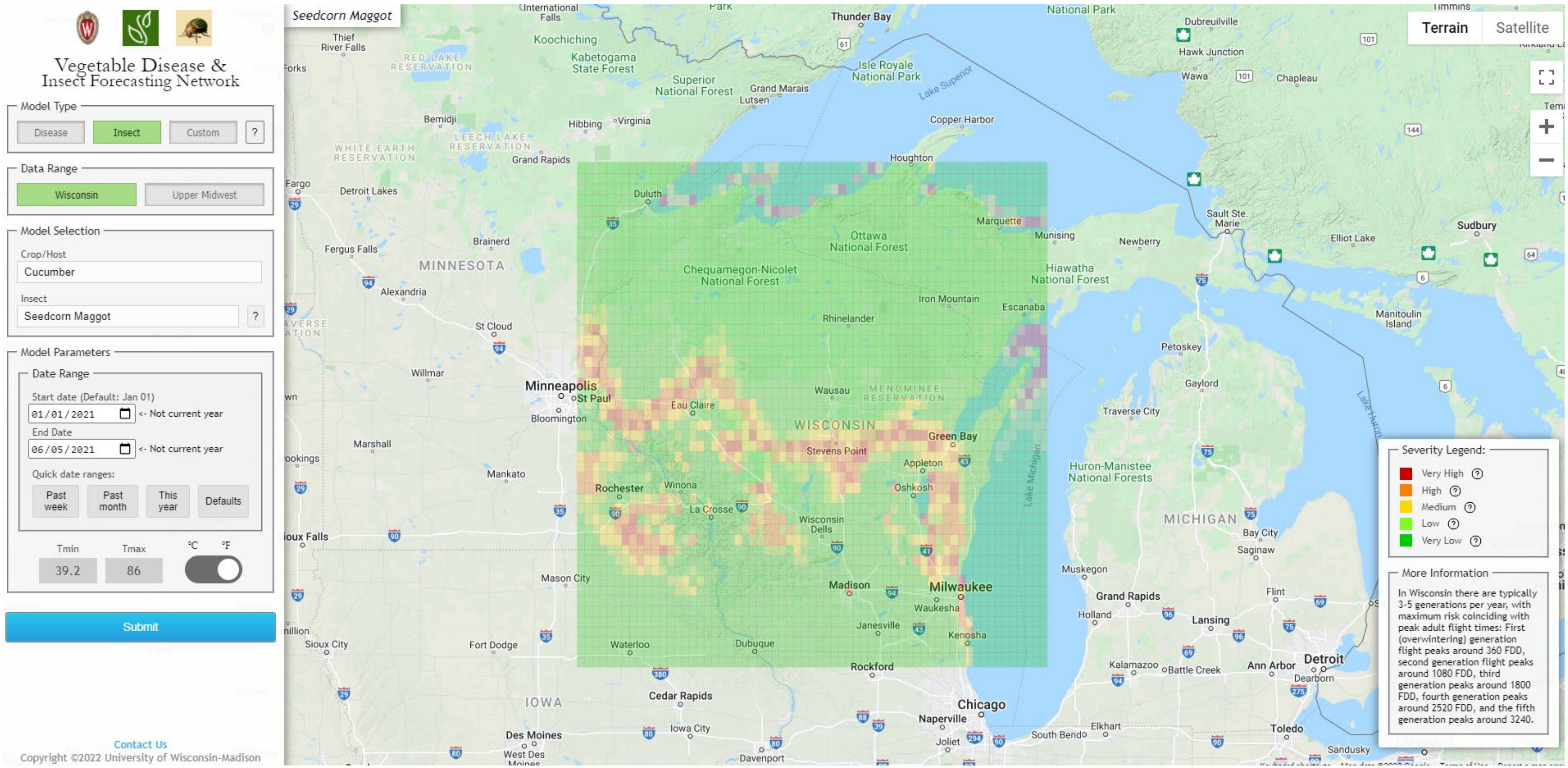
Seed corn maggot: Pest Prediction



Select your pest, data range, crop and insect

https://agweather.cals.wisc.edu/vdifn

