Advanced Vegetable

New Vegetable Problems Detected in Utah
Claudia Nischwitz, USU Extension

Advanced IPM Tools Small-Scale Vegetable Productions
Diane Alston, USU Extension

More than a Bad Smell: Detection and Control of the Brown Marmorated Stink Bug
David Lowenstein, Research Assoc. Post Doc, OSU

Update on Brown Marmorated Stink Bug in Utah
Lori Spears, USU Extension

Attracting and Conserving Wild Pollinators in Urban Vegetable Farms
David Lowenstein, Research Assoc. Post Doc, OSU

USDA Conservation Program for Insect Conservation
David Hanson, District Conservationist, NRCS

New Vegetable Viruses Detected in Utah

New plant diseases that emerged in 2017.

Claudia Nischwitz

Associate Professor and Extension Plant Pathologist

Utah State University

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I have been at USU since August 2010. I am an Associate Professor and Extension plant pathologist. I work on plant disease detection and management mainly for vegetables and tree fruit. I do diagnosis of pathogens on all crops.

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New Vegetable Problems Detected in Utah

Claudia Nischwitz

Associate Professor and Extension Plant Pathologist

Utah State University

- Genetic “disease” problems
- Seedborne High plains virus in corn
- Return of Watermelon mosaic virus and relatives
- Tomato spotted wilt virus
- New hosts for curly top in Utah
- Russet mites on tomato
- Potato virus Y

Genetic “disease” problems

- Onion - variegation
- Corn – leaf lesion mimic
- Tomato – fruit pox

Onion variegation

- Symptoms:
  - Yellow stripes and streaks on leaves
  - Abnormal development of bulb or variegated bulb

Howard F. Schwartz, Colorado State University, Bugwood.org

Corn – leaf lesion mimic

- Symptoms:
  - Occur when plants with mutation are stressed (drought stress, heat stress)
  - Yellow spots on leaves that eventually coalesce (look like bacterial disease)
  - Reduced yield and quality loss

Corn – leaf lesion mimic

- Any corn variety can be affected
- Nothing that can be noticed beforehand
- Seed companies should not harvest seed from symptomatic plants
- No management options once symptoms emerge
- Prevention of symptom development: Reduce stress on plants if possible

Tomato – fruit pox

- Any tomato variety can be affected
- Symptoms occur when fast growing plants and fruit is exposed to high temperature
- Often the side exposed to the sun is affected

Tomato – fruit pox

- Symptoms:
  - Small, brown spots on ripe fruit

Seedborne High plains virus in corn

- Hosts: Corn, small grains and grasses
- High plains virus usually transmitted by wheat curl mite
- Especially problematic in rotations of corn and small grains with strip till or no till
- Can be seedborne
- HPV symptoms in corn consists of white to chlorotic streaking and frequently stunting of plants that are infected early

Seedborne High plains virus in corn

- Plants infected early on either die or are stunted
- Infected seed may not germinate

Seedborne High plains virus

Return of Watermelon mosaic virus

- 2012 – 2014 high incidence of WMV in Utah
- 2015 and 2016 low incidence
- 2017 increase in incidence WMV observed in some counties as well as Papaya ringspot virus (closely related to WMV)
- Transmitted by aphids in non-persistent manner (have to feed on infected plant every time before transmission)

Return of Watermelon mosaic virus

- Affects summer squash, winter squash, pumpkin and zucchini
- Causes color breaking and warts on fruit
- Mosaic and distortion of leaves
- Fruit with warts and color breaking is fine to eat

Symptoms

Return of Watermelon mosaic virus

- Management:
  - resistant summer squash varieties (some are GMO)
  - Good weed control
  - Avoid planting next to alfalfa
  - Non-host border crops

Watermelon mosaic virus - Border crop trials

- Border crops
  - Pepper and eggplants
  - Borders about two feet
  - Planted border crops two weeks prior to seeding summer squash
- Results
  - Plots with no border had about 40% infected plants
  - With border 10%

Watermelon mosaic virus - Border crop trials

- Results
  - Difference was especially noticeable in corner plots that had two edges

Tomato spotted wilt virus


http://www.caes.uga.edu/topics/diseases/tswv/index.html

- TSWV is an important pathogens of tomato, pepper, tobacco and peanut in the U.S.
- It is becoming more and more frequent in Utah and established in the farmscape
- The virus is transmitted by thrips
- Thrips have to acquire the virus as larvae to be able to transmit it as adults. Once larvae are infected, thrips carry and transmit the virus throughout their entire lifespan

Tomato spotted wilt virus


http://www.caes.uga.edu/topics/diseases/tswv/index.html

- TSWV is not seedborne
- Plants get infected early in the season
- Symptoms:
  - Necrotic spots on leaves
  - Wilting
  - Stunting of plants
  - Necrotic rings on immature fruit
  - Chlorotic ringspots on mature fruit

Tomato spotted wilt virus

Tomato spotted wilt virus

Tomato spotted wilt virus


http://www.caes.uga.edu/topics/diseases/tswv/index.html

- Management:
  - Good weed control
  - Resistant tomato varieties (Finish Line, Fletcher, Crista, Red Defender, BHN 602 and Picus)
  - No resistant pepper varieties
  - Reflective mulch
  - Insecticides for thrips control

New hosts for curly top viruses

- Beets
- Chards
- Amaranth

Symptoms

- Beets
  - Crinkled leaves, yellow stunted plants, discoloration of vascular tissue in tuber
- Chards
  - Crinkled leaves, yellow stunted plants
- Amaranth
  - Yellow leaves, stunted plants

New hosts for curly top viruses

Beet

New hosts for curly top viruses

Beet

New hosts for curly top viruses

Chard

New hosts for curly top viruses

Amaranth

Russet mites on tomato

- Eriophyid mites
- Need a strong hand lens or dissecting microscope to see them
- Cream to pale orange colored

www.omafra.gov.on.ca

Russet mites on tomato

- Other hosts: Potato and pepper but usually not a problem on those hosts
- Symptoms:
  - Bronze discoloration of leaves and stems (russeting)
  - Severe infestations, stems will lose their hairs
  - Fruit: russeting and cracking od fruit, uneven ripening
  - Plants will die from severe infections

Russet mites on tomato

www.growingproduce.com

Russet mites on tomato

- Management:
  - Applications of sulfur or Abamectin
  - Remove alternate weed host like nightshade and morning glory

Potato virus Y - Potato

- Three strains: PVY^{O}, PVY^{N}, PVY^{NTN}
- PVY^{O} cause mosaic symptom on leaves, no tuber symptoms
- PVY^{N} cause necrotic lesions on leaves, no tuber symptoms
- PVY^{NTN} cause necrotic lesions on leaves, and ring spots on tubers that extend into flesh (Yukon Gold very susceptible to tuber necrosis)

Potato virus Y - Potato

Potato virus Y - Potato

- Transmitted by aphids and equipment
- Main spread and introduction to fields: infected seed pieces
- Management:
  - Certified seed pieces (best option but no guarantee)
  - Remove infected plants from field

Downy mildew of spinach

- Symptoms:
  - Leaves turn yellow
  - Gray fungus growing on the underside of the leaf
- Host: Spinach
- High humidity and cool temperatures
- Dispersal:
  - Airborne spores
  - Seedborne and thought to be seed transmitted

Downy mildew of spinach

- Symptoms can develop and the pathogen can decay the leaf tissue while stored in bag when non-symptomatic leaves are harvested

Downy mildew of spinach

- Consists of many races
  - Newest race is race 16
- Management:
  - Fungicides need to be applied before symptoms occur: Aliette 80 WDG, Ridomil Gold, Revus or copper-containing products
  - Resistant varieties

    No variety is resistant to all races but several have resistance to many varieties

Downy mildew of spinach

Variety	High resistance	Intermediate resistance
3665 (F1)	Races 1-5, 8, 9, 11-12, 14	
Anna (F1)	Races 1, 3, 5	
Baker (F1)	Races 1, 3, 5, 8, 9, 11, 12, 14	
C2-606 (F1)	Races 1-9, 11-16	
C2-608 (F1)	Races 1-7, 9, 11, 13, 16	
Carmel (F1)	Races 1-11,13	
Corvair (F1)	Races 1-12, 13	
Emperor (F1)	Races 1-10	
F91-415 (F1)	Races 1-2	
Flamingo (F1)	Races 1-11	Races 12-13
Gazelle (F1)	Races 1-13	
Kookaburra (F1)	Races 1-13, 15	
Persius (F1)	Races 1-3, 5, 8, 9, 11, 12, 14, 16	
Red Kitten (F1)	Races 1-13, 15	
Reflect (F1)	Races 1-11	
Seaside (F1)	Races 1-12	Race 14
Space (F1)	Races 1- 3, 5-6, 8, 11-12	
Viceroy (F1)	Races 1-2	
Woodpecker (F1)	Races 1-15	

Tobacco Mosaic Virus/Tomato Mosaic Virus: Symptoms, Transmission and Prevention of Infection

Virus del mosaico del tabaco/Virus del mosaic del tomate

TRANSMISSION
La transmisión

TMV/ToMV is transmitted from handling contaminated tobacco products. TMV/ToMV is also transmitted by handling infected plants.

TMV/ToMV es transmitido por el manejar con las manos los productos de tabaco contaminados. TMV/ToMV también es transmitido por el manejar con las manos las plantas infectadas.

Once a plant is infected with TMV/ToMV the virus will contaminate the seeds and subsequently infect the seedling.

Una vez que la planta sea infectada con TMV/ToMV el virus contaminará las semillas de la planta misma y después infectará los semilleros.

SYMPTOMS IN TOMATO, PEPPER AND PETUNIA
Las síntomas en el tomate, pimiento y las petunias

TOMATO/TOMATE

- Symptoms vary by variety and TMV/ ToMV strain.
- Brown rings or sunken lesions occur on susceptible fruit.
- Dark and light green modeling will occur on some varieties on leaves.

- Las síntomas de tomate varian por la variedad y la cepa de TMV/ToMV.
- Anillos marrones con un halo o lesiones sangrado marrones ocurren en fruta susceptibles.
- Síntomas de mosaico se producirán en algunas variedades en las hojas. A veces son difíciles de ver.

PEPPER/PIMIENTO

- Only leaves show symptoms.
- Oak leaf pattern.
- Yield loss of tomato and pepper plants is between 5-100%.

- En pimiento, sólo las hojas mostrarán síntomas.
- Es un modelo de la hoja de roble.
- La pérdida de rendimiento de las plantas de tomate y pimiento es entre 5-100%.

PETUNIA/PETUNIA

- Symptoms can be seen on flowers.
- On purple flowers darker spots appear.
- On other flowers white spots appear.

- En las petunias, las síntomas se ven en las flores.
- En flores de color púrpura aparecen manchas más oscuras.
- Otras flores manchas blancas se muestran. Las hojas no pueden mostrar síntomas.

MANAGEMENT AND PREVENTING TRANSMISSION
El mantenimiento y el evitar la transmisión

Transmission can be prevented by dipping tools into 20% powdered milk suspension before use.

Se puede evitar la transmisión al undir las herramientas en una suspensión de 20% leche de polvo antes de usar.

Transmission can also be prevented/managed by wearing clean gloves while working with plant.

Transmisión también puede ser evitado/mantenido al vestir guantes limpios cuando se trabaja con la planta.

EXTENSION
UtahStateUniversity

Authors: Claudia Nischwitz, Brooke Olson, Rhett Taylor

Thank you for your attention

Advanced IPM Tools for Small-Scale Vegetable Production

I will review fundamental and advanced tools for managing vegetable insect pests with an integrated pest management (IPM) approach. I will include IPM for some of the difficult to manage insects on the small farm: squash bug, spider mites, and grasshoppers.

Diane Alston

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I am an extension and research entomologist for Utah State University. I serve as the Utah Extension Integrated Pest Management (IPM) Coordinator. This program aims to increase the implementation of IPM on Utah lands (agricultural, urban, range, and forested) through demonstration and education. The Utah Extension IPM program is an interdisciplinary collaboration that involves faculty and staff from across the state. I also co-direct the Utah Plant Pest Diagnostic Laboratory. The UPPDL provides services in pest identification and management recommendations to the citizens of Utah I study and provide outreach education for fruit and vegetable insect pest management in Utah. I am an avid gardener and trail runner.

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ADVANCED IPM TOOLS

FOR SMALL-SCALE VEGETABLE PRODUCTION

Diane Alston, Entomologist
Utah State University

Urban and Small Farms Conference
February 22, 2018
Viridian Events Ctr., West Jordan

EXTENSION
UtahStateUniversity

Vegetable IPM Resources

Utah Vegetable Production & Pest Management Guide (online & pdf)

- Production (soil nutrient & water management)
- IPM (pest monitoring & identification)
- Insects & Diseases
- Pesticide Tables

vegetableguide.usu.edu

Insects & Diseases

- Brassica
- Cucumber, Pumpkin, Squash
- Onion
- Potato
- Tomato, Pepper, Eggplant
- Sweet Corn
- Coming soon:
  - Leafy greens
    - Arugula
    - Collards
    - Lettuce
    - Spinach

Diamondback Moth (Plutella xylostella)

Order Lepidoptera: Family Plutellidae

DESCRIPTION:

Adult: Small (1/3 inch), slender, grayish brown moths with folded wings that flare outward and upward at the hind end (Fig. 4.7). Male moths have a row of three yellow diamond-shaped spots down the middle of their back.

Figure 4.7 - Adult diamondback moth (DBM).

Egg: Very small and yellow to white in color; laid singly or in group

Larva: Mature larvae are about 1/3 inch long with a pale yellow-green body that is pointed at both ends (Fig. 4.8). Diamondback larvae are distinguished by their habit of wriggling vigorously or dropping from a plant on a string of silk when disturbed.

Figure 4.8 - DBM larva (wriggles or drops from plants on a silk string when disturbed).

Pupa: Green in color and develop in a loosely spun, lace-like cocoon that is attached to the leaves or plant stems (Fig. 4.9).

Figure 4.9 - DBM pupa and window pane damage to the host leaf; note the lace-like cocoon.

LIFE HISTORY:

Diamondback moths overwinter as adults, but don't survive the winter in colder areas of Utah. They are re-introduced to cooler areas on strong winds from warmer, southern locations. Adult flight occurs in the spring; first eggs are laid in the late spring and early summer. Eggs hatch within 4-8 days; larvae initially feed on the undersides of older or outer leaves of older plants. Larvae mature in 10-30 days depending on temperatures; pupation lasts for 10-14 days. Up to 4-6 overlapping generations of diamondback moth may occur each year in Utah.

DAMAGE:

Diamondback moths prefer cabbage and broccoli, but will feed on other cole crops and cruciferous weeds. Immediately after hatching, tiny larvae mine through leaves (leaving the upper side of the leaf intact) creating small depressions called "window panes" that appear as holes (Fig. 4.9). This damage primarily occurs on outer or older leaves of older plants. Larvae will also feed on flower buds and floral stalks. Larvae present in the heads and stems at harvest reduce the marketability of the crop (Fig. 4.10).

Figure 4.10 - DBM damage on cabbage; note the ragged holes and smaller cabbage head (right).

MONITORING:

- Scout for larvae and pupae on leaves of susceptible plants at the seedling stage, during crop thinning, and just before crop head formation. Select 10 mature, unfolded, leaves (but not old and discolored) from 10 different areas in a field (100 leaves total); inspect the leaves for "window pane" damage, larvae, and pupae.
- Use pheromone monitoring traps. Mount traps on a stake and place just above the crop canopy height at the field edges. Use pheromone lures specific for diamondback moth to attract male moths for counting.
- When monitoring, pay attention to border rows that are next to fields that have had high populations of diamondback moths and high weed populations. Adults commonly migrate to new areas from fields that have recently been harvested or disked under.

MANAGEMENT:

Cultural and Mechanical

- Hand pick and destroy larvae
- Heavy irrigation (or rainfall) can reduce early larval populations. Crops that are drip or furrow-irrigated may have higher diamondback moth populations.
- Use row covers on susceptible crops to exclude diamondback moths. Remove covers during flowering for pollination.

Biological:

Parasitoid wasps that attack diamondback moth include *Diadegma insulare*, *Diadromus subtilicornis*, *Micropitis plutellae*, and *Trichogramma pretiosum* (egg parasitoid). Generalist predators include predaceous arthropods such as ground beetles, syrphid fly larvae, true bugs, lacewing larvae, and spiders.

Chemical:

Worldwide, diamondback moth has developed resistance to multiple insecticides. Although no resistance has been reported in Utah, it is crucial to rotate insecticide groups to prevent the development of insecticide resistance. Consider chemical treatment options when 5% of the crops are infested with larvae and before they move into crop heads or broccoli and cauliflower buds expand. *Bacillus thuringiensis* var. *kurstaki* (Bt) and spinosad (e.g. Entrust) are organic options that can control small populations of diamondback moth, but may not be effective in major outbreaks.

SEARCH THE INTERNET FOR MORE INFORMATION:

- UC Davis IPM Cole Crops Diamondback Moth
- Penn State Diamondback Moth
- Oregon State University Diamondback Moth

Squash Bug (Anasa tristis)

Order Hemiptera: Family Coreidae

DESCRIPTION:

Adult: About 5/8 inch long and about 1/3 as wide. Wings are folded over a flat back, and the body is brown to gray with orange and brown stripes along the edges of the abdomen and underside (Fig. 5.10).

Figure 5.10 -Squash bug adult on a zucchini plant.

Egg: Clusters of 15 to 40, shiny bronze to red eggs located on the undersides of leaves starting in midspring (Fig. 5.11).

Figure 5.11 - Squash bug eggs are shiny bronze to red eggs laid in clusters of about 15-40 on host leaves.

Nymph: Five instars ranging from 3/16 to ½ inch long. The 1st instar has a red head, antennae and legs with whitish to greenish gray bodies. The 2nd and 3rd instars have black appendages and greenish gray bodies (Fig. 5.12). The 4th and 5th instars develop wing pads and begin to resemble adults.

Figure 5.12 -A squash bug nymph on the underside of a leaf.

LIFE HISTORY:

Squash bugs overwinter as adults in protected sites around building foundations and under plant debris or compost piles. In southern Utah, they usually emerge in April, and in northern Utah they generally emerge in May. After emerging, adults will fly to host plants to feed, mate, and lay eggs. The new generation of adults show up in June to July in northern Utah and 3 to 4 weeks earlier in southern Utah. There is one generation per year in Northern Utah and a partial second generation is possible in southern Utah.

MONITORING:

Monitor in the spring for squash bug adults under plant debris, perennial plants, or near buildings. Look daily for eggs under leaves and watch for plant wilt. Place wooden boards in susceptible areas. Lift them up every morning and destroy existing eggs and adults.

MANAGEMENT:

Cultural:

- Sanitation. Remove or till under plant debris at the end of the season and keep fields free of trash or wood that could provide overwintering sites.
- Hand-picking. Physically remove adults and nymphs by hand. Kill/remove egg clusters by squashing, tearing out the leaf section, covering in petroleum jelly, or using duct or packaging tape to "peel" them off. Begin physical removal early in the season and continue every 2 to 3 days to keep population numbers low. This may be more practical for home gardens, or small commercial or organic fields.
- Trellising. Trellising vining types of squash and melons can make them less accessible to squash bugs as the bugs prefer to hide under vines and leaves near the soil.
- Resistant varieties. Although there are no cucurbit varieties that are immune to squash bugs, there are some that have lower susceptibility or relative resistance compared to other varieties. Some variety susceptibilities are as follows: Butternut and Royal Acorn (resistant); Sweet Cheese and Green Striped Cushaw (moderately resistant); Pink Banana and Black Zucchini (susceptible); and Yellow Straightneck, Yellow Crookneck, and Hubbard Pumpkin (highly susceptible and attractive).
- Trap crops. Along the borders of the field or planting area, plant cucurbit cultivars that will attract overwintering adult squash bugs. Once adults have been lured to the trap crops, apply an insecticide or mechanically destroy the trap crop before eggs begin to hatch. This will reduce squash bug populations that would later attack the main crop. Yellow straightneck and crookneck have been found to be preferred by squash bugs for egg laying as compared to acorn, zucchini, butternut, and spaghetti squash
- Crop rotation. To avoid overwintering adult squash bugs, rotate to non-cucurbit crops in alternating years.
- Mulches. Mulches can harbor squash bugs but may also have benefits such as suppressing weeds, reducing soil moisture loss, and attracting beneficial insects. When used in combination with other cultural practices such as row covers, the benefits of mulches may outweigh the negatives.