Seed corn maggot: Pest Prediction Resources



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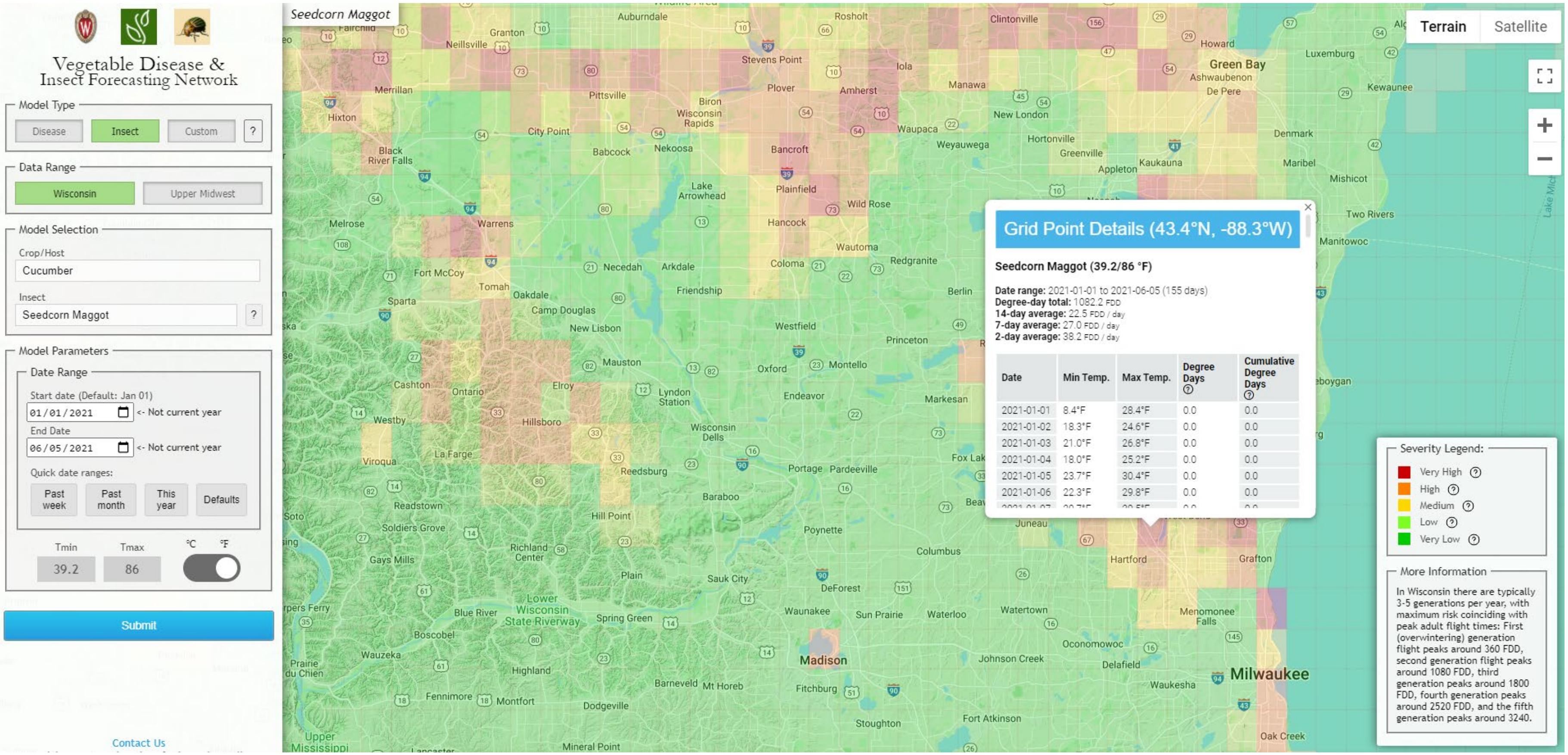
Seed corn maggot: Pest Prediction Resources



https://agweather.cals.wisc.edu/vdifn

Next steps with insect management

RNAi for Agriculture

https://www.greenlightbiosciences.com/

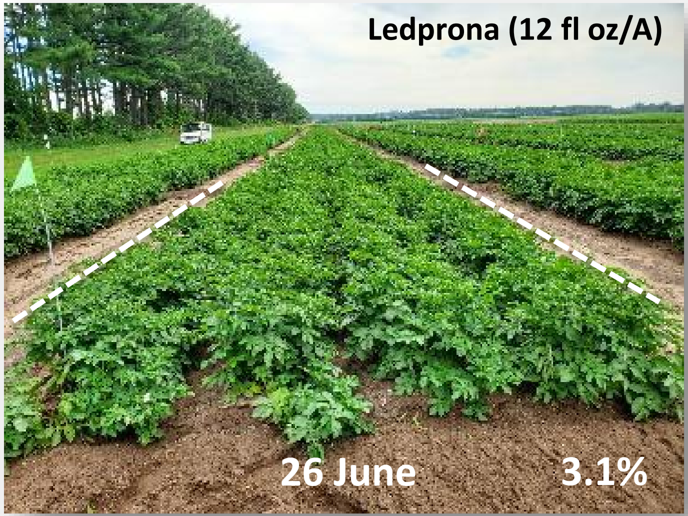
- *"RNAi is a process found in most living organisms wherein it acts to transiently control a variety of functions."*
- *"We can take advantage of this process to control pests through suppression of key genes in a temporary and reversible manner."*
- *"By matching the sequence of the native RNA encoding an essential gene in the target pest, expression of that gene can be disrupted, effectively silencing it, resulting in lethal, or functionally non-lethal phenotypes."*

Honeybee & Varroa mite
(*Apis mellifera*)
(*Varroa destructor*)

Colorado potato beetle
(*Leptinotarsa decemlineata*)