Chemical:

Insecticides should be applied shortly after egg hatch, as they work best on nymphs. Sprays must penetrate the plant canopy and thoroughly cover the top and undersides of leaves, fruits, and vines in order to be effective. Sprays will dry more slowly and result in better coverage of vegetation when applied in the early morning or late evening. When plants are blossoming, don't spray during the day to avoid harming pollinators.

Biological:

Natural enemies of squash bugs include several species of parasitic wasps and the tachinid (parasitic) fly Trichopoda pennipes (Figs. 5.14 and 5.15), which is squash bug-specific. Although there are predators of squash bugs, predation tends to be low because noxious odors that repel predators are released when squash bugs are attacked.

Description
Life History
Damage
Monitoring
Management
Cultural
Chemical
Biological

Pesticide & Herbicide Tables

Brassica
Cucumber, Pumpkin, Squash
Melon
Onion
Potato
Tomato, Pepper, Eggplant
Sweet Corn
Herbicides – Commercial
Insecticides - Commercial
Insecticides - Home
Pesticide information

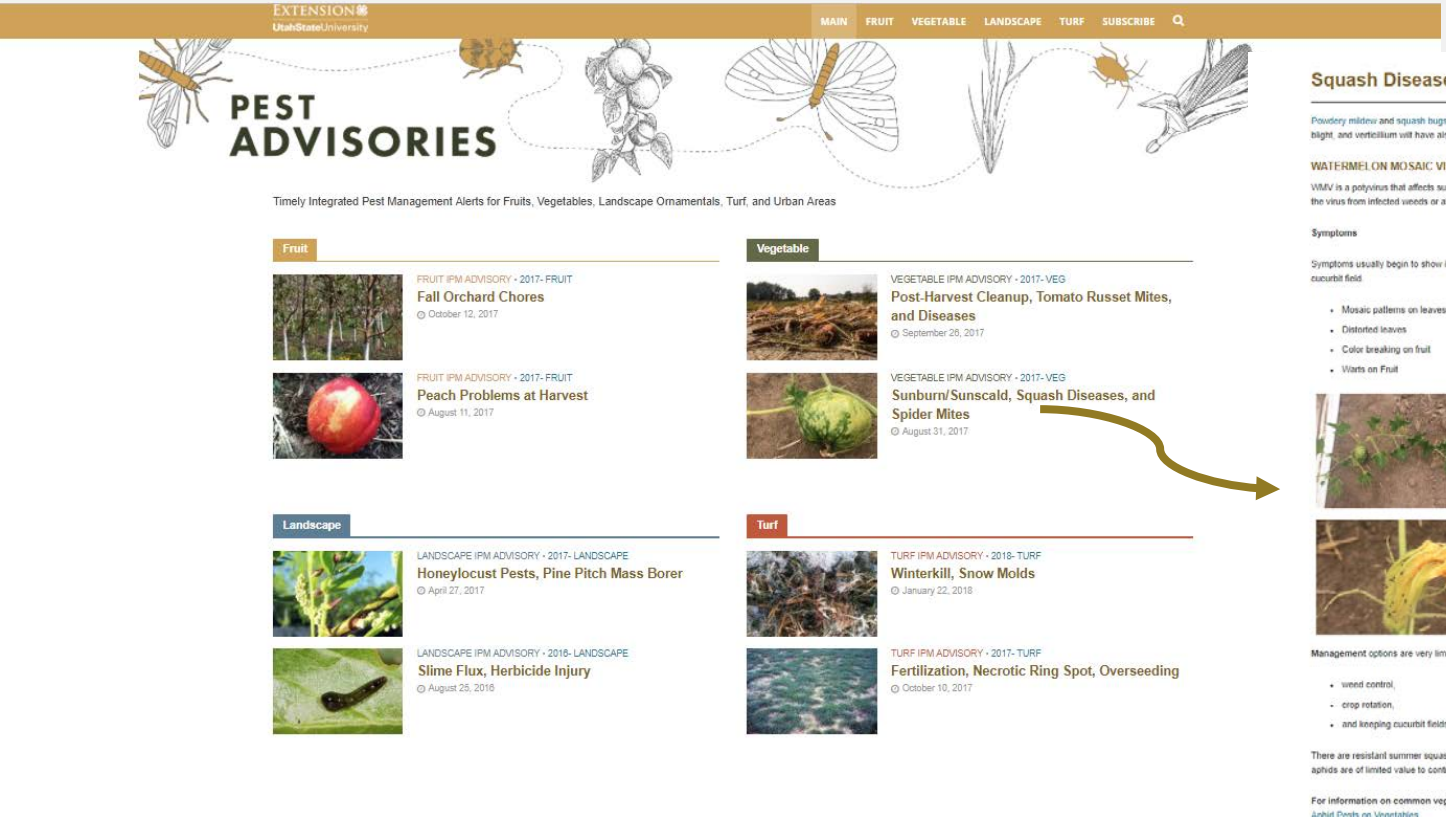
Insecticides Commercial

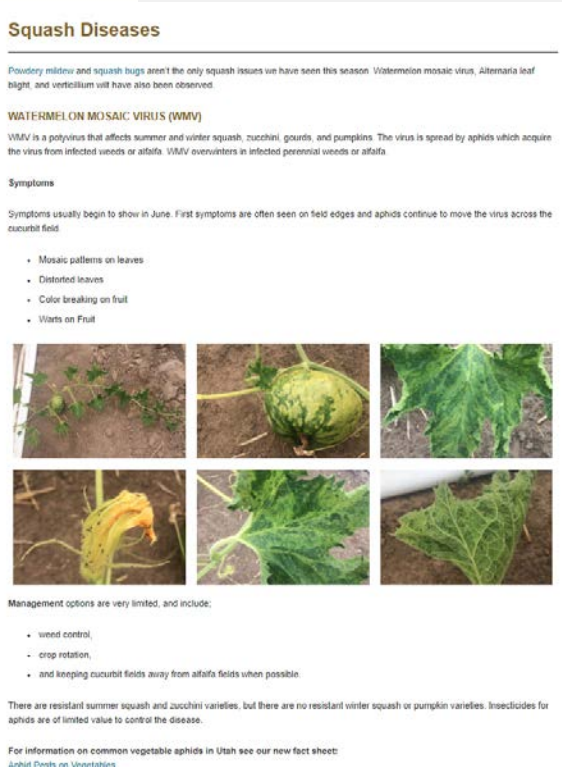
Table 10.3. Insecticides registered for **COMMERCIAL** use on **Sweet Corn** in Utah, organized by Mode of Action (MoA).

Active Ingredient	Brand Name	MoA	Residual (days)	Aphids	Corn Earworm	Cutworm	Earwigs	Fall Armyworm	Sap Beetle	Seed Ma
carbaryl	Carbaryl, Sevin	1A	3		X	X		X	X	
methomyl	Lannate^{R}, Nudrin^{R}	1A	5	X	X	X		X		
chlorpyrifos	Chlorpyrifos^{R}, Lorsban	1B	10	See label	See label	See label	See label	See label	See label	See
ethoprop	Mocap^{R}	1B	(++)			X				
malathion	Malathion, Fyfanon	1B	5	See label	See label	See label	See label	See label	See label	See
phorate	Thimet^{R}	1B	(++)							
chlorpyrifos + gamma-cyhalothrin	Bolton^{R}, Cobalt^{R}	1B/3	10	X	X	X		X	X	
chlorpyrifos + lambda-cyhalothrin	Cobalt Advanced^{R}	1B/3	10	X	X	X			X	
chlorpyrifos + zeta-cypermethrin	Stallion^{R}	1B/3	10	X	X	X		X	X	

USU Extension Pest Advisories

Fruit
Vegetable
Landscape
Turf





Utah Pests Quarterly News

- Timely pest-related news articles

UTAH PESTS QUARTERLY
NEWSLETTER

Fall 2017 / Vol. XI

Utah Plant Pest Diagnostic Laboratory
USU Extension

IN THIS ISSUE

NEW FACT SHEETS

Aphid Pests on Vegetables
Leafrollers in Fruit Orchards
Spotted Wing Drosophila (update)
Minute Pirate Bug

EXTENSION
UtahStateUniversity

Brown Marmorated Stink Bug Status in Utah

Brown marmorated stink bug adult on corn leaf.

Brown marmorated stink bug (BMSB; *Halyomorpha halys*) is an invasive insect from Asia that is a nuisance pest of homes and landscape ornamentals, and an economic pest of various fruits, vegetables, nuts, and other valuable crops in Utah. It was first detected in the U.S. in Pennsylvania in the late 1990s and has since spread to at least 44 U.S. states (www.stopbmsb.org).

BMSB was first detected in Utah (Salt Lake City) in 2012 by the general public and by 2015 was causing nuisance problems in parts of northern Utah. BMSB is currently found in Utah, Salt Lake, Davis, Weber, Box Elder, and Cache Counties. BMSB is strongly associated with urban developments and railroads (Wallner et al. 2014), so it is possible that it will become established in other portions of the state. This field season, the Utah BMSB team scouted for BMSB in ornamental hosts, and fruit and vegetable crops throughout northern Utah. For the first time, agricultural damage due to BMSB feeding was confirmed, and many individuals in Utah reported damage to the USU BMSB team.

Ornamental Hosts

Cody Holthouse, a USU graduate student, is studying BMSB phenology and plant host use in urban-agricultural landscapes, and is also conducting biological control surveys. He has found BMSB on more than 40 ornamental hosts, with high numbers on catalpa, chokecherry, Siberian pea shrub, common lilac, and apple. Other North American studies have revealed that BMSB uses at least 200 hosts from annuals to trees, and are most commonly found on non-native woody plants. Further, BMSB uses different host plants throughout the growing season, and all life stages are more commonly observed on angiosperms (flowering plants) than gymnosperms (e.g., conifers) (Bergmann et al. 2016). Therefore, selective planting of non-hosts, such as gymnosperms, may help reduce the agricultural and nuisance pest status of BMSB (Bergmann et al. 2016).

continued on next page

UTAH PESTS QUARTERLY
NEWSLETTER

Summer 2017 / Vol. XI

Utah Plant Pest Diagnostic Laboratory
USU Extension

IN THIS ISSUE

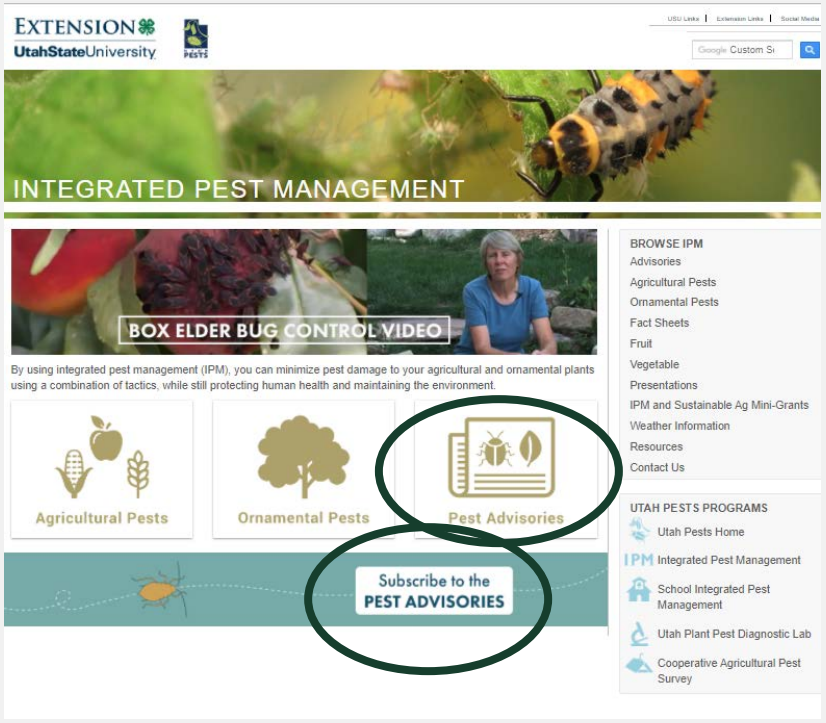
High Tunnel Arthropod Pest Management

High tunnels can extend the growing season in a cold location such as northern Utah.

Use of high tunnels or field greenhouses is a popular production method in Utah to substantially extend the length of the growing season. Tunnels can provide benefits beyond temperature regulation, such as increasing humidity, shading, and reducing populations of some pests through exclusion and concealment. However, some insect and related pests can thrive in the plastic-covered environment. If plants are irrigated with driplines, the dry soil between plant rows is a conducive location for ant nests. Moist, shaded plants can be attractive

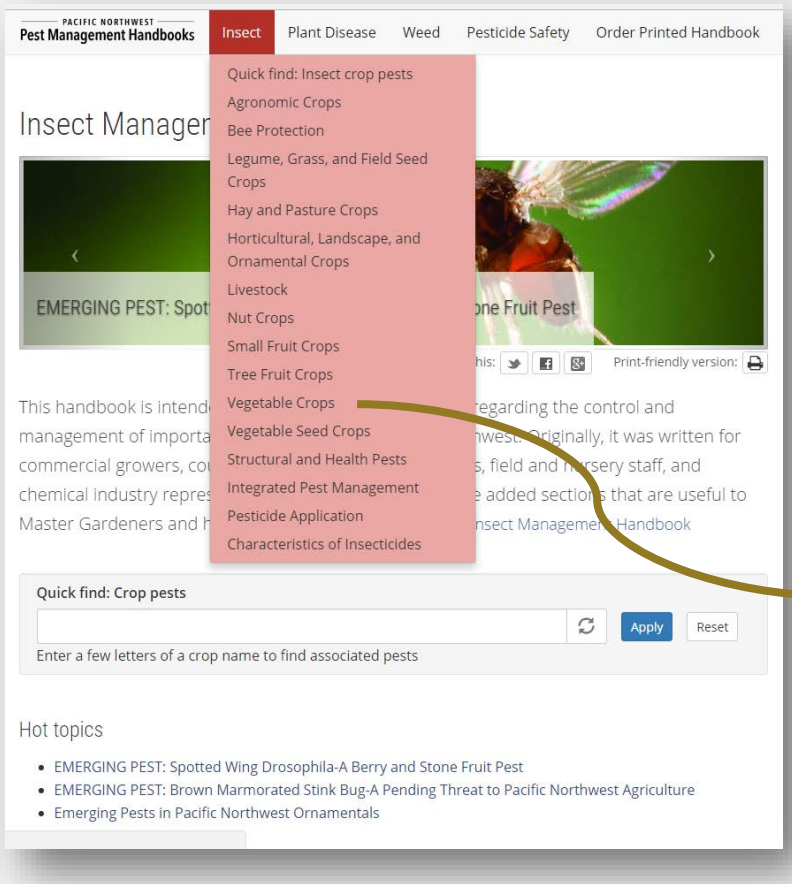
Some of the primary tactics that can be used to effectively suppress pests in high tunnels include:

- Place floating row cover over susceptible plants for concealment and to exclude pests that have entered the high tunnel. Row covers, or low tunnels, can exclude insects that fly or jump onto plants, including thrips, flea beetles, leafhoppers, whiteflies, aphids, leafminers and grasshoppers. Additionally, curly top virus infection of

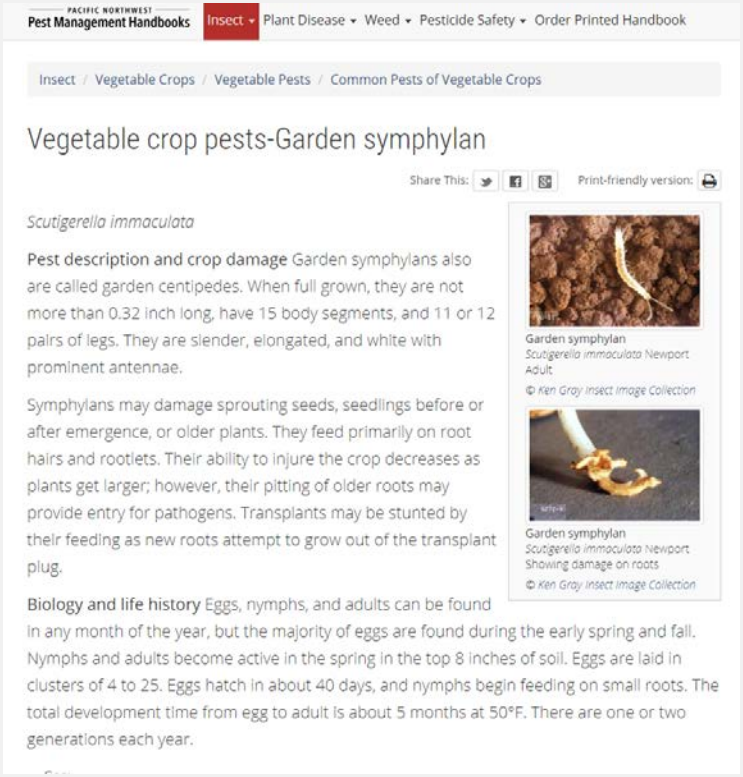


ipm.usu.edu

Pacific Northwest Insect Management Handbook

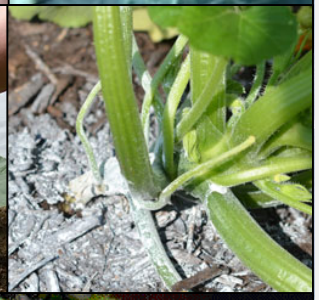


pnwhandbooks.org/insect



Squash Bug

- Squash & pumpkin
- Adults & nymphs suck fluids from plant leaves, stems & fruit
- “Sudden wilt” – disruption of xylem vessels
- Congregate in plant debris under plants
- Overwinter in protected places, under crop debris



Squash Bug

- Sanitation: Remove garden debris, nearby woodpiles or other protected sites (adults overwinter)
- Use clean cultivation
- Early plantings more susceptible to damage
- Hand pick / destroy eggs & nymphs
  - Duct tape removal method
- Floating row cover over transplants
- Chemicals: spray when first detect nymphs, drench undersides of leaves & stems
  - kaolin clay (Surround)^{O}, acetamiprid, azadirachtin/neem oil^{O}, bifenthrin, esfenvalerate, zeta-cypermethrin, pyrethrins^{O}, carbaryl, novaluron, dinotefuran
- Rotate chemical modes of action to avoid resistance

Squash Bug Fact Sheet

UTAH PESTS fact sheet — UtahState University extension

Published by Utah State University Extension and Utah Plant Pest Diagnostic Laboratory ENT-120-08 August 2008

Squash Bug
(Anasa tristis)

Diane G. Alston, Entomologist • James V. Barnhill, Weber County Agriculture Agent

What You Should Know

- In Utah, the squash bug is primarily a pest of squash and pumpkin.
- Plant injury includes leaf necrosis, scarred fruits, and rapid plant wilt.
- Squash bugs are prone to develop resistance to insecticides and adults are difficult to kill.
- Best management is achieved by suppressing squash bugs when eggs or nymphs are first detected.
- Preventive cultural and mechanical controls should be the first line of defense.
- One egg cluster per plant is the treatment threshold.

Fig. 1. Mating pair of adult squash bugs.[1]

Fig. 2. Immature squash bugs, or nymphs.[1]

Squash bug (*Anasa tristis*) is a "true bug" with piercing-sucking mouthparts (Order Hemiptera) in the leaf-footed bug family (Coreidae). It is common throughout the U.S. and found from Canada to Central America. Adults (Fig. 1) emit a foul odor when disturbed and may be called "stink bugs"; however, true stink bugs are in a different true bug family. The insect spends the winter in the adult stage. In the late spring to early summer, adults seek out young cucurbit plants on which to lay eggs. Adults and immatures (called nymphs) (Fig. 2) feed on leaves, fruits, and vines. Typical feeding symptoms include yellow to brown spots on leaves, and if feeding is heavy, entire leaves will turn black and dry out. Feeding on fruits can cause scars and desiccated, sunken areas. Entire plants may wilt when squash bug-feeding severs xylem vessels in vines. Injection of a toxin during feeding has been proposed as a cause for rapid plant wilt, but no salivary toxins have been confirmed in squash bugs.