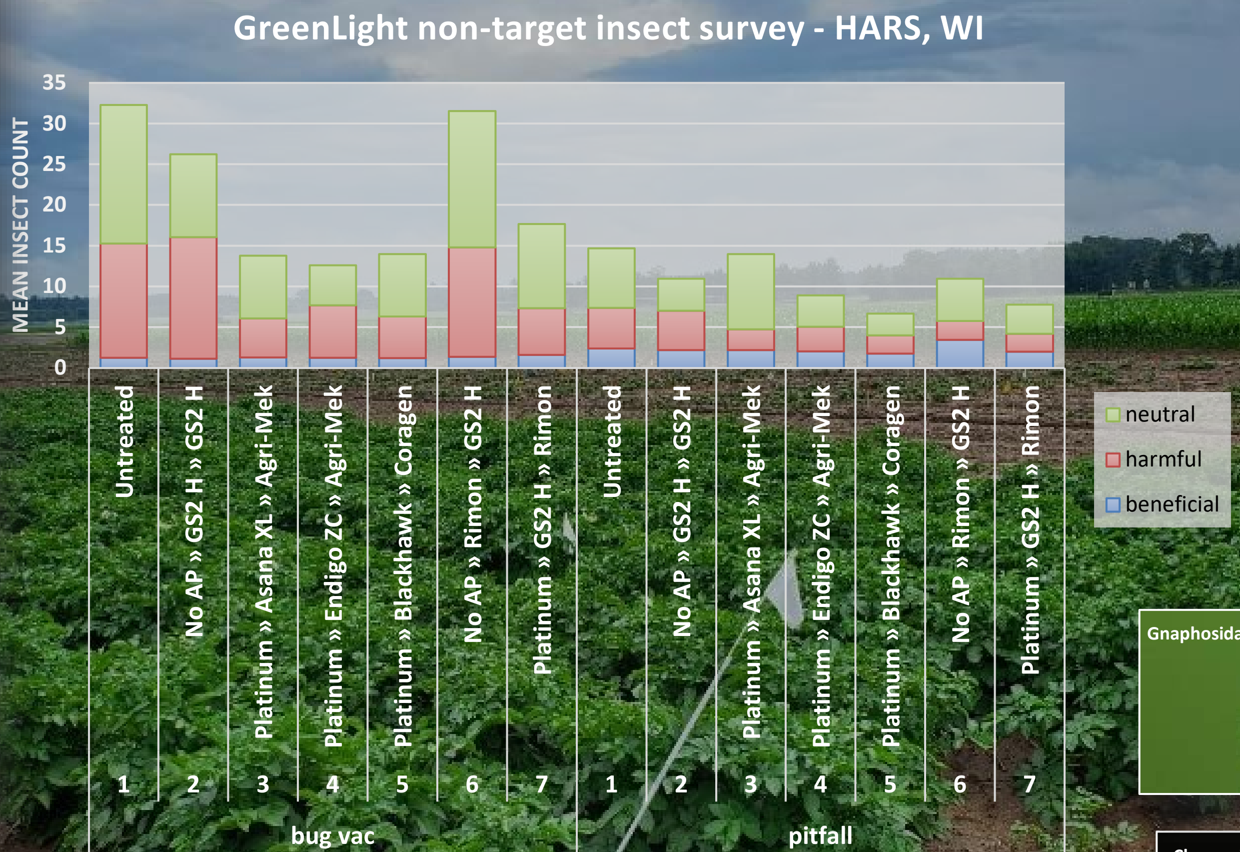
Greenlight Biosciences 2020 assays

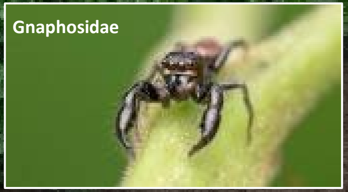
- **Calantha™ <u>full season management</u> - HARS, WI**



Greenlight Biosciences 2021 assays

- **<u>Natural Enemies Trial</u> – HARS, WI**





New insect management tools - diamides

Exirel ® ***(cyantraniliprole):***

- *Anthranilic diamide (MoA Group 28)*
  - *Do not exceed > 2 appl/crop season*
  - *Use rate 5.0 – 13.5 fl. oz / ac (foliar 61.7 fl oz) - Exirel*
  - *0.25-0.5% V:V, methylated seed oil (MSO)*
  - *pH < 7.0*
  - *Insect control spectrum (whitefly, armyworm, cabbage maggot, leafhoppers, aphids grasshoppers, flea beetles, thrips, leafminer, psyllids, potato beetle, loopers, diamondback moth, European corn borer, stalk borer)*

Coragen® ***(chlorantraniliprole)***

- *Anthranillic diamide (MoA group 28)*
  - *Do not exceed > 4 appl/crop season*
  - *Use rate 3.5 – 7.5 fl. oz / ac (foliar 15.4 fl oz) – Coragen*
  - *Do not apply > 2 appl per generation*
  - *0.25-0.5% V:V, methylated seed oil (MSO)*
  - *pH < 7.0*
  - *Insect control spectrum (whitefly, armyworm, grasshoppers, leafminer, potato beetle, loopers, diamondback moth, European corn borer, stalk borer)*

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New insect management tools - diamides

Elevest ® (cyantraniliprole + bifenthrin):

- *Anthranilic diamide (MoA Group 28 + 3A)*
  - *Control of CPB eggs, larvae, & adults*
  - *Do not exceed 2 appl/crop season*
  - *Use rate 5.6 – 9.6 fl. oz / ac (foliar 28.8 fl oz) - Exirel*
  - *0.25-0.5% V:V, methylated seed oil (MSO)*
  - *Insect control spectrum (very broad)*
  - *RUP*

Vantacor® (chlorantraniliprole)

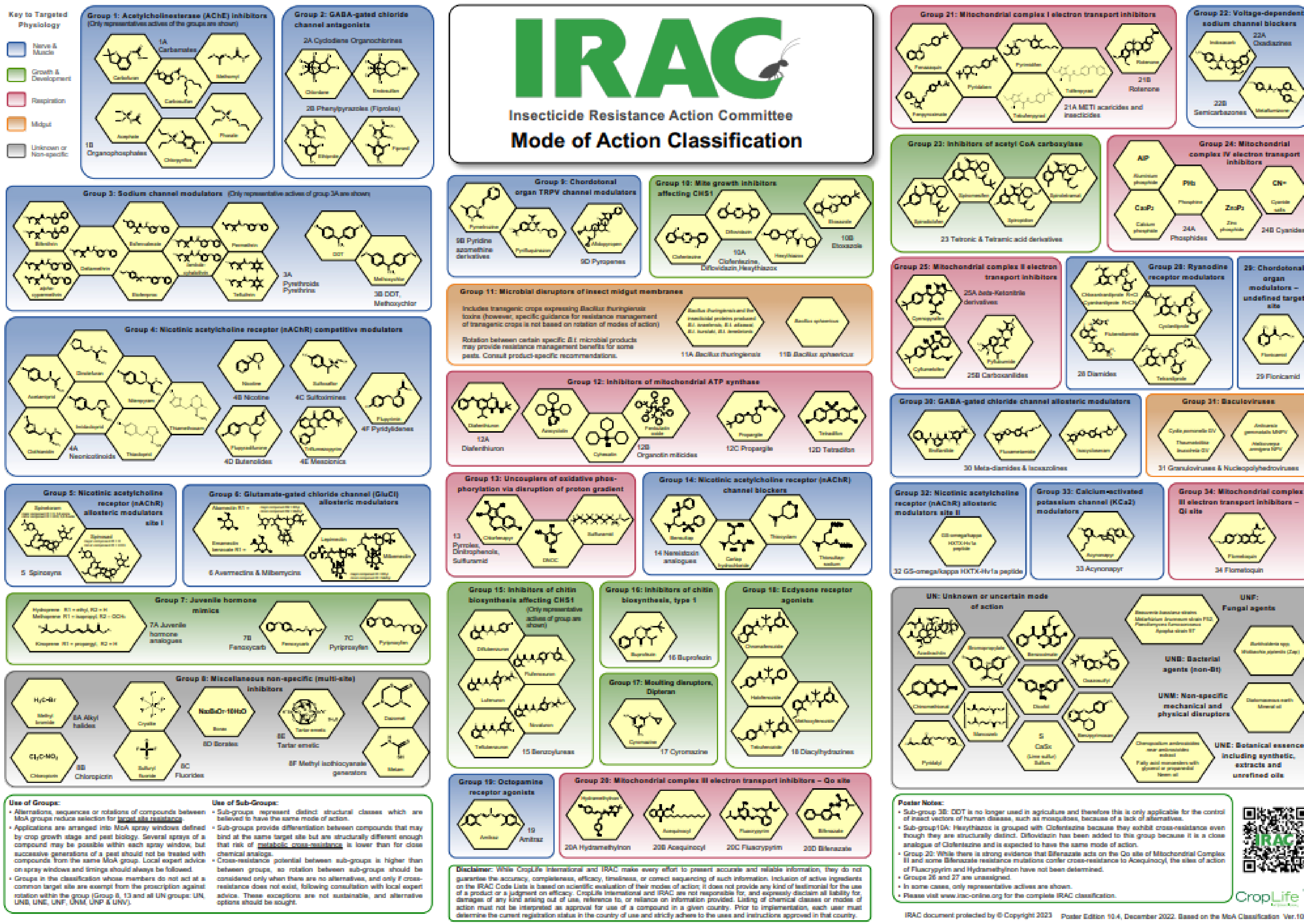
- *Anthranillic diamide (MoA group 28)*
  - *Do not exceed 2 appl/crop season*
  - *Use rate 1.2 – 2.5 fl. oz / ac (foliar 5.0 fl oz)*
  - *Do not apply > 2 appl per generation*
  - *0.25-0.5% V:V, methylated seed oil (MSO)*
  - *Insect control spectrum (same as Coragen)*