Early to mid season population reduction is critical to effective squash bug management. Squash bugs are prone to develop resistance to insecticides and adults are difficult to kill. Sustainable management relies on cultural and mechanical practices, such as crop residue removal, resistant cultivars, crop rotation, maintenance of healthy plants, and hand removal of eggs and nymphs.

HOST PLANTS

All cucurbits are hosts, but pumpkin and squash are most attractive; cucumber, melons and gourds are less attractive. Pumpkins, 'Hubbard' and yellow (straightneck and crookneck) squash are more severely damaged than other squash varieties.

LIFE HISTORY

There is one generation per year in northern Utah. A partial second generation may occur in southern Utah, but that hasn't been documented.

utahpests.usu.edu

Spider Mites

Bean, Corn, Melon, Eggplant, Pepper, Pumpkin, Squash

- Twospotted spider mite (most common)
- Bank's grass mite (corn)
- Pierce leaf cells with mouthparts
  - Suck out cell contents
  - Gray stippling damage
  - 'Mite burn'
- Populations increase rapidly under hot, dry conditions
- More prominent along field borders
  - Weeds alternate plant hosts
- Yield loss can be severe
- Infestations usually begin in lower plant and move upward

Spider Mite Monitoring & Management

- Scout to detect mites early
  - Select older, lower leaves – look for stippling, webbing, dirty leaves
  - 10 – 30 x magnification hand lens
  - Shake leaves over white paper
- Adequate irrigation
  - Mites like it hot & dry!
  - Sprinkler irrigation – wash mites off
- Control weeds
  - Field edges (sources of mites)
- Avoid creating dust
- Avoid excessive nitrogen fertilization
- Minimize broad-spectrum insecticides (kill mite predators)

Miticides

- abamectin (Agri-Mek)
- acequinocyl (Kanemite)
- azadirachtin / neem^{O}
- bifenazate (Acramite)
- etoxazole (Zeal)
- fenbutatin-oxide (Vendex)
- hexythiazox (Onager)
- horticultural oil ^{O}
- insecticidal soap^{O}
- spiromesifen (Oberon)

Mite Biological Control: Natural Enemies

Western predatory mite
-eat eggs & nymphs

Predatory true bugs:
Minute pirate bug

Western flower thrips
-eat eggs

Spider mite destroyer:
small, black lady beetle

Lacewing larvae

Big-eyed bug

Grasshoppers

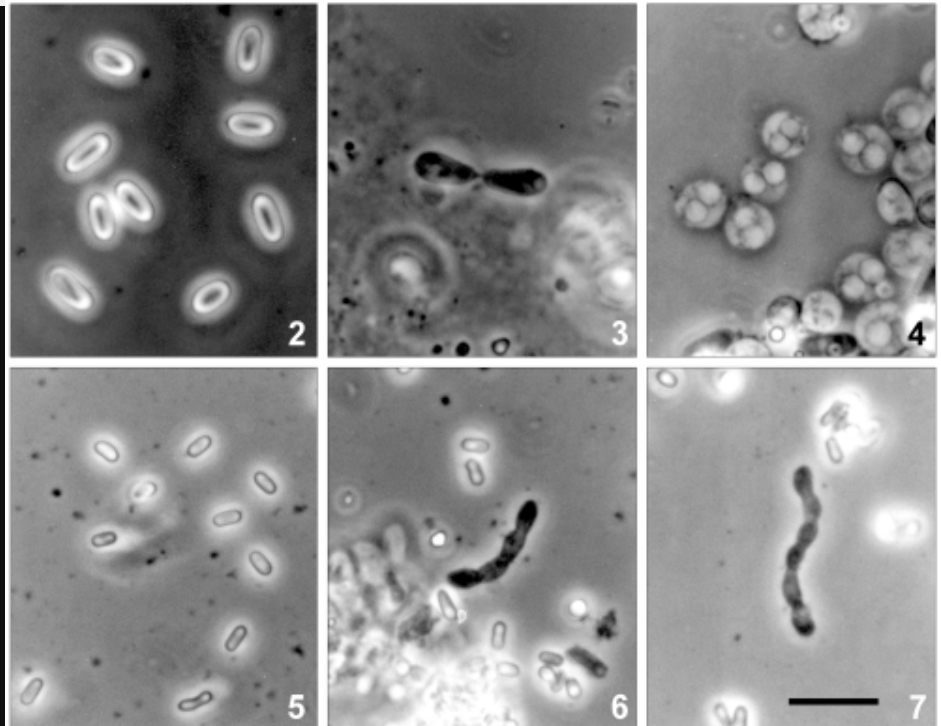
- Redlegged (*Melanoplus femurrubrum*)
- Differential (*Melanoplus differentialis*)
- Twostriped (*Melanoplus bivittatus*)
- Migratory (*Melanoplus sanguinipes*)

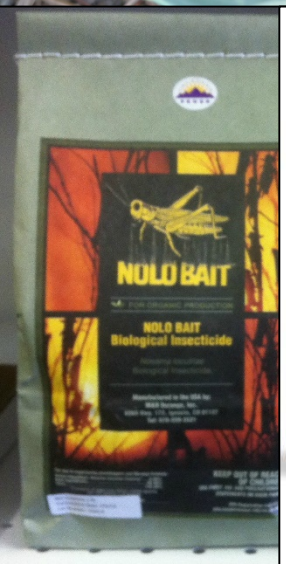
Grasshopper Biology & Management

- Overwinter as eggs within pods (50-100 eggs) in upper 2 inches of soil
  - Lay eggs in undisturbed soil in late summer – early fall
- Eggs hatch in mid- to late-spring
- Nymphs (5 instars) feed on nearby plants
- Nymphs migrate to attractive plants when rangeland vegetation dries up
- Treat large areas bordering open lands
- Cultural: Floating row cover – open up during pollination

Biological

- *Nosema locustae* – biological insecticide (NoLo, Semaspore)
- Specific to grasshoppers (microsporidia)
- Must be applied to early- to mid-nymph stages for good efficacy
- The pathogen will spread to other grasshoppers





Chemical

- Baits:
  - carbaryl + wheat bran
  - *Nosema* + bran
  - Reapply after rain/irrigation, place inside PVC pipe to keep dry
- Sprays:
  - Pyrethroids (many)
    - cyfluthrin
    - deltamethrin
    - pyrethrins[O]
  - Insecticidal soap
- Recruit neighbors for community-wide grasshopper control efforts

Grasshopper Fact Sheet

UTAH PESTS fact sheet — UtahState University COOPERATIVE EXTENSION

Published by Utah State University Extension and Utah Plant Pest Diagnostic Laboratory ENT-131-09 September 2009

Community-Wide Grasshopper Control

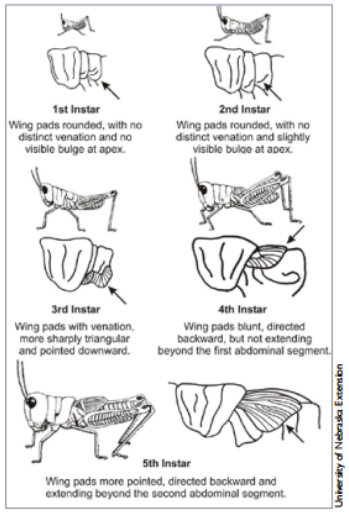
Marion Murray, IPM Project Leader

Springtime, while grasshoppers are still nymphs, is the best time for communities or neighborhoods to work together to suppress grasshopper populations. Treating as wide an area as possible is the key to success. When grasshoppers become adults, they can travel great distances and may not remain in one area long enough for an insecticide to be effective.

HOW TO IDENTIFY NYMPHS

Grasshoppers go through five nymph stages before becoming adults. Look closely at a few individuals to assess the size of their wing pads (see diagram below and table at right). Grasshoppers that are able to fly have already reached the adult stage. Mobility increases after the 4th instar, so insecticide treatments are not as effective on 5th instar, or adult stages.

Images and Descriptions of Grasshopper Stages



General Sizes of Grasshopper Stages

Stage	Size
1st instar	1/4 inch
2nd instar	3/8 inch
3rd instar	1/2 inch
4th instar	3/4 inch
5th instar	1 inch
Adult	1.5 inches

Note: Size is approximate, and depending on species, can vary by 1/4 to 1/2 inch.

Newly hatched grasshopper nymphs

WHERE TO TREAT

- open fields
- hedgerows
- boundaries between yard and open space
- roadsides
- drainage ditches
- other weedy areas

TREATMENT OPTIONS

1. ***Bait + insecticide***:
   - wheat bran + carbaryl or *Nosema locustae* (a natural grasshopper pathogen) that must be consumed
   - spread evenly through the habitat, grasshoppers eat the bait as they are foraging for food
   - easy to apply, but expensive
   - selectively kills only grasshoppers and other foraging insects
   - must be reapplied frequently and immediately following wetting events (rain, sprinkler irrigation)
   - very effective option
2. ***Dust*** (carbaryl):
   - easy to apply, but expensive
   - does not readily adhere to foliage and must be reapplied frequently
3. ***Sprays*** (malathion, carbaryl, permethrin, bifenthrin):
   - less expensive, but must have the equipment to apply
   - adheres to plant material
   - kills on contact, or when grasshoppers eat foliage

EXAMPLE MATERIALS

There are over 500 products registered in Utah for grasshopper control. Below are some popular examples. See *precautionary statement* at the bottom of this page.

Baits	***Sprays***
Corry's Bug Bait	Sevin
Deadline Bug Bait	Malathion
Lilly Miller Grasshopper Bait	permethrin:
Sevin 5 Bait	Basic Solutions
Eco Bran 2%	Bonide Eight
*NOLO Bait Biological	Gordons
*†Planet Natural Semaspore Bait (*planetnatural.com*)	Spectracide
	bifenthrin
Dust	[1]Allectus
Sevin	[2]Brigade
	[3]Sniper
	[3]Talstar

*biological insecticide that contains *Nosema locustae* and must be applied at early nymph stages; [1]not for edible plants; [2]restricted use

FOR MORE HELP

Some county weed offices will provide sprayers to use for free, but the applicator must purchase the insecticide.

USDA-APHIS is responsible for control programs against grasshoppers on public lands. When grasshoppers occur at high numbers, owners may join together to receive state and federal aid in planning and conducting a Cooperative Rangeland Grasshopper Management Program.

DAMAGING SPECIES IN UTAH

Redlegged grasshopper (*Melanoplus femurrubrum*)
Adults are 1-1⅛" long. This is the most widely distributed species, and prefers tall forbs, grasslands, meadows, crop borders, rangeland, and roadsides.

Differential grasshopper (*Melanoplus differentialis*)
Adults are 1¾" long, and live in fields, open woods and along the edges of water, and feed on grasses, weeds, and crops.

David Cappaert, MSU

Twostriped grasshopper (*Melanoplus bivittatus*)

Whitney Cranshaw, CSU

Adults are 1¼ - 2" long, and prefer tall, lush, herbaceous vegetation, and reside in ditch banks, roadsides, and crop borders. This species can be a major pest in small grains, alfalfa, and corn. It is one of the first species to appear each season.

Migratory grasshopper (*Melanoplus sanguinipes*)
Adults are 1" long and prefer forbs, grasslands, and meadows. This grasshopper causes more crop damage than any other species of grasshopper on small grains, alfalfa, clover, vegetables, and ornamentals.

Joseph Berger

For more information see: Evans, Edward, and Erin Hodgson. **Utah Pests Fact Sheet: Grasshoppers.** USU Extension. ENT 125-08. June 2008.


Questions?

More than a bad smell: Detection and Control of the Brown Marmorated Stink Bug

Several crops are at risk from feeding by the invasive, brown marmorated stink bug. Learn about its current distribution, whether it is causing economic damage in the West, how to monitor for it, and its lookalikes. Dr. Lowenstein is managing the BMSB project in Oregon to investigate a potential biocontrol, the Samurai wasp, and he will also include a description of his work on this important parasitoid wasp.

David Lowenstein
Research Associate Post Doc
Oregon State University

David is an ecologist and entomologist at Oregon State University whose primary responsibility is to manage the Brown Marmorated Stink Bug Project, including potentials for biological control using the Samurai wasp. Before coming to OSU, David worked in IPM of vegetable crops in the Midwest and studied pests and pollinators in urban agriculture. He holds a PhD in Ecology and Evolution from University of Illinois-Chicago, and an MS in Entomology from University of Wisconsin.

Back to Top

More than a bad smell: Detection and Control of the Brown Marmorated Stink Bug

David M. Lowenstein

Feb. 22, 2018

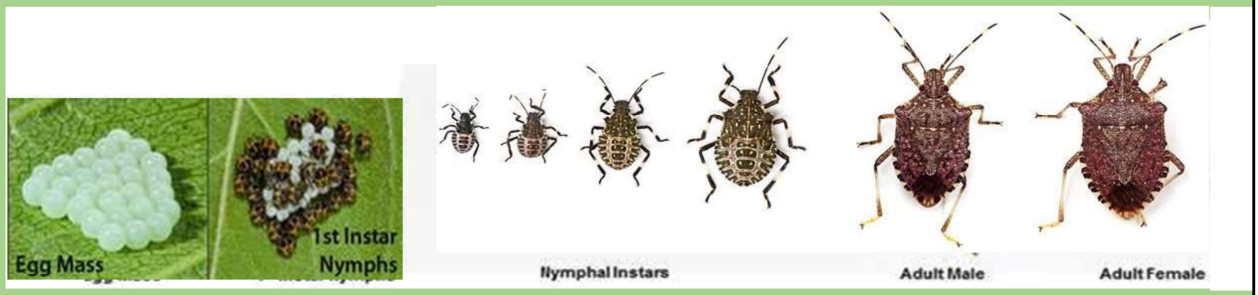
Oregon State University

Outline

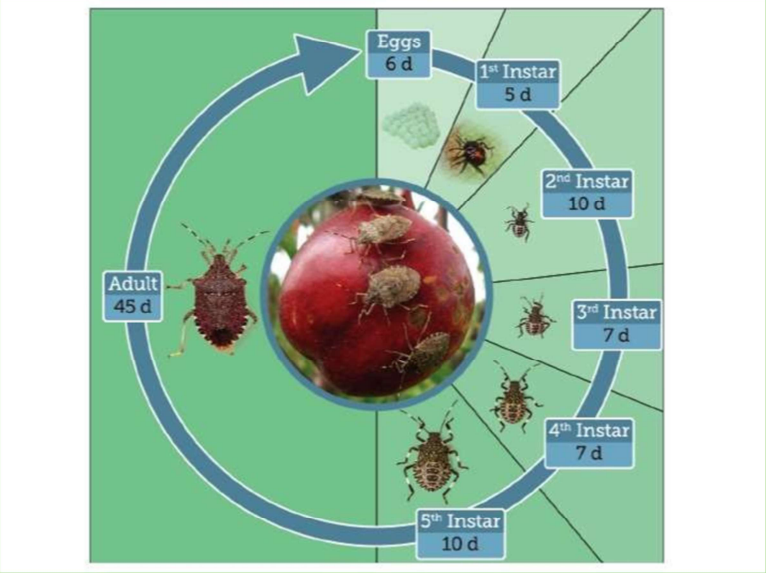
Basic biology
- Life cycle
- Crops damaged
- Phenology
- Movement

Management
- Chemical control
- Trapping and monitoring
- Biological control

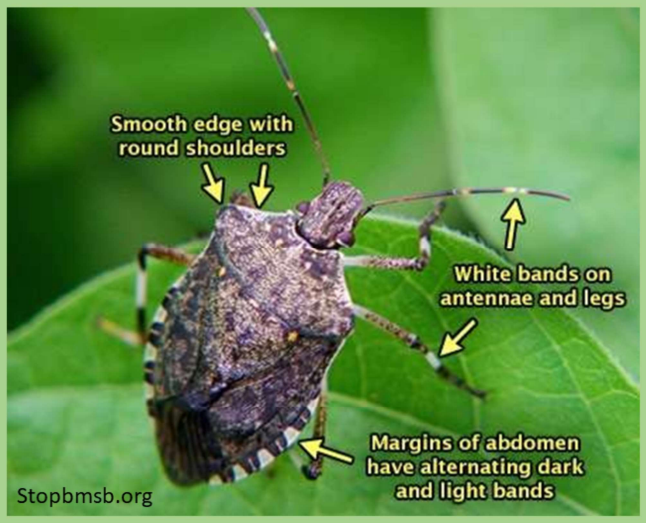
BMSB feed as nymphs and adults



Long life cycle – 1-2 generations per year



Characteristics of BMSB



Other stink bugs

Other stink bugs

Wrong color

Other stink bugs

Pointed shoulder
No white antennae

Other stink bugs

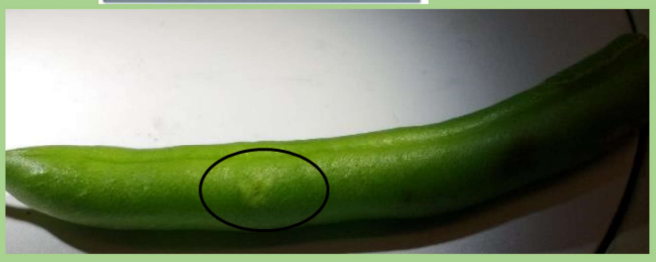
No white antennae
Toothed mandible

Other stink bugs

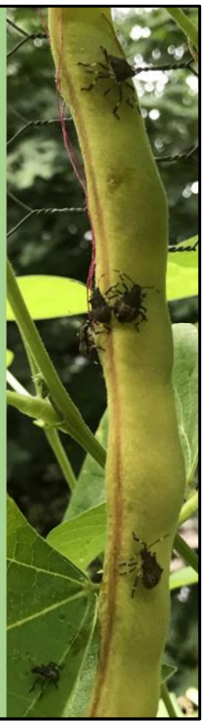
Pointed shoulder

Have you seen BMSB on your property?