New insect management tools - diamides

- ***MinectoPro™ (abamectin + cyantraniliprole)***
  - *MoA groups 6 + 28*
    - *Use rate 5.5 – 10.0 fl oz / ac (CPB) (20 fl oz total)*
    - *2 appl / yr*
    - *Insect control spectrum (very broad)*
    - *RUP*

- ***Besiege® (lambda-cyhalothrin + chlorantraniliprole)***
  - *MoA groups 3 + 28*
    - *Use rate 6 – 9 fl oz / ac (CPB) (27 fl oz total)*
    - *Insect control spectrum (very broad)*
    - *RUP*

New insect management tools – mode of action (MoA)

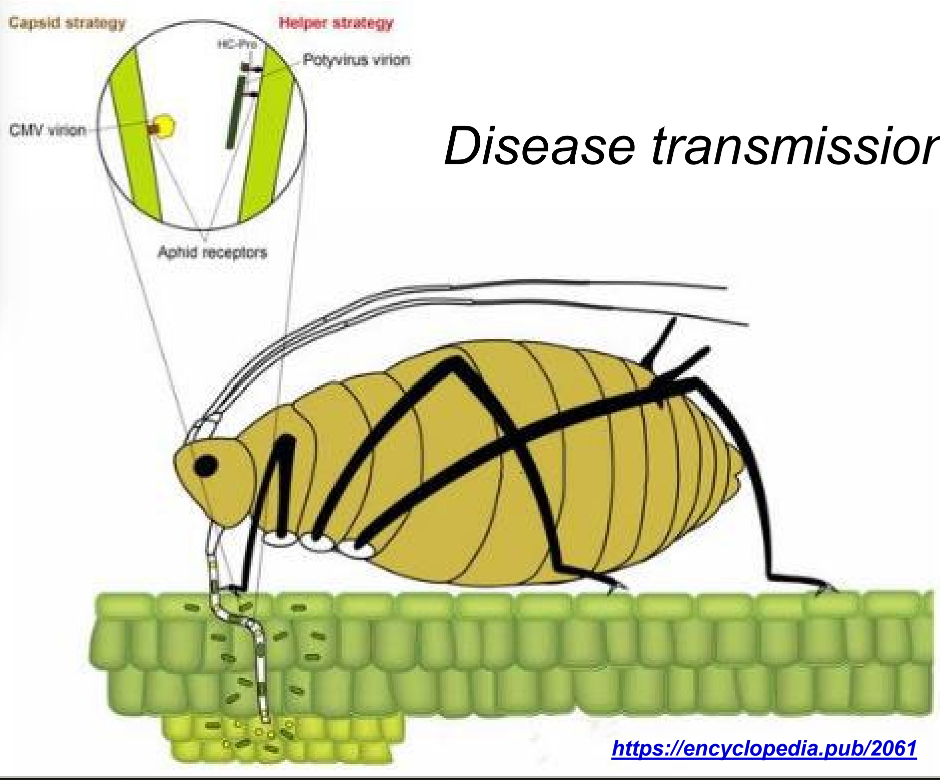


Aphid damage (direct & indirect)

Sap feeding

https://ipmworld.umn.edu/aphid-alert/1998/aug-28-no-5
Photo courtesy T. Radcliffe (1998)