Damage



Beans



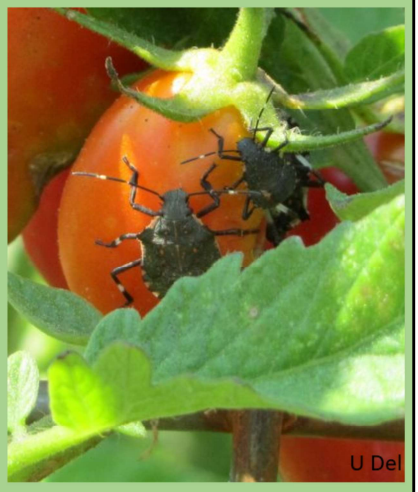
Damage

Peppers

Damage

Sweet corn

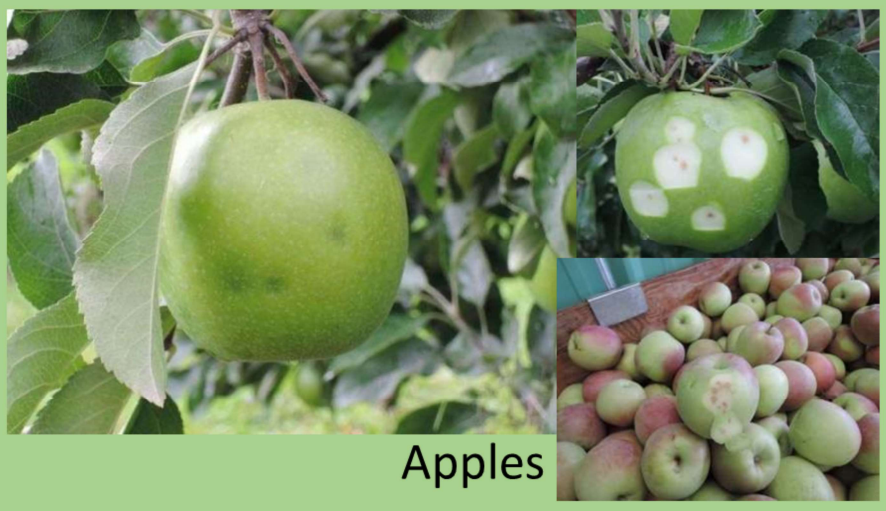
Damage



Tomatoes

BMSB feeds on a wide range of vegetables, including eggplant, lima beans, okra, pepper, snap beans, sweet corn, and tomatoes. Sweet corn , Not cucurbit or brassica

Damage



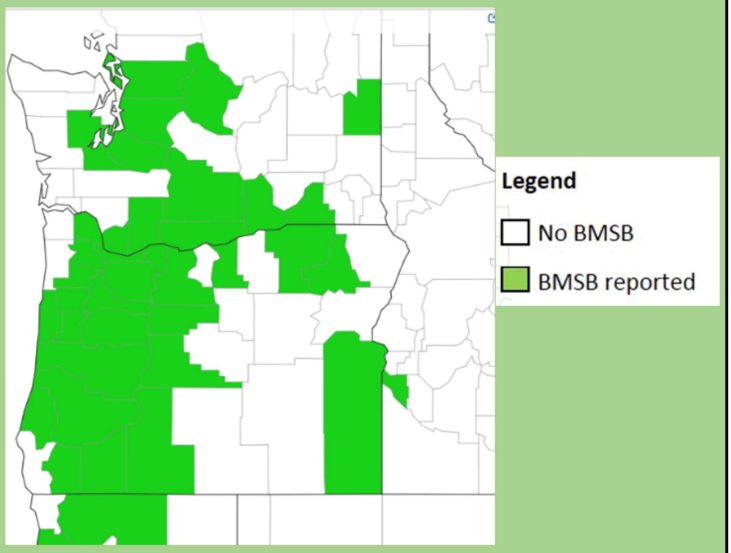
Apples

Damage

Peaches

BMSB in Oregon & Pacific Northwest

- Economic concern across major vegetable and fruit production regions
- Difficult to manage strictly with insecticides




Oregon State UNIVERSITY
COLLEGE OF AGRICULTURAL SCIENCES
Brown Marmorated Stink Bug
Report a parasitized BMSB egg mass or samurai wasp sighting
Visit here for information on identifying and reporting parasitized eggs.
Report a BMSB Sighting
In or around a home or structure
In an orchard,field, or crop
In a vehicle or other place
Brown marmorated stink bug (BMSB), Halyomorpha halys, is an important exotic pest insect in Oregon. It first arrived from Asia to the Portland area around 2004. This insect is relatively unique as it affects a wide segment of Oregon society including citizens, business owners, and farmers. In and around the home BMSB is a problem when it aggregates on structures where it overwinters and can become a continual winter annoyance to residents. It also has a negative effect on urban agriculture including backyard gardens where it damages fruits and vegetables, sometimes causing complete crop destruction. Businesses are also targeted by BMSB for overwintering. In the urban environment populations of the pest build up primarily on ornamental trees. Farmers are most adversely affected by the pest. BMSB causes feeding damage on a huge spectrum of crops, including high-value specialty crops such as vegetables, hazelnuts, tree fruits, and small fruits. In other areas of the country management of BMSB in agriculture has been very challenging and costly. Current management programs are heavily reliant on insecticides and this has disrupted Integrated Pest Management (IPM) Programs that took years to develop.
Oregon offers BMSB a comfortable environment with abundant habitat and less pressure from natural enemies than it has in its native range of China, Korea, and Japan. However, that may be changing as its chief natural enemy in Asia was discovered in 2015 along the Oregon border in Vancouver and in 2016 in Portland. This natural enemy is a minute wasp (1-2 mm) called Trissolcus japonicus. Female wasps seek out the egg masses of BMSB and they lay their own eggs inside. Instead of the BMSB eggs hatching with BMSB nymphs, they instead produce a new set of wasps. They don't sting people but a clear sign of their activity are BMSB egg masses that darken to a black color. BMSB is present in counties throughout Oregon, but are most prevalent in
Stop BMSB
News
Oregon hopes 'Samurai wasp' will battle invasive bro...
Statesman Journal
Oregon hopes 'Samurai wasp' will battle invasive brown marmorated stink bug Statesman Journal Scientists across the U.S. are gett...
Mar 22, 2017 6:40 PM
news.google.com
Long-Lasting Insecticide Nets Show Promise for Contr...
Entomology Today
Long-Lasting Insecticide Nets Show Promise for Control of Brown Marmorated Stink Bug Entomology Today "Relatively little work has ...
Mar 6, 2017 8:35 PM
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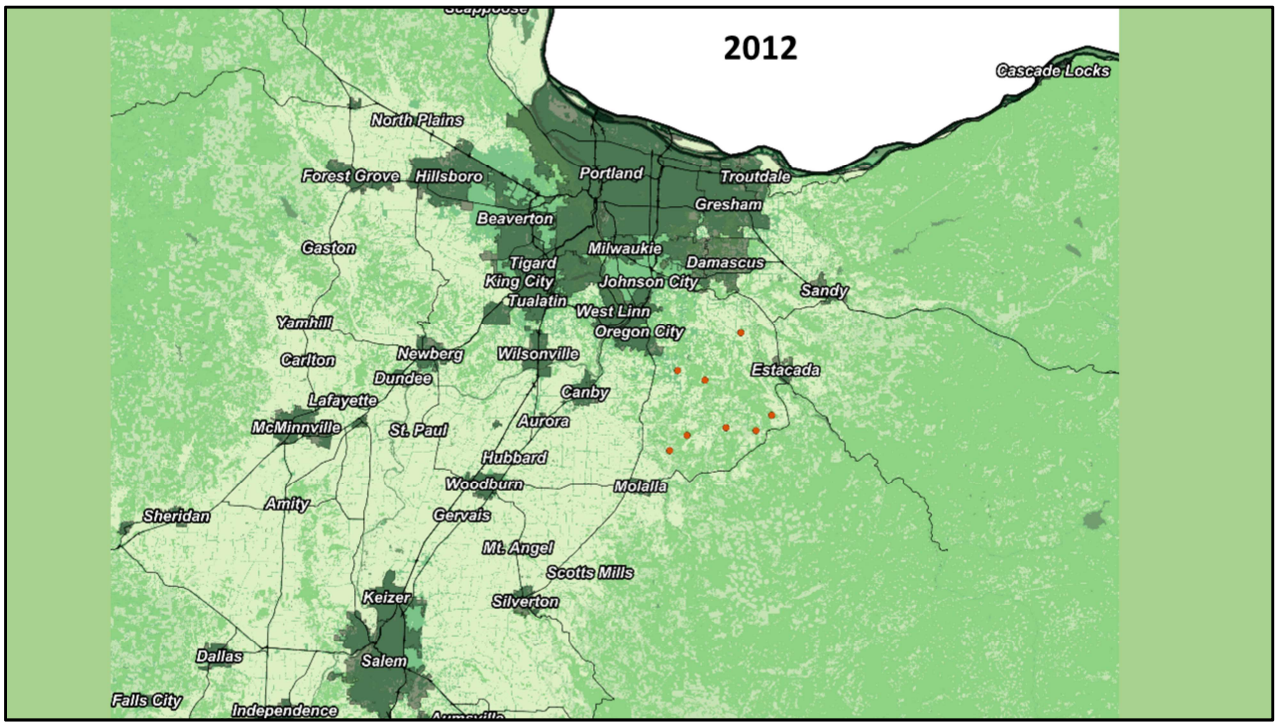
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Falls City
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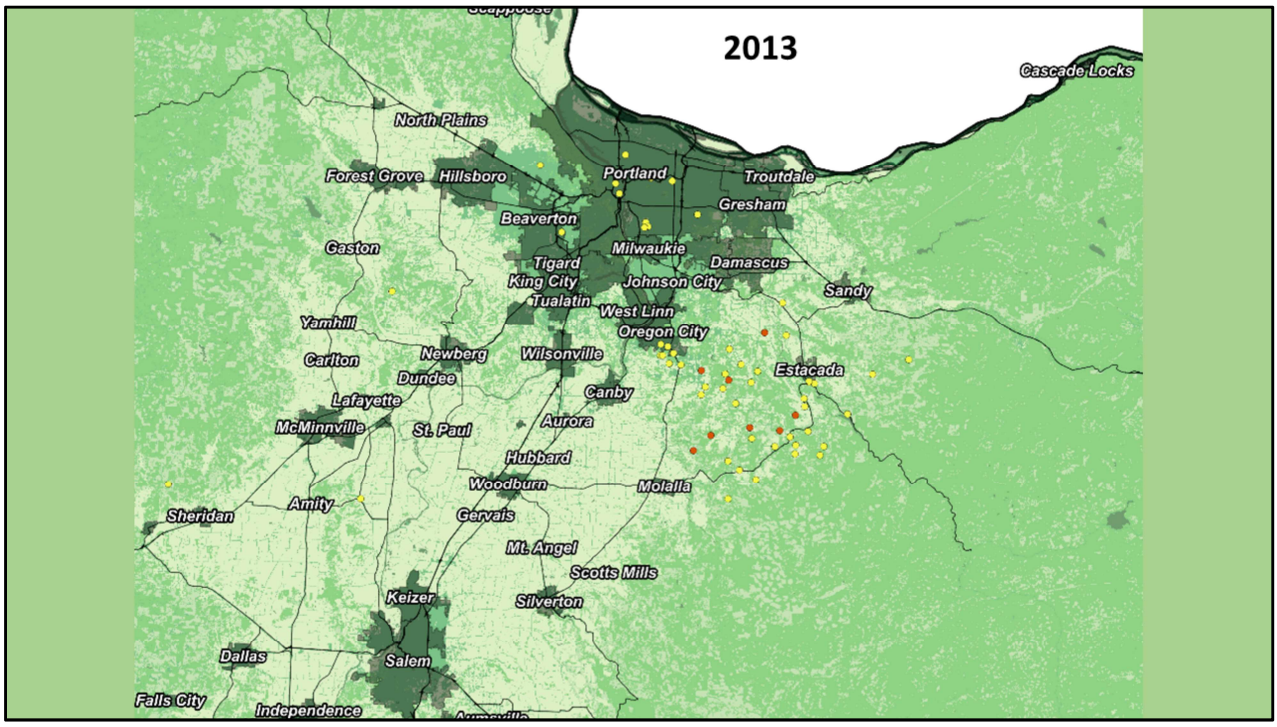
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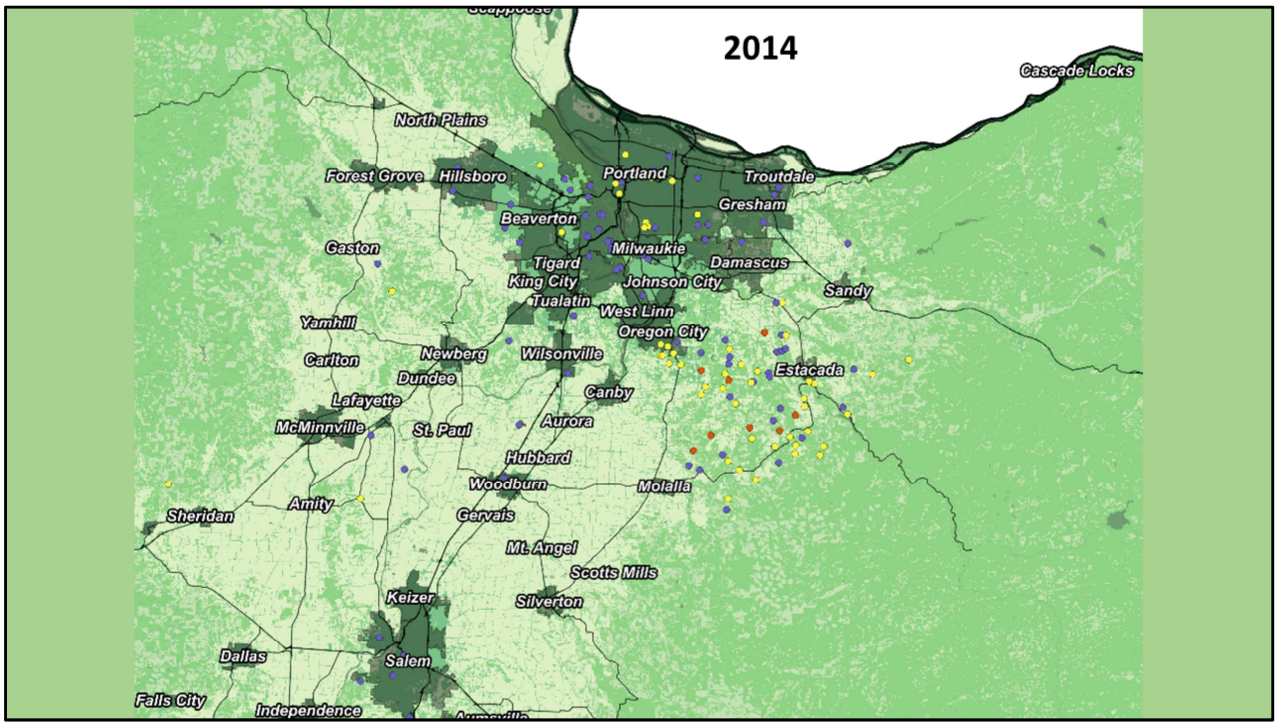
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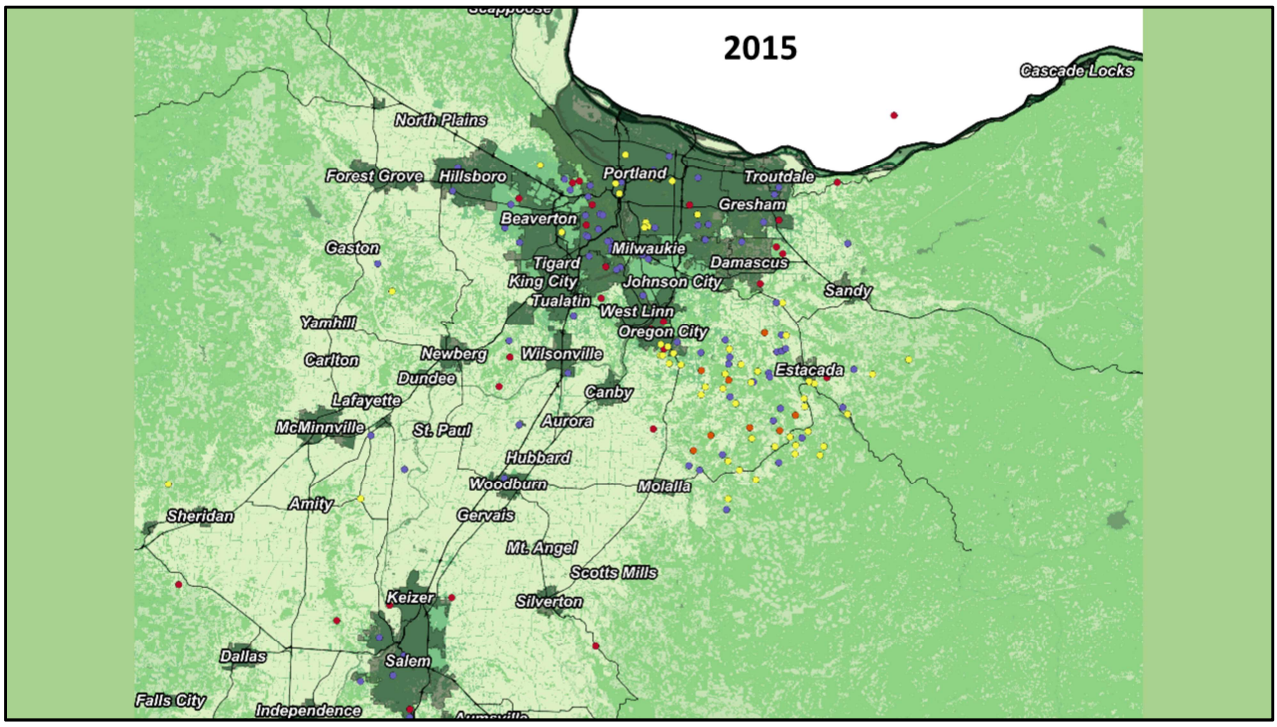
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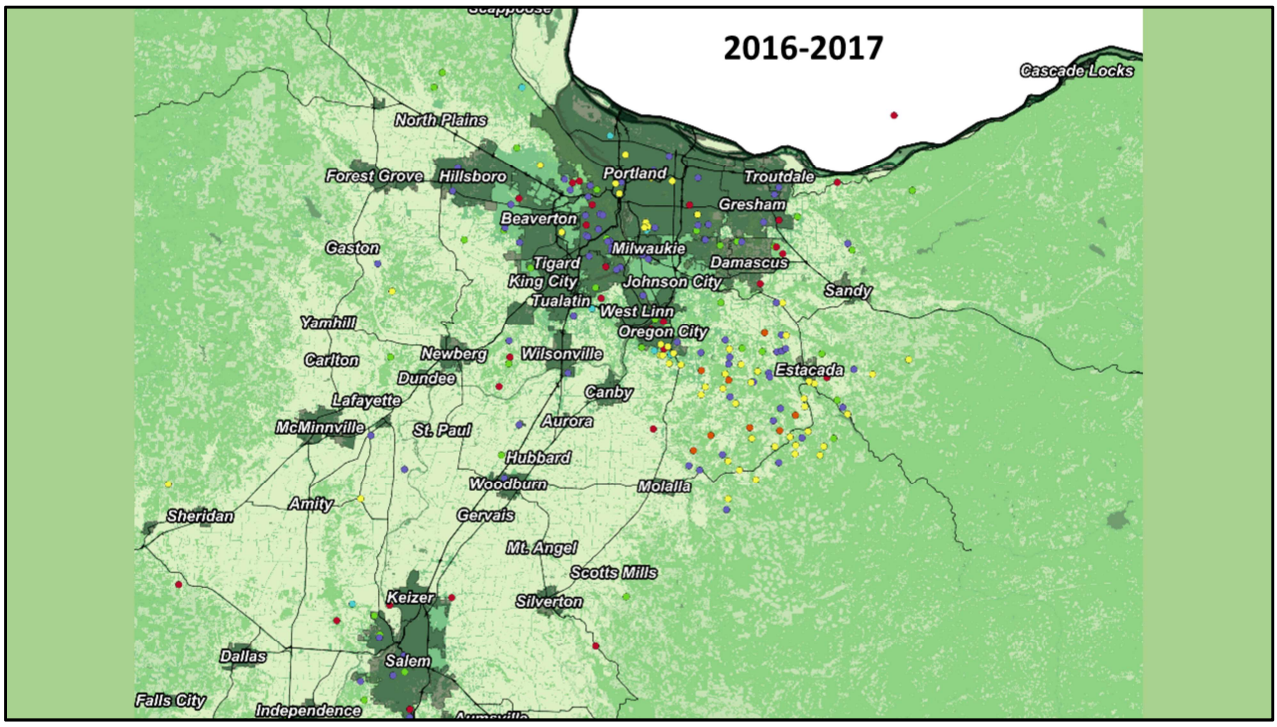
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Keizer
Silverton
Dallas
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Falls City
Independence

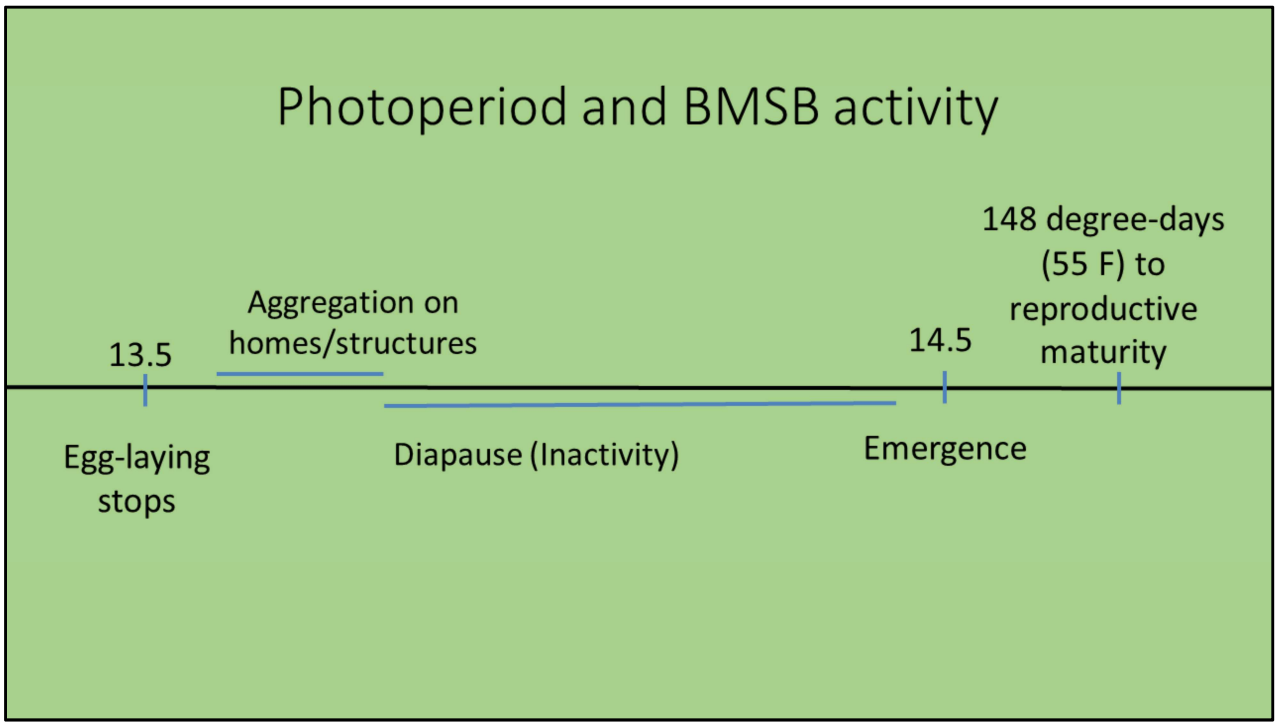
Photoperiod and BMSB activity

13.5

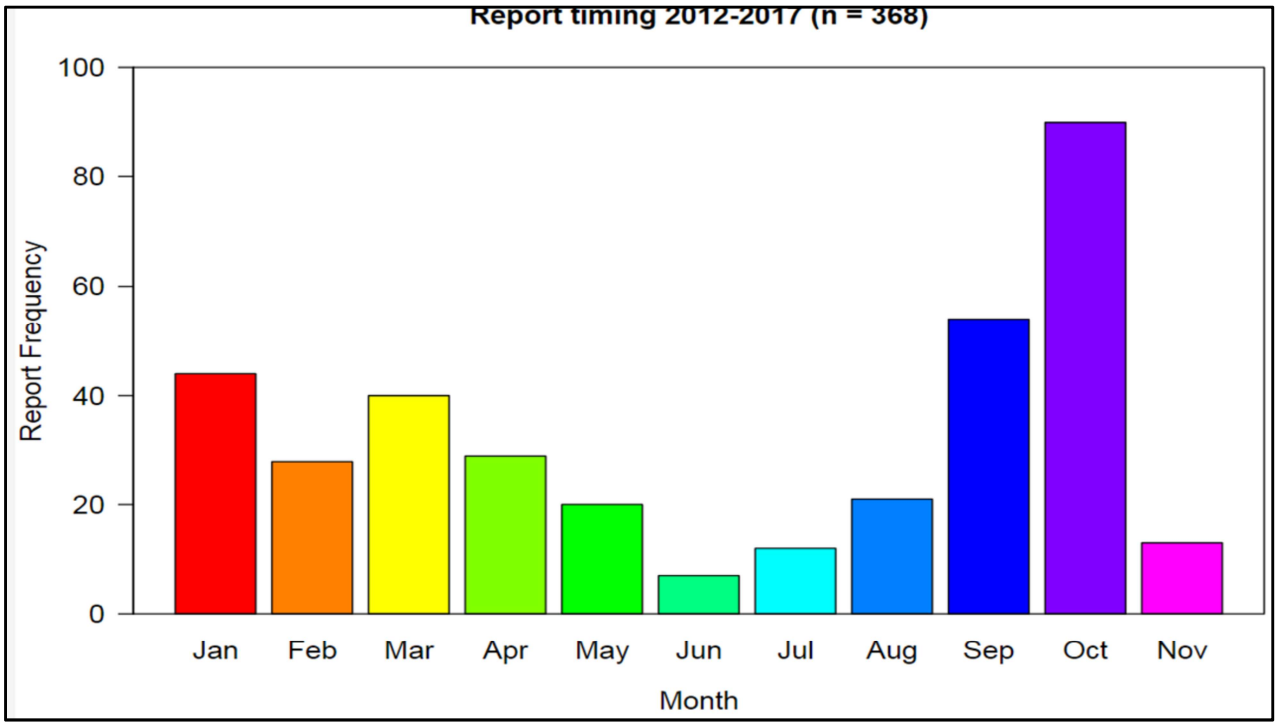
Aggregation on homes/structures

Egg-laying stops

Mid to upper 60's in Mid-october



Mid to upper 60's in Mid-october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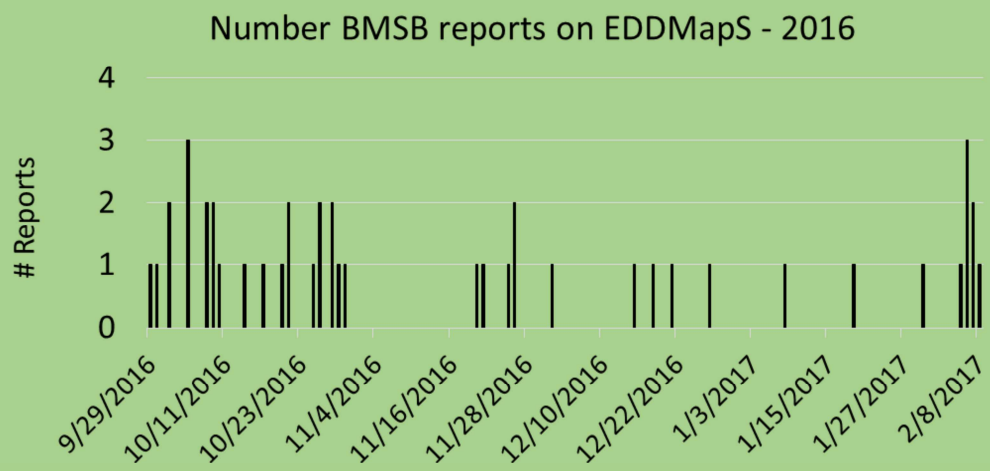
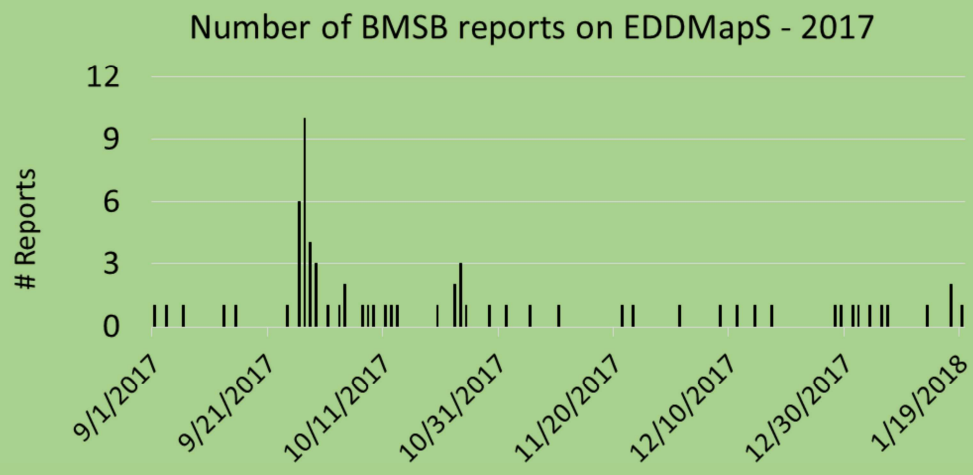
Swarming in Fall with activity on warm winter days



Mid to upper 60's in Mid-october

Swarming in Fall with activity on warm winter days



Sep 26 = 12 hours of daylight

Common ornamental host plants

Catalpa

Holly

Tree of heaven

Mountain ash

http://www.stopbmsb.org/where-is-bmsb/host-plants/

Catalpa

Holly

Tree of heaven

Mountain ash

Quiz time: Which insect is BMSB?

A

B

C

Managing BMSB

- Chemical control
- Trapping and monitoring
- Biological control
  - Samurai wasp and other parasitoids
  - Predators

Chemical control

Mostly pyrethoids & neonicotinoids

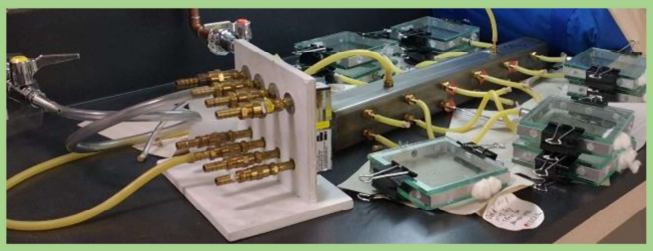
		Crops listed on pesticide label with pre-harvest interval (days). "NL" indicates not labeled on that crop.					
Active Ingredient (IRAC class*)	**Product Name(s)**	**Sweet Corn**	**Bean**	**Pepper**	**Tomato**	**Okra**	**Swiss Chard**
acephate (1B)	Acephate 97, Orthene	NL	NL	7	NL	NL	NL
alpha-cypermethrin (3A)	Fastac EC	3	1	1	1	1	NL
beta-cyfluthrin (3A)	Baythroid XL	0	NL	7	0	NL	0
beta-cyfluthrin (3A) + imidacloprid (4A)	Leverage 360	NL	7	7	0	NL	NL
bifenthrin (3A)	Bifenture, Brigade, Sniper, others	1	3	7	7	7	7
clothianidin (4A)	Belay	NL	NL	21	21	NL	NL
cyfluthrin (3A)	Tombstone	0	NL	7	0	NL	0
dinotefuran (4A)	Venom, Scorpion	NL	NL	21	21	NL	7
imidacloprid (4A)	Admire Pro, 2F form.	NL	7	0	0	0	NL
lambda-cyhalothrin (3A)	Warrior II, Karate, Lambda-Cy, Lambda T, Silencer, others	1	7	5	5	NL	NL
lambda-cyhalothrin (3A) + imidacloprid (4A)	Brigadier	NL	7	7	1	7	NL
lambda-cyhalothrin (3A) + chlorantraniliprole (28)	Besiege	1	7	NL	NL	NL	NL
methomyl (1A)	Lannate LV	0	3	3	1	NL	NL
permethrin (3A)	Permethrin 3.2EC, Perm-UP, others	1	NL	3	0	NL	NL
thiamethoxam (4A)	Actara 25WDG	NL	NL	0	0	NL	7
thiamethoxam (4A) + lambda-cyhalothrin (3A)	Endigo	NL	NL	5	5	NL	NL
zeta-cypermethrin (3A)	Mustang Maxx	3	1	1	1	1	1
zeta-cypermethrin + bifenthrin (3A)	Hero EC	3	3	7	1	7	NL

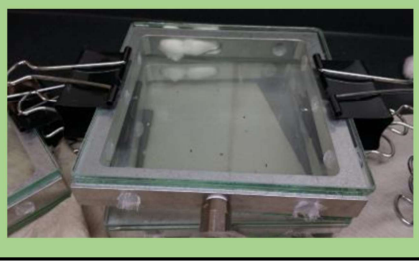
Mostly pyrethoids & neonicotinoids

		Crops listed on pesticide l (days). "NL" indicates not		
Active Ingredient (IRAC class*)	**Product Name(s)**	**Sweet Corn**	**Bean**	**Pepper**
acephate (1B)	Acephate 97, Orthene	NL	NL	7
alpha-cypermethrin (3A)	Fastac EC	3	1	1
beta-cyfluthrin (3A)	Baythroid XL	0	NL	7
beta-cyfluthrin (3A) + imidacloprid (4A)	Leverage 360	NL	7	7
bifenthrin (3A)	Bifenture, Brigade, Sniper, others	1	3	7
clothianidin (4A)	Belay	NL	NL	21
cyfluthrin (3A)	Tombstone	0	NL	7
dinotefuran (4A)	Venom, Scorpion	NL	NL	21

Potential non-target effects of chemical application

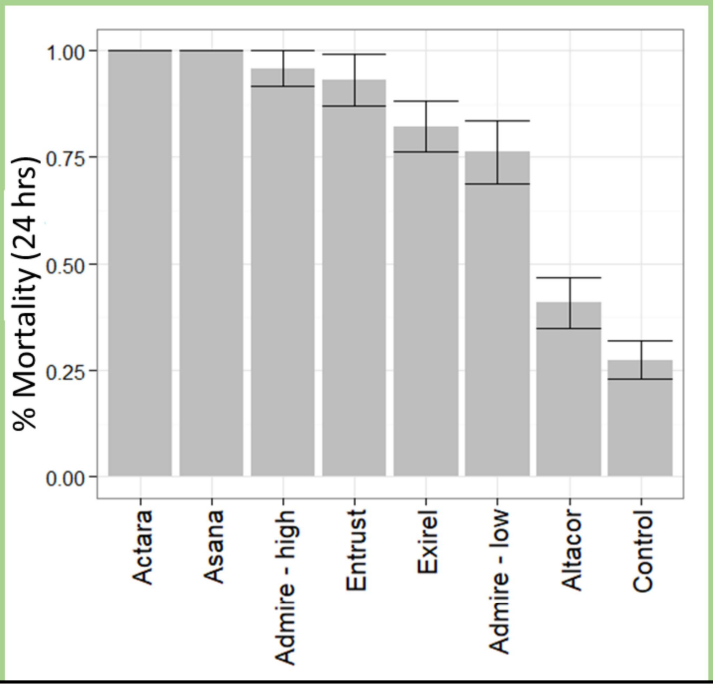
Exposing samurai wasp to chemical residues





% Mortality – 24 hours

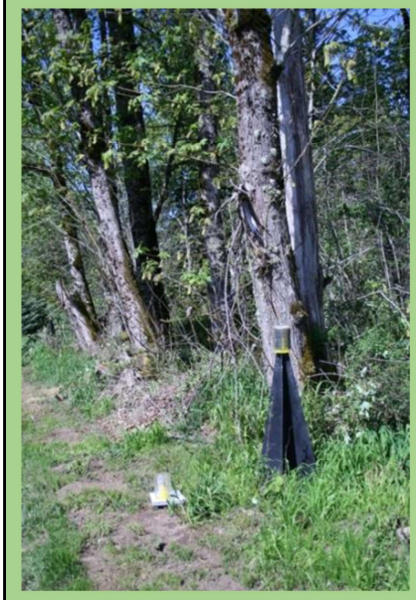
- High mortality from exposure to neonicotinoids and pyrethroids
- Additional analyses and field rates ongoing

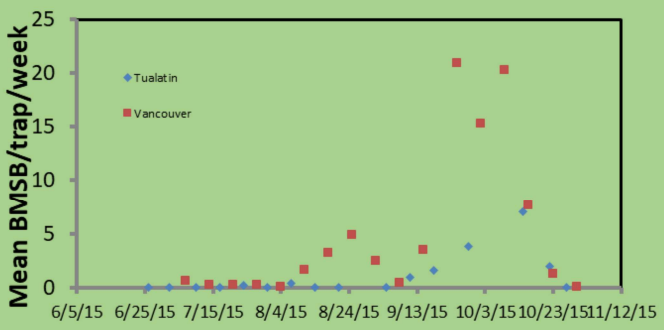


Admire high = 2.4 fl oz / acre, low = 1.2 fl oz / acre
Neonics = Actara (thiamethoxam), Admire (imidacloprid)
Pyrethroid = Asana (esfenvalerate)
Spinosad = Entrust
Diamide = Exirel, Altacor (lepidopterous pests)

Traps – many types

Trap trials - Pyramid trap

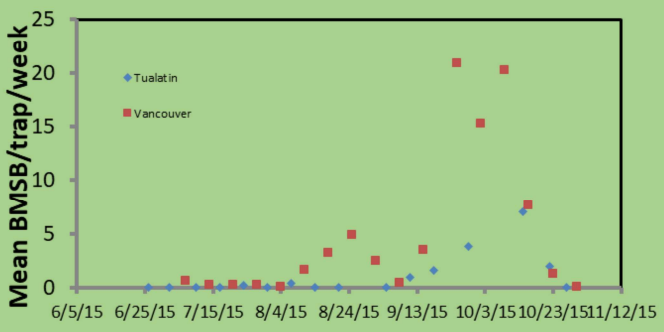




Populations explode in late season

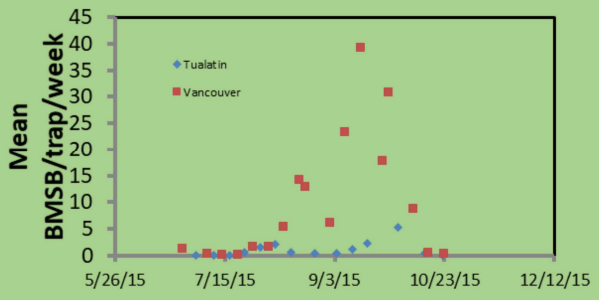
Trap trials - Pyramid trap

Baited with aggregation pheromone



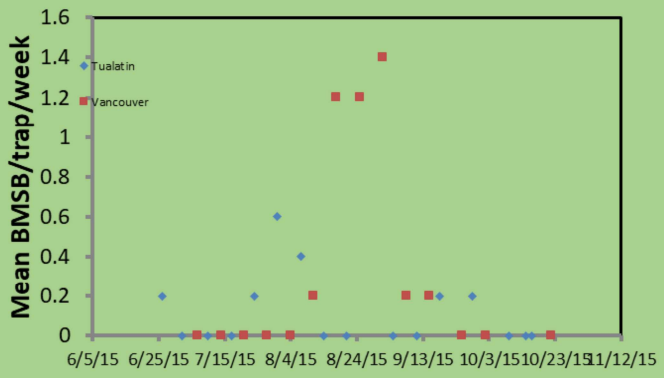
Populations explode in late season

Trap trials – Panel trap



Panels are more sensitive?