Disease transmission



https://encyclopedia.pub/2061

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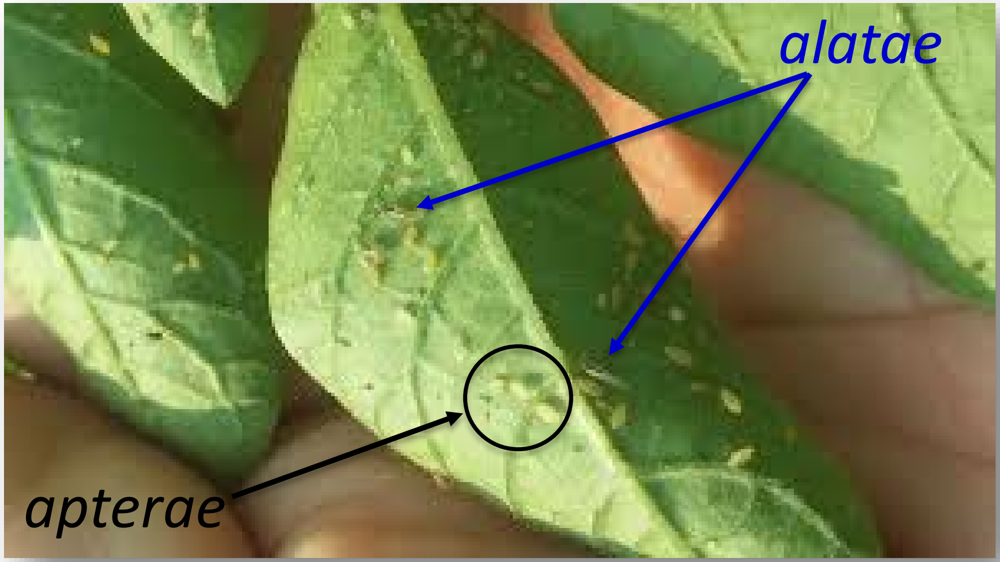
Scouting is key.



- Scout 10-12 sites per field
- Turn over 25 whole leaves per site
- Turn leaves from mid- to lower canopy positions
- Thresholds:
  - Avg 5 apterae (wingless) per leaf (action threshold)
  - > 15% of leaves infested (4/25)

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https://potatovirus.smugmug.com/Virus-Vectors/

New, recent or existing registrations

- **PQZ** (pyrifluquinazon, Nichino America) – brassicas, cucurbits, potato, leafy: aphids only (Group 9B)
- **Sefina/Versys** (afidopyropen, BASF) – brassicas, leafy, potato: aphids only (Group 9D)
- **Sivanto HL** (flupyradifurone, Bayer Crop Sci) – beans, peas, sweet corn, brassicas, potato: aphids, PLH (Group 4D)(soil and foliar)
- **PFR-97** (*Isaria fumosorosea* Apopka Strain 97, Certis USA) – aphids only; (Group UNK, biologic)
- **Transform WG** (sulfoxaflor, Corteva) – aphids and PLH
  beans, peas, sweet corn, brassicas, carrot, onion, potato:
  aphids, PLH (Group 4C)

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IRM considerations less problematic

- **Populations are typically migratory**
- **Application coverage is critical to target colonizing species in mid- to low canopy**
- **Reduced-risk or soft chemistry can conserve beneficial insects that parasitize aphids**

https://potatovirus.smugmug.com/Virus-Vectors/

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Potato leafhopper

Photo courtesy M. Rice

<u>*Occurrence*</u>

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

<u>*Appearance*</u>

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

Photo courtesy T. Murray

Potato leafhopper IRM

Chemical

- Begin monitoring May 15 - June 1
- Treat only when threshold exceeded (1 adult / sweep)
- Tolerant varieties (1-2 / sweep)

- Synthetic pyrethroids (@ mid rates) remain effective

Cultural (plant early for avoidance - always a challenge)

Biological (few effective biologicals)

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PC: USGS Bee Inventory and Monitoring Lab

Balancing trade-offs, improving sustainability


j. petersen


j. petersen

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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Protecting pollinators through conservation

Resources for Growers

[Farming for Bees: Guidelines for Providing Native Bee Habitat on Farms.] (The Xerces Society)

A detailed PDF booklet describing actions farmers can take to protect bees on their farm.

[Protecting Pollinators and Improving Pollination on Wisconsin Cranberry Marshes.] (University of Wisconsin-Madison Extension)

[Wild Pollinators in Wisconsin's Apple Orchards.] (UW-Madison Department of Entomology)

[Wild Pollinators of Eastern Apple Orchards and How to Conserve Them.] (Cornell University, Penn State University, and The Xerces Society)

[NRCS portal: How Farmers Can Help Pollinators]

A portal to USDA sponsored programs for pollinator conservation.

"Encouragement to be outside and assess the situation in your crop; a well spent 5 min to learn about pollination services"


Questions?