Trap trials – yellow sticky card



Sensitivity ≠ utility: Simple trap can represent population trends

Low-tech scouting

Economic threshold for management

- Traps should be placed near orchard edges
- Check weekly

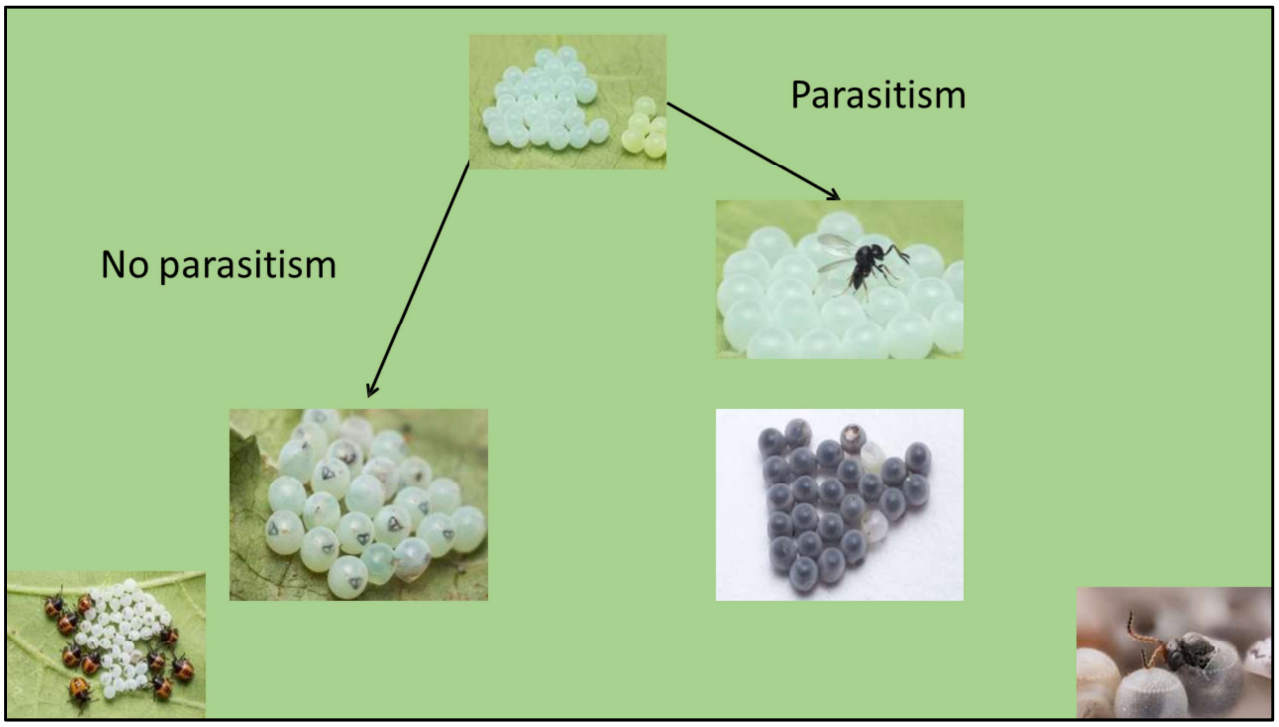
- 10 adults / trap in orchard crops
- 2.5 stink bugs / 15 sweeps in soybean (Penn State)

Biological control by *T. japonicus* – samurai wasp

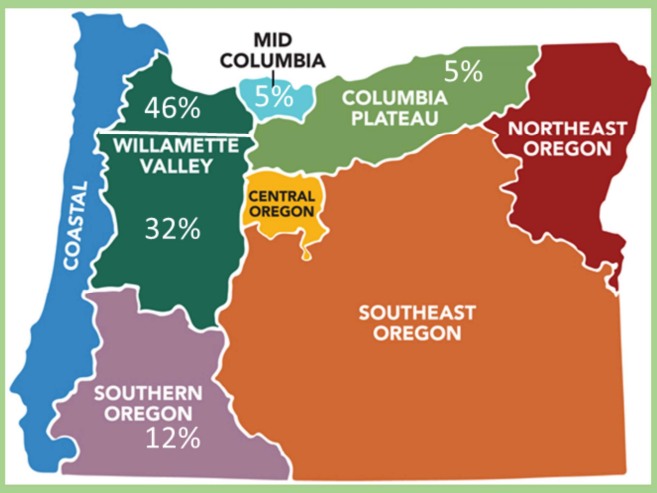
- Native to same region as BMSB
  - >75% parasitism
- Small (1.5 mm) egg parasitoid

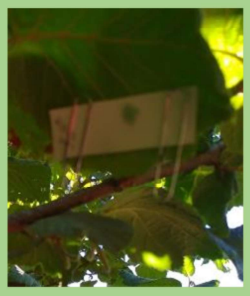
Biological control by *T. japonicus* – samurai wasp

- Native to same region as BMSB
  - >75% parasitism
- Small (1.5 mm) egg parasitoid
- Accidentally introduced to USA
  - WA in 2015
  - OR in 2016


Parasitism
No parasitism

2017 monitoring - 325+ egg masses





This figure shows the % of eggs placed in each region. 5% in Columbia Plateau were placed in Hermiston and Milton freewater. Mid-Columbia includes the Dalles and Hood River. 46% is Portland metro.
32% is Between Aurora – Eugene. 12% is in Jackson and Josephine counties (primarily Ashland, Medford, and 1 site in Grants Pass)

2017 monitoring – 14% of eggs parasitized

- 26 egg masses with emerged samurai wasps
- Mostly in Portland area

14% is the total % of eggs parasitized by any wasp. This includes frozen and fresh egg masses.

2017 monitoring – 2 new finds from wild eggs

- Salem, OR

- Found August 30, 2017

Tree of heaven

Description of new samurai detections from wild egg masses. Found a parasitized egg mass in an abandoned commercial lot near the Willamette river in salem.

2017 monitoring – 2 new finds from wild eggs

- Beaverton, OR
- Report of parasitized egg mass by Master Gardener
- Found 10/25/2017

Description of new samurai detections from wild egg masses. Master gardener contacted me by email with egg mass. Small egg mass of 7 eggs. 6/7 emerged. Very late!!

2017 monitoring – 2 new finds from wild eggs

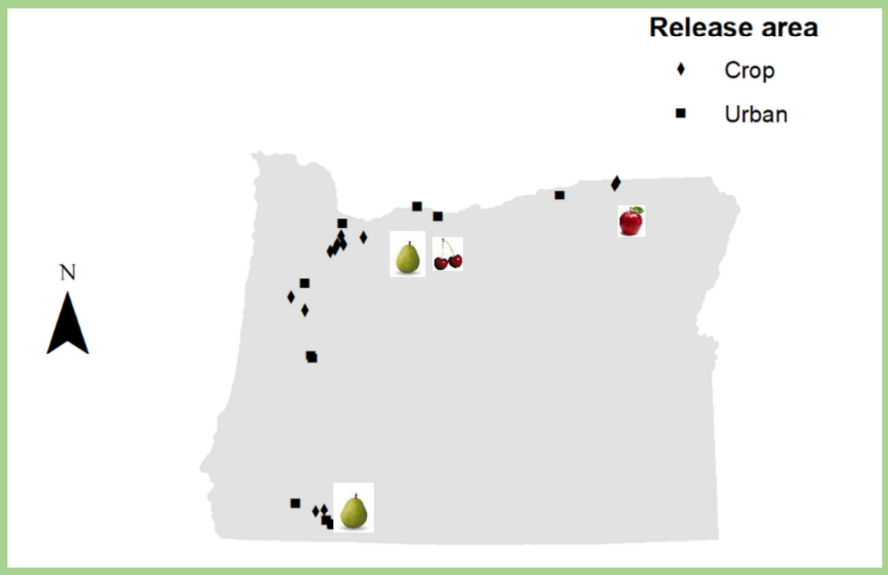
- Beaverton, OR
- Report of parasitized egg mass by Master Gardener
- Found 10/25/2017

Clerodendrum trichotomum

Host tree of parasitized egg mass. A pleasant smelling tree byt very attractive tree for late season BMSB. Beat sheet catches can have as many as 5-10 BMSB per beat.

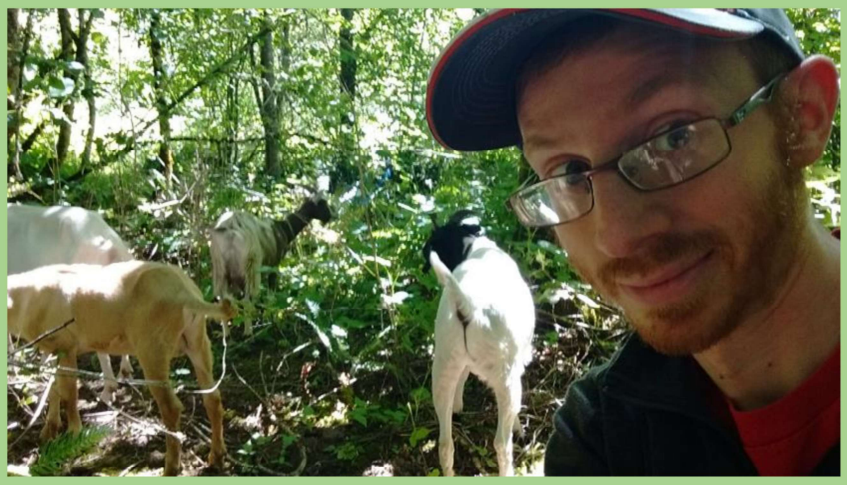
2017 monitoring – Released wasps at 28 sites

- 40 female wasps / site
- May – Aug. 2017
- 208 sentinel BMSB egg masses

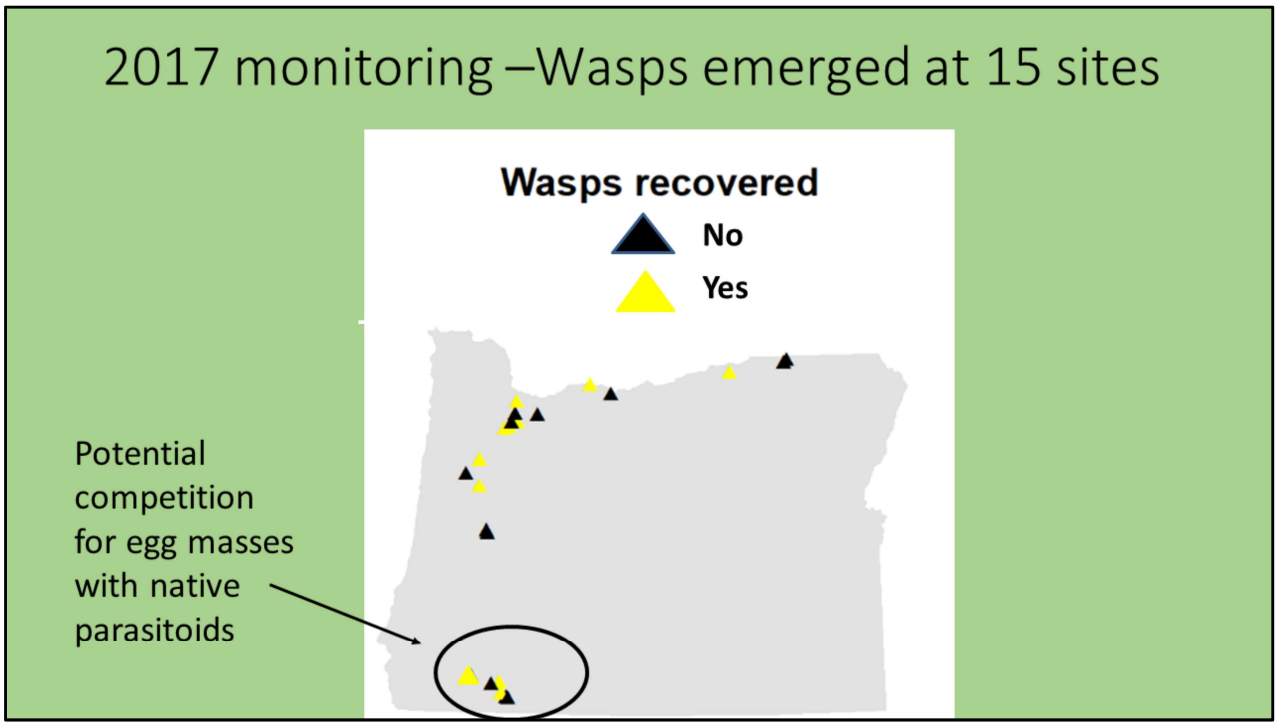


Releases occurred from May- August 2017. Sites classified as being in urban areas or adjacent to crop habitat

Hazards of placing sentinel egg masses!



Hazards of placing eggs at 1 site, goats interrupt research!



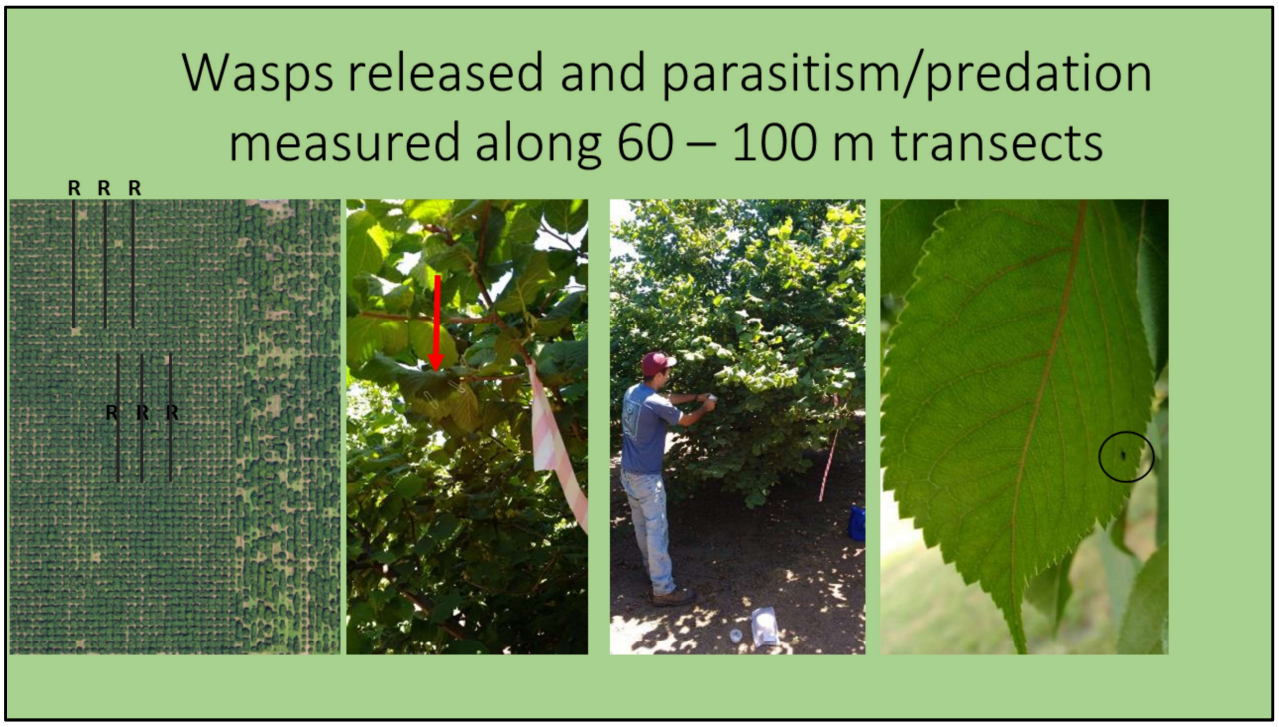
Mostly frozen egg masses placed in S. oregon. Nearly 75% of southern OR egg masses parasitized by native Trissolcus (Not TJ). In all other regions, TJ was the dominant parasitoid emerging from eggs

Dispersal differences by crop?

Hazelnut

Caneberry

Evaluated dispersal in 2 caneberry fields (at OSU research stations) and 2 hazelnut orchards (commercial). Caneberry in June/July 2017. hazelnut in July/August 2017. 2-3 weeks between releases in the same orchards. Limited chemical inputs in each site. Hazelnut thought to be better candidate for samurai releases, due to its broad canopy. TJ is a shade tolerant species.

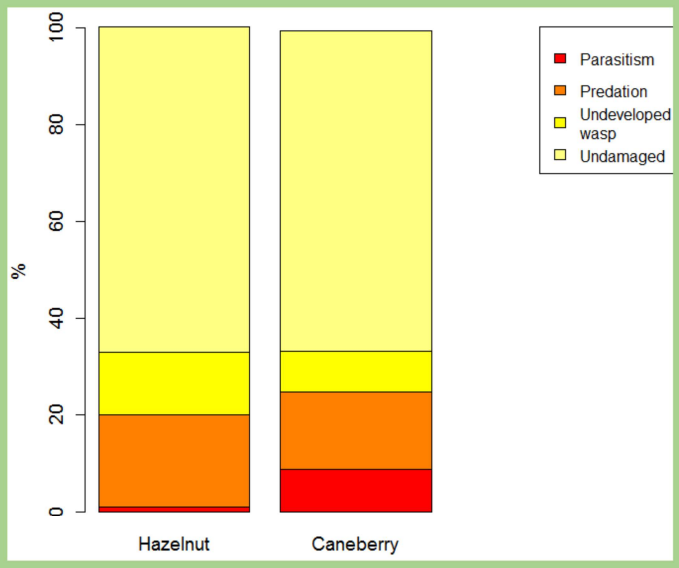


Released wasps at orchard edges and interiors and placed egg mass every 10 m. Released wasps afterwards. Last picture shows small size of parasitoid and the reason we need to use egg masses for sampling rather than visual searching for the wasps

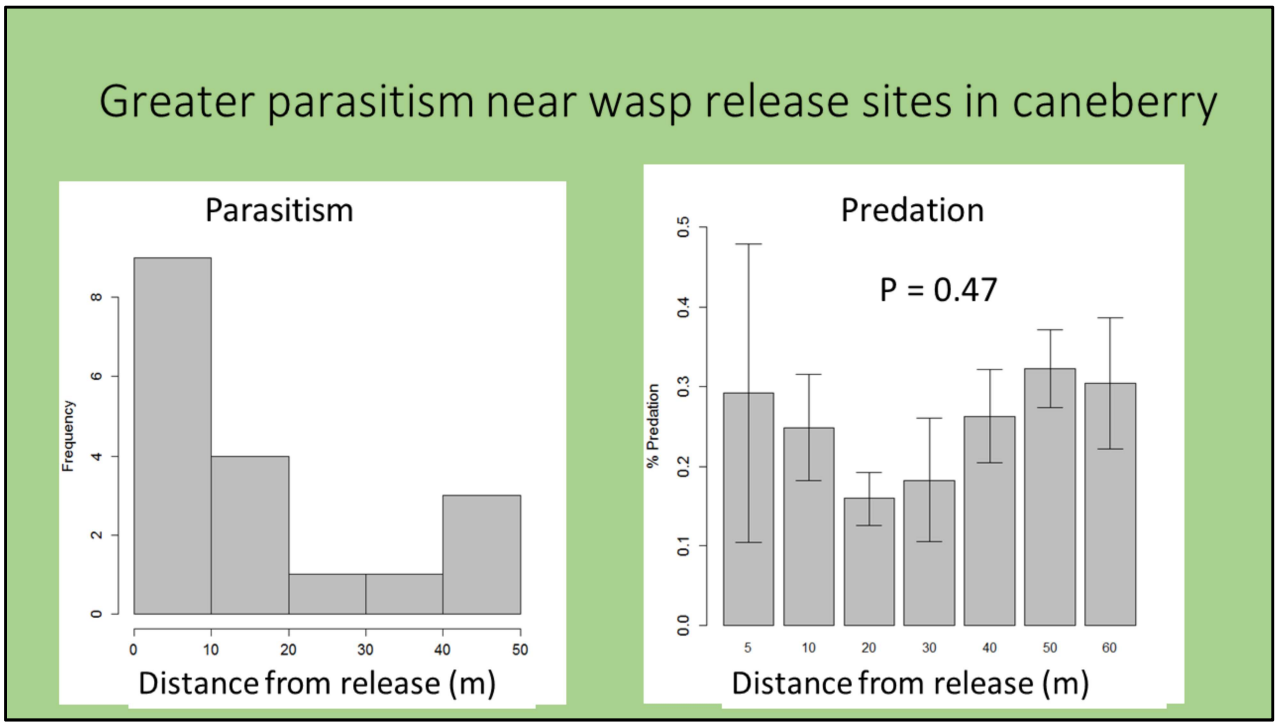
In case anyone asks: Also set up a control in clip cage. 60% emergence. Non-emergence due to older frozen egg masses, except for 1 fresh egg mass that was not parasitized during heat wave.

Most BMSB eggs undamaged

- 10% of sentinel eggs parasitized in caneberry
- Only 2/137 eggs parasitized in hazelnut
  - Harder to detect wasps in broad canopy
- 15% of eggs with predation



Results. 208 egg masses placed in caneberry. Predation attributed to spiders, lacewings, and earwigs.

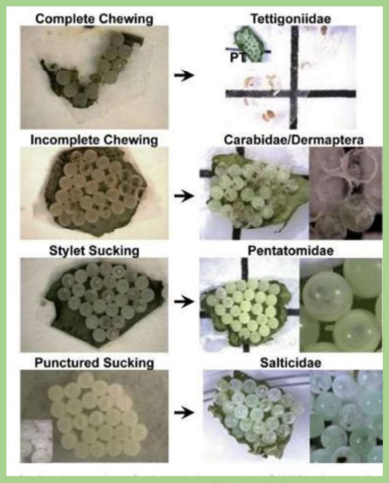


This figure shows number of parasitized egg masses at each distance from release in the caneberry orchard.

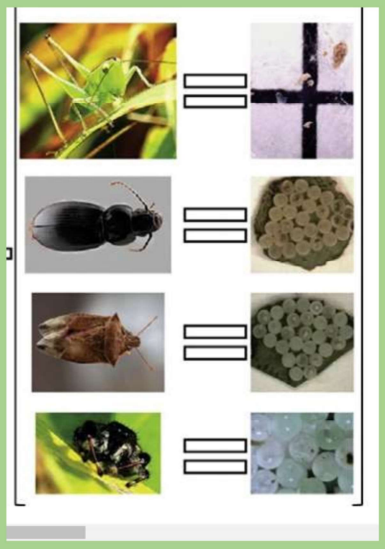
The only parasitized hazelnut egg masses were at 0 and 80 M.
F = 0.53, P = 0.47

More parasitism and predation at orchard edge, but not significant.

Other predators



Morrison et al. (2016) Biol Control



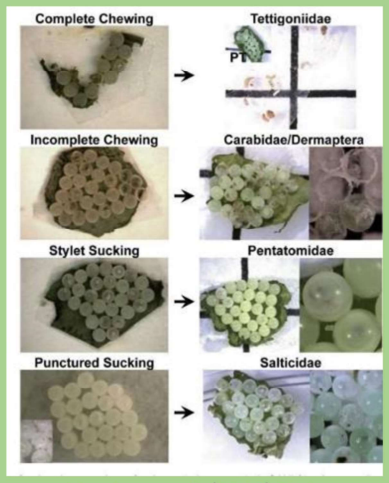
Katydids

Ground beetles and earwigs

Spined soldier bugs

Spiders

Other predators

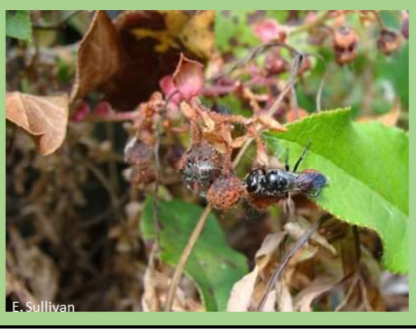


Morrison et al. (2016) Biol Control

But, these are generalists!

Astata predatory wasps

- Collect BMSB nymphs to feed offspring
- Nest in hard-packed soils



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Erica Rudolph
Nik Wiman

Growers

Miller and Birkemeier orchards

Update on Brown Marmorated Stink Bug in Utah

Brown marmorated stink bug is a newly introduced pest that can destroy fruit and vegetable crops in Utah. Learn about its current distribution and how to monitor for it.

Lori Spears

Professional Practice Assistant Professor

Utah State University

lori.spears@usu.edu

Dr. Lori Spears conducts invasive species surveys throughout Utah. Her research focuses on invasive species dynamics including the spread and host use of brown marmorated stink bug, and factors affecting spotted wing drosophila abundance in the Intermountain West. She holds a PhD in Ecology from Utah State University and a BS in Anthropology from Weber State University.

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Update on Brown Marmorated Stink Bug in Utah

Lori Spears, Diane Alston, Cody Holthouse, Zach Schumm, Cami Cannon

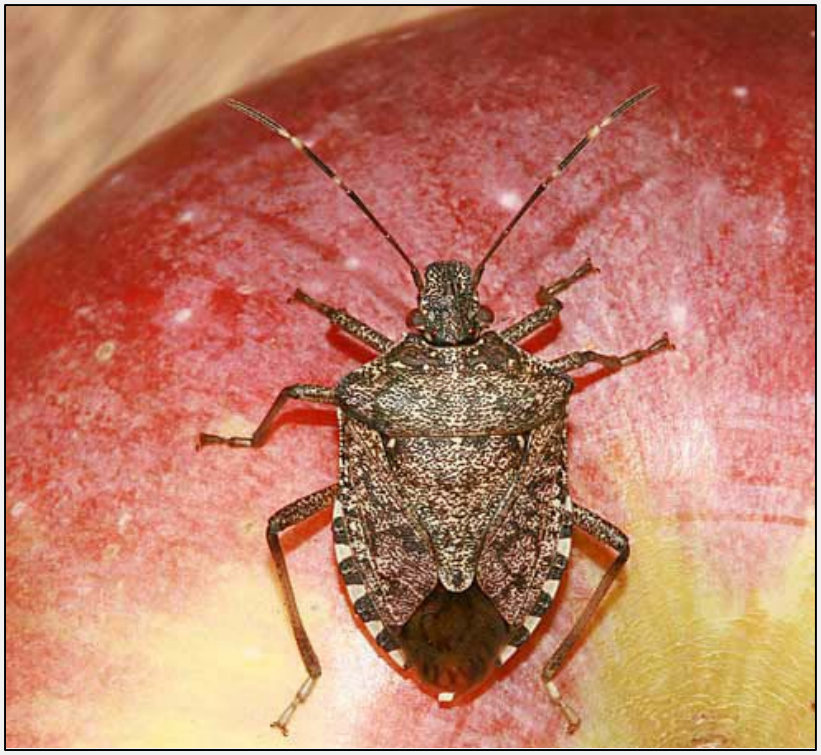
Utah State University - Biology

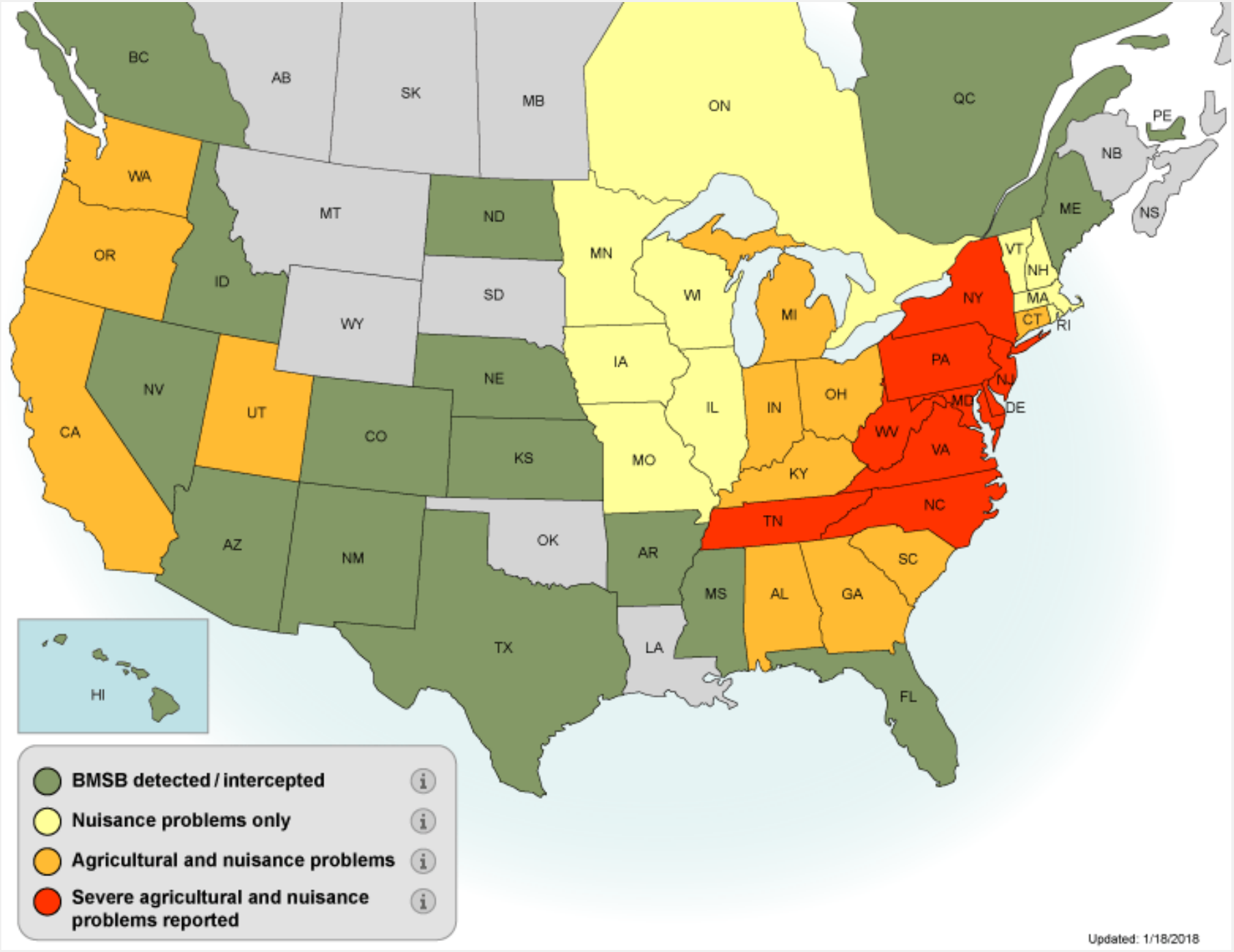
Urban and Small Farms Conference

February 22, 2018

BROWN MARMORATED STINK BUG

- Native to eastern Asia
- First reported in the U.S (PA) in 2001
- First detected in Utah in 2012
- Poses a significant risk to specialty crop growers
- Invades structures in large numbers for overwintering




BC
AB
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QC
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NB
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OR
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CO
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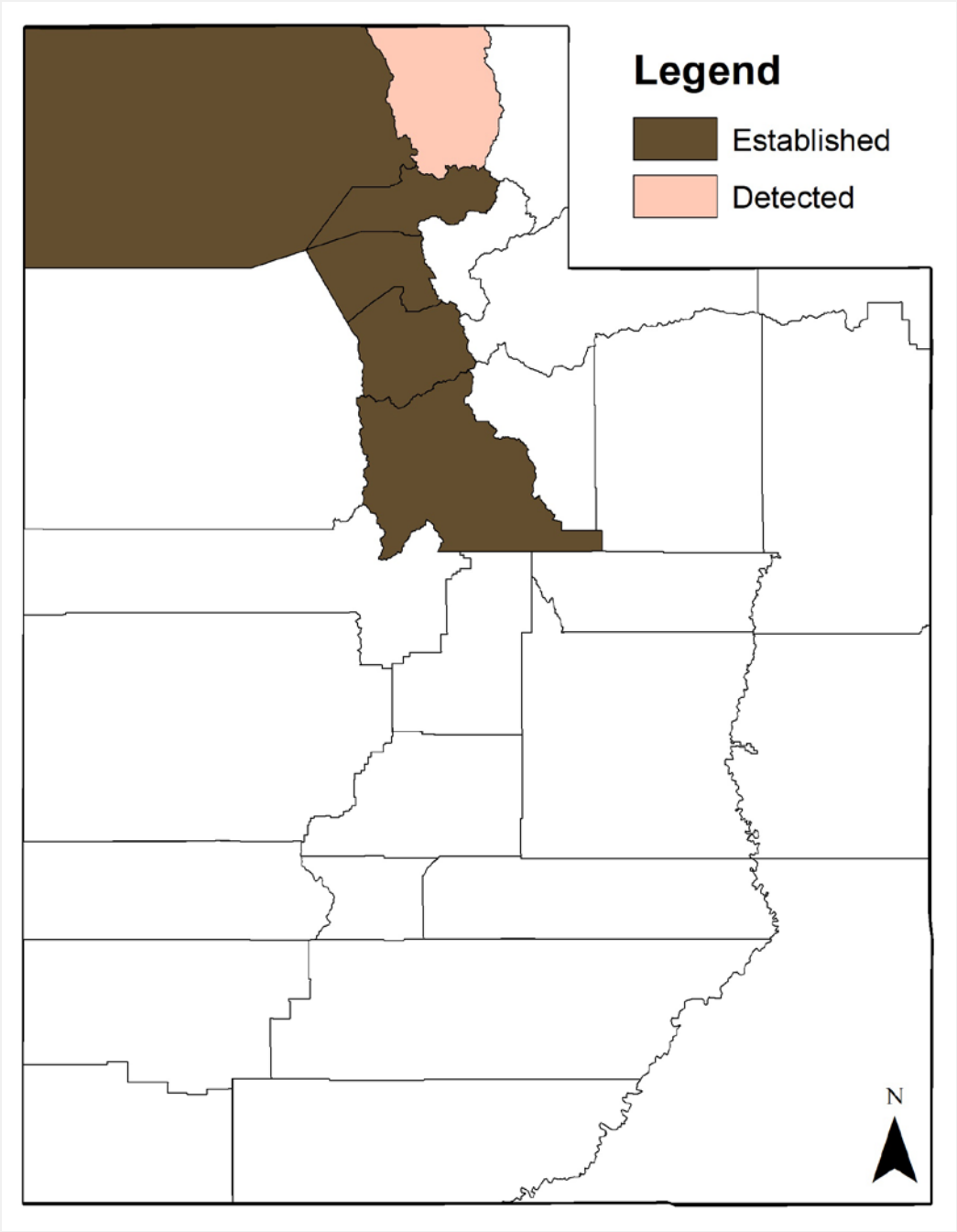
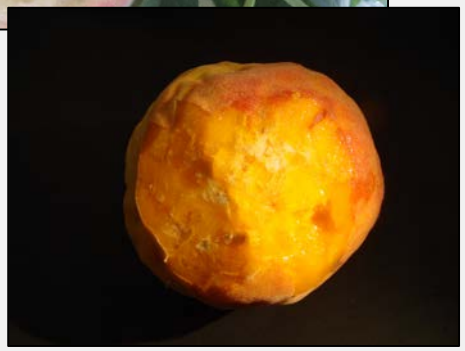
OK
TX
MN
IA
MO
AR
LA
WI
IL
MS
MI
IN
KY
TN
AL
OH
WV
GA
FL
SC
NC
VA
PA
NY
VT
NH
MA
CT
RI
NJ
MD
DE
HI
BMSB detected / intercepted
Nuisance problems only
Agricultural and nuisance problems
Severe agricultural and nuisance problems reported
Updated: 1/18/2018


Legend
Established
Detected
N

CROP DAMAGE (1ST CONFIRMATION)

Peach



Commercial & Small-scale Orchards, Multiple Counties

Apple

Popcorn

Community Garden, Salt Lake City

Squash

Invasive Fruit Pest Guide for Utah

Insect & Disease Identification, Monitoring & Management

2016

EXTENSION

UtahStateUniversity

CHAPTER 4 BROWN MARMORATED STINK BUG

Quick Facts

- Brown marmorated stink bug (BMSB) is native to Asia (China, Japan, Taiwan, and Korea).
- In the U.S., BMSB was first introduced into Pennsylvania in the late 1990s, and now occurs in most states.
- BMSB is a tree-loving bug, but attacks many types of plants; feeding causes misshapen fruit, discolored spots on leaves and fruit, and wounds and oozing sap on tree trunks and branches.
- BMSB can be a major nuisance pest when adults invade buildings and other structures during the fall and winter.
- BMSB can be difficult to control with insecticides; however, natural enemies may be effective along with an integrated pest management approach.

Background

The brown marmorated stink bug (BMSB), *Halyomorpha halys* (Stal) (Hemiptera: Pentatomidae), is a major pest of important agricultural crops such as tree fruits, small fruits, legumes, vegetables and ornamentals. Originally from Asia (China, Japan, Korea and Taiwan), BMSB was first found in the U.S. in Allentown, PA around 1996, but was initially misidentified as a local species. In 2001, after increasing homeowner complaints, BMSB was positively identified as a new invasive species. The range of BMSB has since expanded throughout much of the U.S., including Hawaii, California, Oregon, and Washington, and has become an economic agricultural pest in many parts of the country.

BMSB was first detected in Utah in 2012, and is now considered to be established in Weber, Davis, Salt Lake, and Utah counties (as of 2015). Reproducing populations have been found on ornamental plants, particularly catalpa trees, and massing adults can be seen on buildings.

In China, BMSB prefers to feed on the rubber bark tree (*Eucommia*), a small tree that is cultivated for its medicinal properties and threatened in the wild. BMSB feeds on many fruit and ornamental trees such as pear, peach, apple, plum and mulberry. In Korea, BMSB can be a pest on soybean, sweet persimmon, yuzu, and citrus. Its primary plant hosts in Japan include cedar and cypress. BMSB is not a significant pest in its native habitats because natural enemies keep its populations low, but when environmental conditions are ideal, BMSB outbreaks may occur.

In the U.S., BMSB has an abundant food supply and limited natural enemies. Due to its broad plant host range, potential for severe crop injury, and adult behavior of congregating for winter shelter on buildings, BMSB has become a major economic concern and nuisance pest in many regions of the U.S.

Pest Identification and Life History

Accurate identification is critical, as there are several look-alike species, including other stink bugs *(Figs. 4.1-4.7)*.

ADULT: REPRODUCTIVE, DISPERSAL, DAMAGING, AND OVERWINTERING STAGE

- About 5/8 in (17 mm) long and ½ in (13 mm) wide *(Figs. 4.1, 4.3, 4.5)*.
- Shield-shaped body.
- Marmorated means "marbled", referring to the brown mottled pattern on the back- and under-side of adult bodies.
- Antennae, legs, and posterior edge of the back have distinct light and dark banding patterns.
- "Shoulders" are rounded and smooth, as opposed to other stink bug species that have notched or pointed shoulders.

EGG

- Typically laid on the underside of leaves.
- Barrel-shaped, 1/16 in (1.6 mm) wide.
- Translucent to white in color.
- Mature eggs develop dark triangular-shaped spots *(Fig. 4.8)*.

NYMPH: DISPERSAL, DAMAGING, AND OVERWINTERING STAGE

- Five instars or immature stages (nymphs).
- Range from 1/10-1/2 in (2.5-12 mm) long.

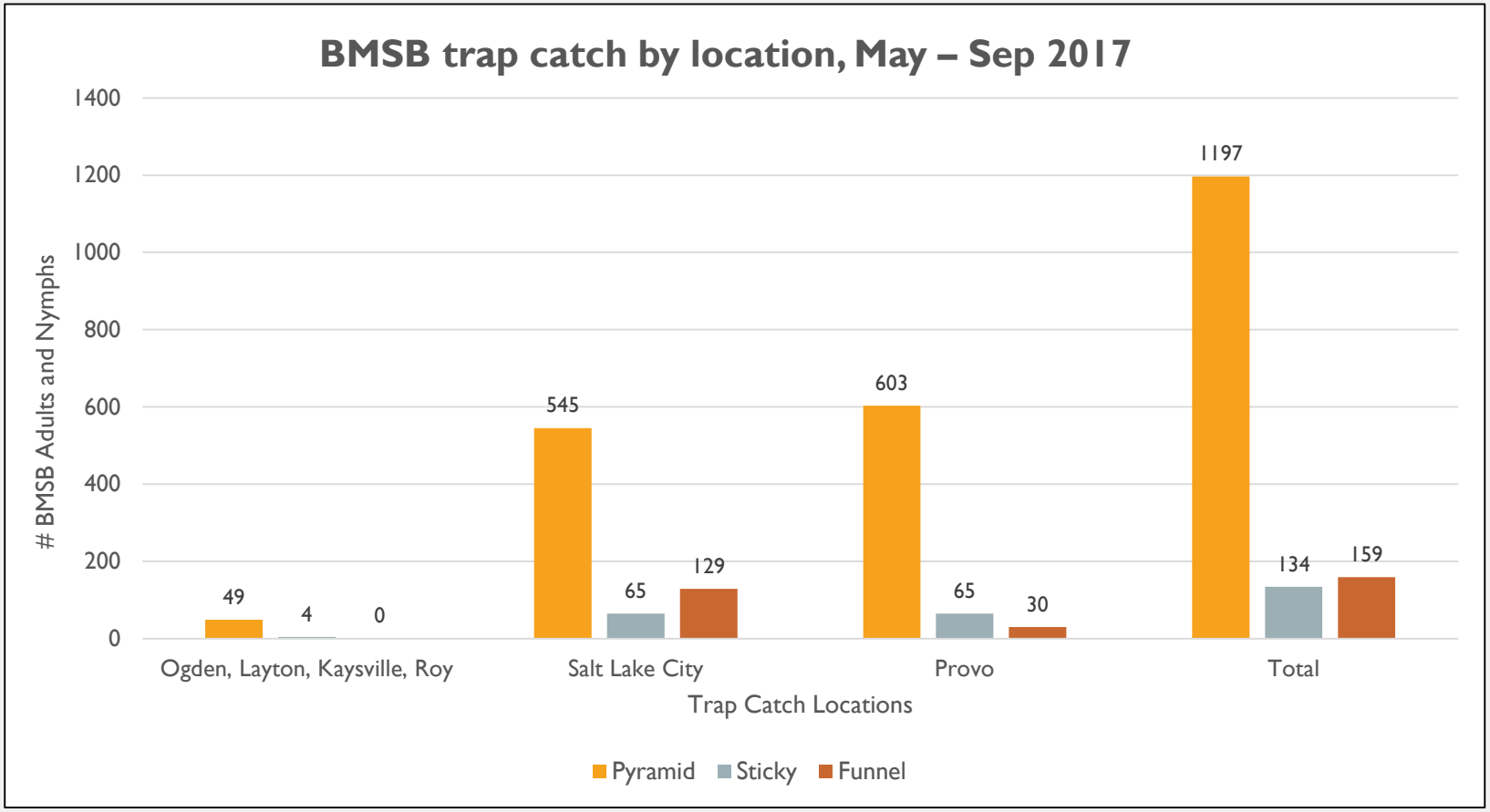
BMSB MONITORING

- Visual stimulus
  - Large black pyramid (trunk-mimicking stimulus)
- Capture mechanism
  - Inverted funnel jar with insecticide-treated net
- Olfactory stimulus
  - PHER + MDT (Trécé Dual Lure)
- Deployment strategy
  - Traps placed in peripheral row or border area

Can we make trapping easier and cheaper for growers?

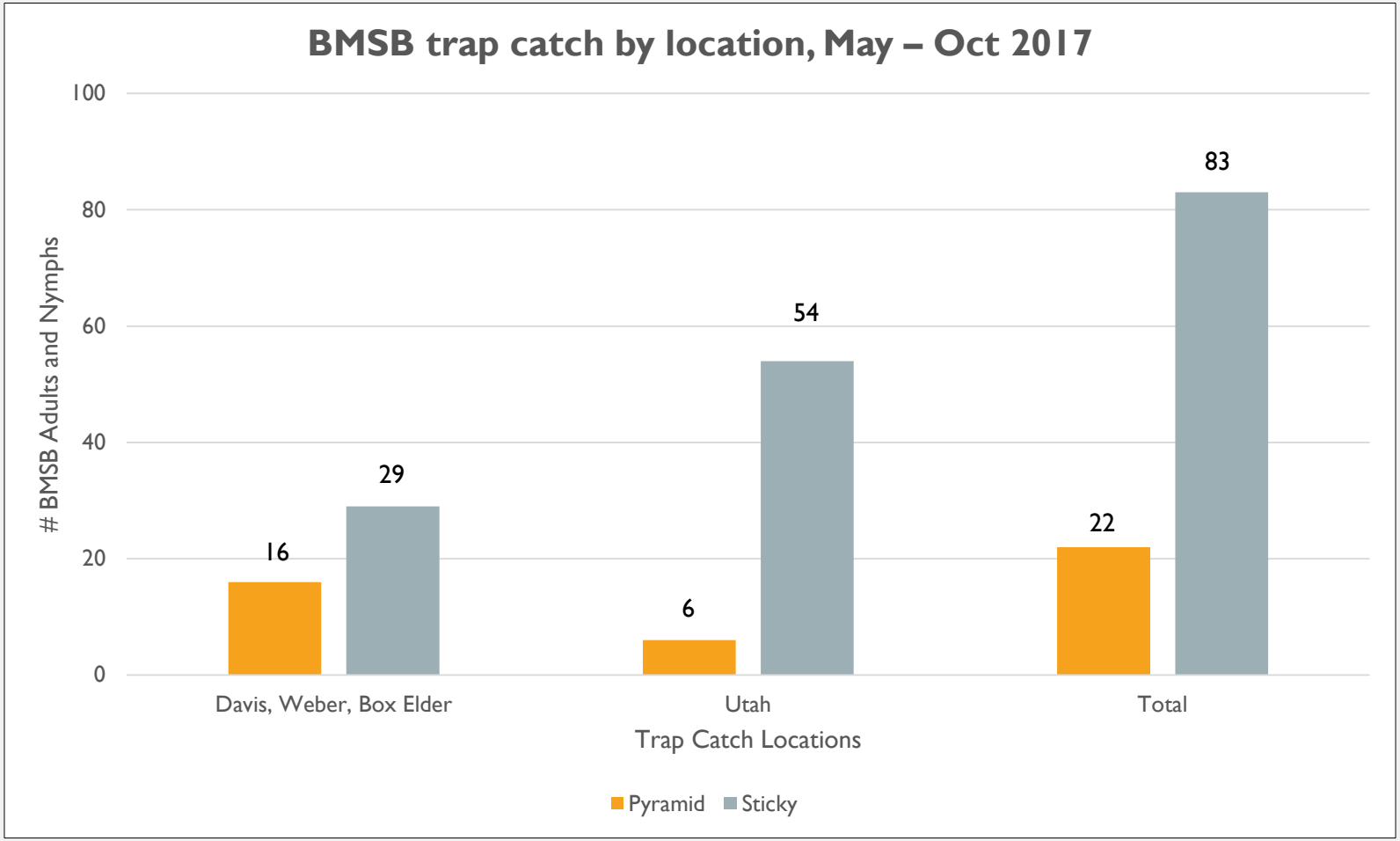
TRAP EFFICIENCY

Residential Ornamental Sites

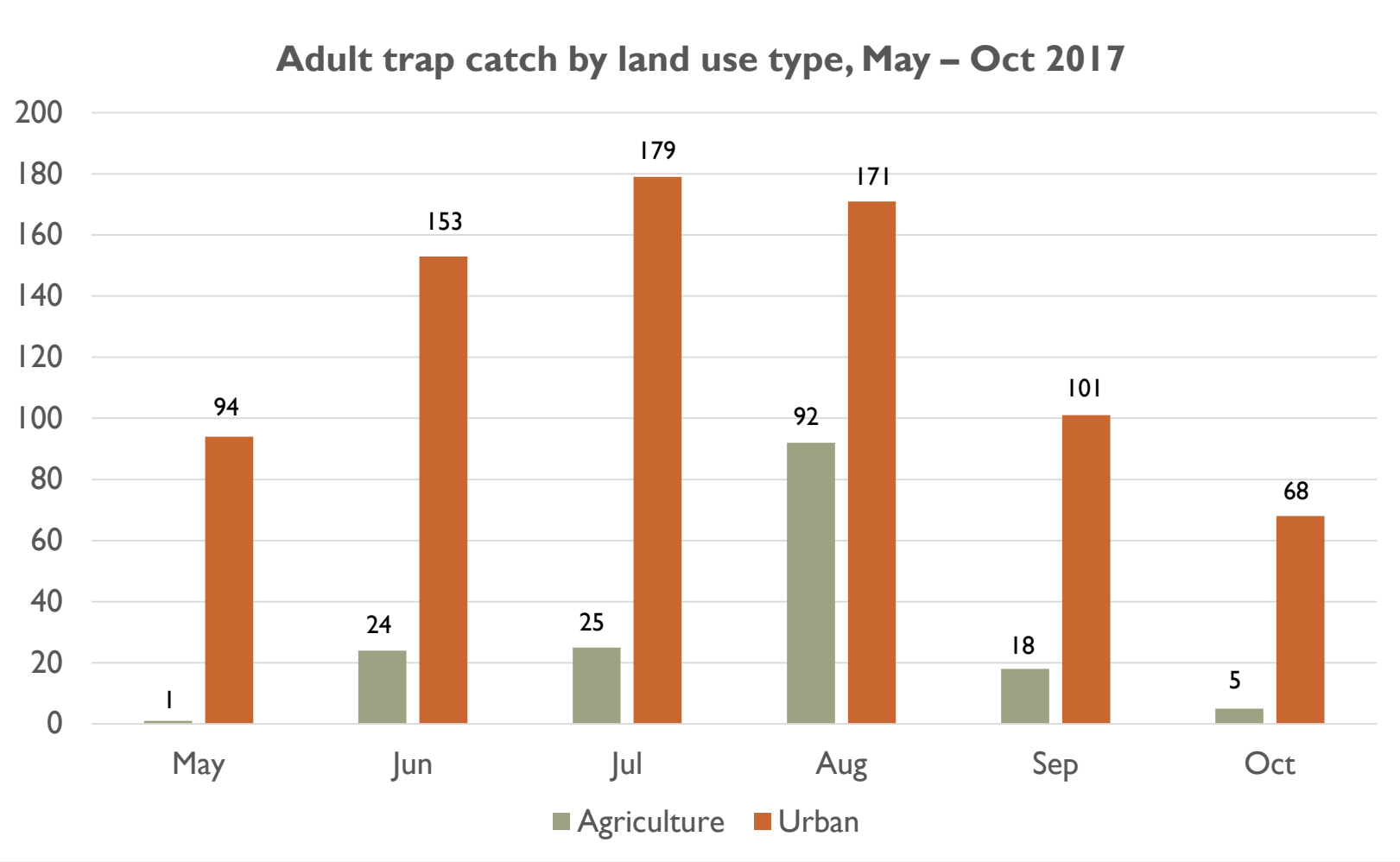


TRAP EFFICIENCY

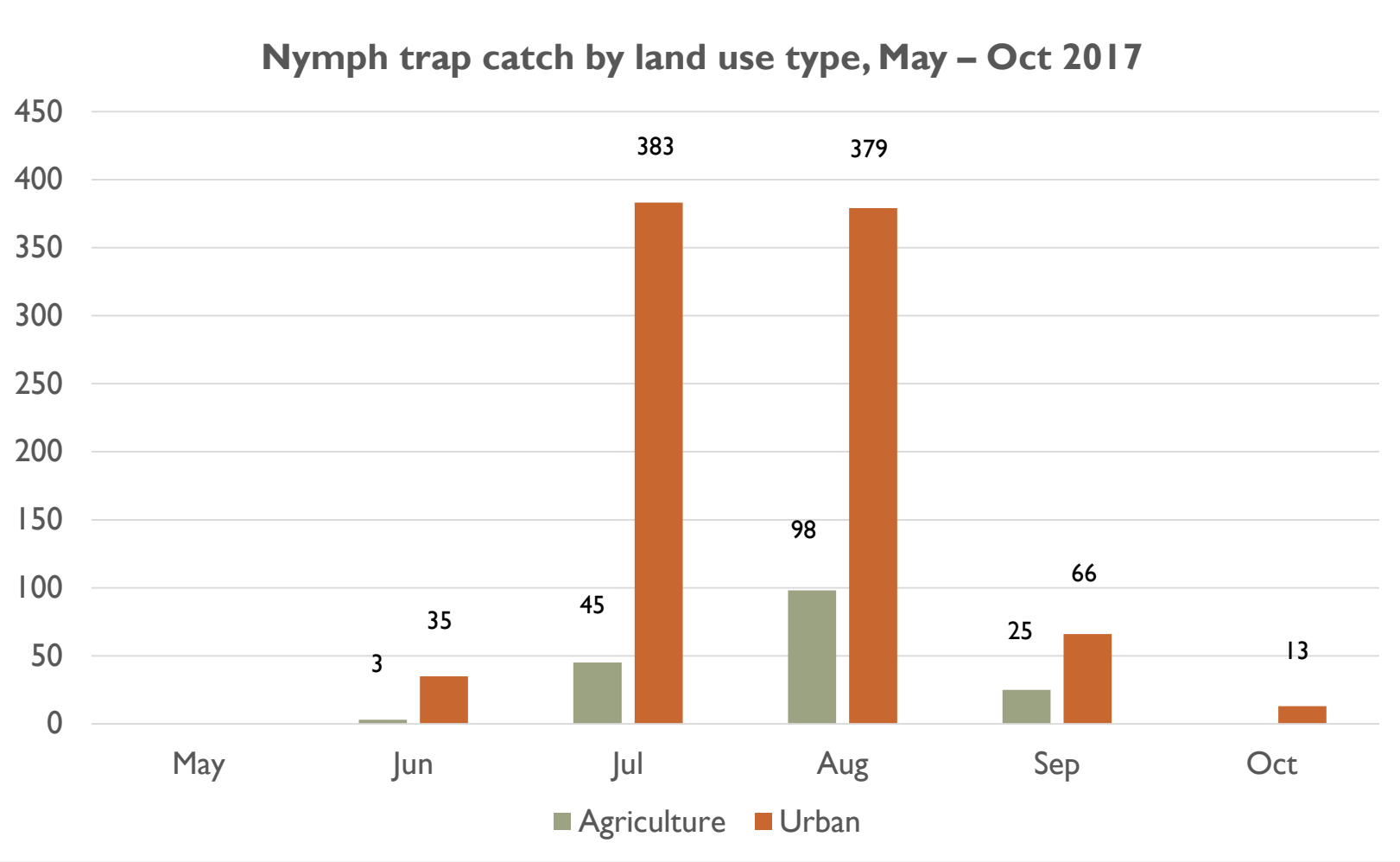
Commercial Orchard Sites



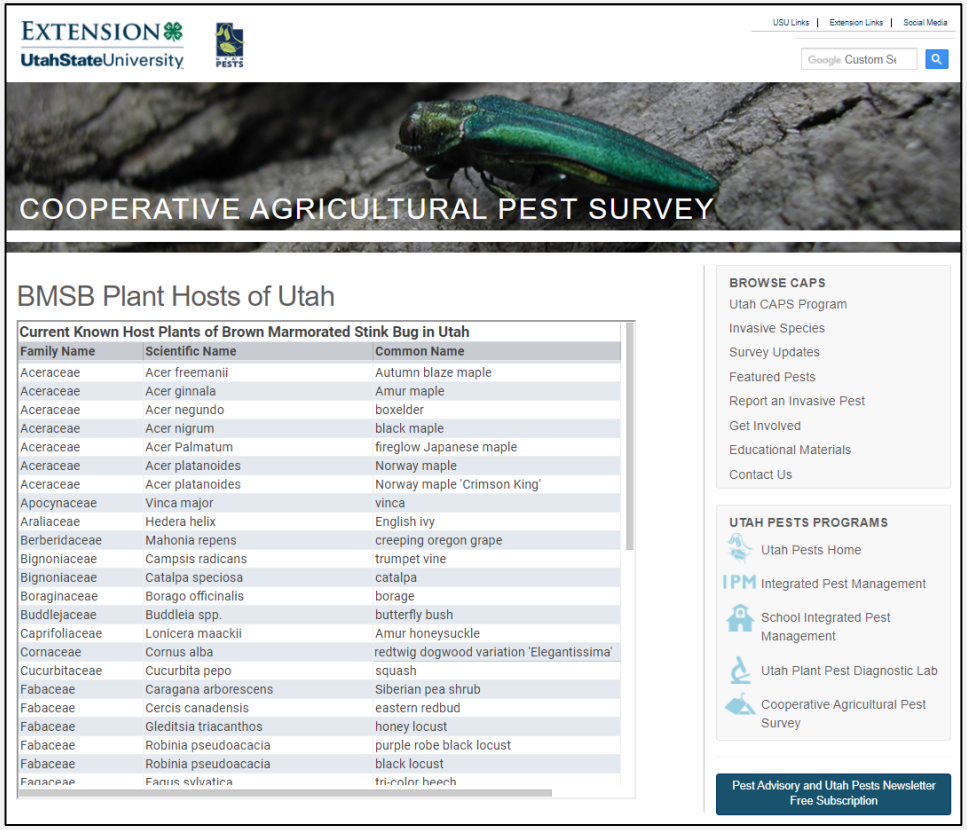
PHENOLOGY


Adult trap catch by land use type, May – Oct 2017
200
180
160
140
120
100
80
60
40
20
0
94
153
179
171
101
68
1
24
25
92
18
5
May
Jun
Jul
Aug
Sep
Oct
Agriculture
Urban

PHENOLOGY


Nymph trap catch by land use type, May – Oct 2017
450
400
350
300
250
200
150
100
50
0
383
379
98
66
45
35
25
13
3
May
Jun
Jul
Aug
Sep
Oct
Agriculture
Urban

HOST PLANT USE



Residential surveys in 4 counties

- 49 plant species
- 20 plant families

Most common families/highest populations:

- Aceraceae (maple, boxelder)
- Bignoniaceae (catalpa, trumpet vine)
- Fabaceae (Siberian pea shrub, locust)
- Oleaceae (privet, lilac)
- Rosaceae (apple, cherry, peach, plum)

https://utahpests.usu.edu/caps/bmsb-host-plants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GOOD FRUIT GROWER

Meet the stinkbug's worst nightmare

A wasp no bigger than a flea could be the best tool against BMSB


organic garden corn

Anastatus mirabilis

Trissolcus sp.

T. euschisti

T. erugatus

Telenomus sp.

T. utahensis

Survey Updates

Featured Pests

Report an Invasive Pest

Get Involved

BROWSE CAPS

- Utah CAPS Program
- Invasive Species
- Survey Updates
- Featured Pests
- Report an Invasive Pest
- Get Involved
- Educational Materials
- Contact Us

UTAH PESTS PROGRAMS

- Utah Pests Home
- IPM Integrated Pest Management
- School Integrated Pest Management
- Utah Plant Pest Diagnostic Lab
- Cooperative Agricultural Pest Survey

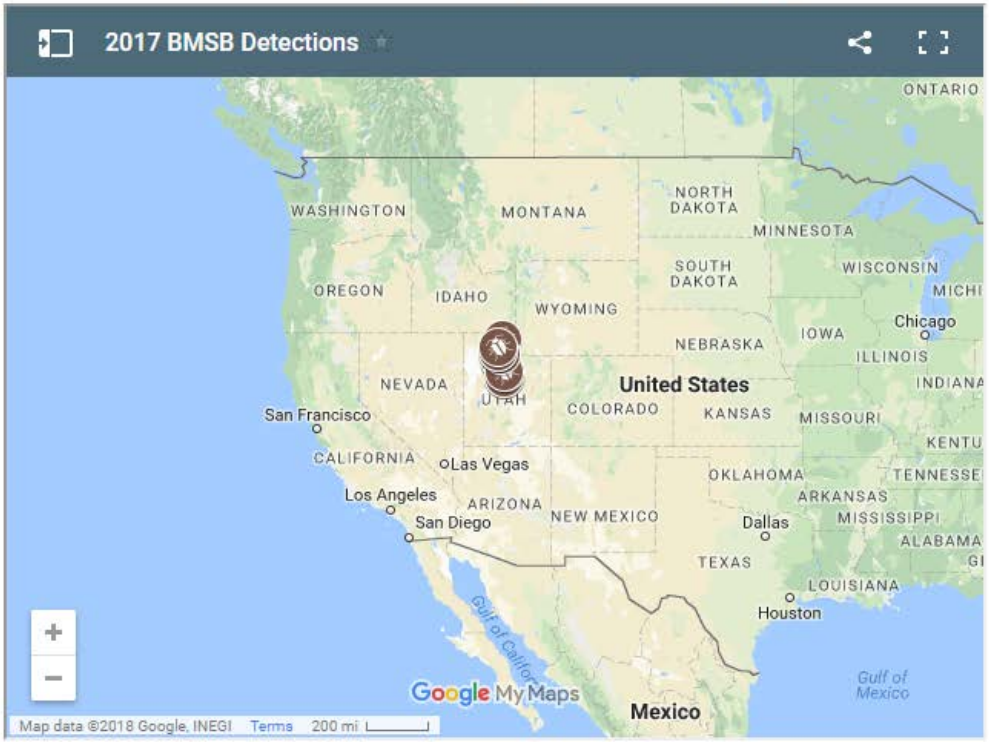
Pest Advisory and Utah Pests Newsletter Free Subscription

utahpests.usu.edu

COOPERATIVE AGRICULTURAL PEST SURVEY

Survey Updates for Utah

Brown Marmorated Stink Bug Utah Survey Updates



Spotted Wing Drosophila Utah Survey Updates

BROWSE CAPS

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Pest Advisory and Utah Pests Newsletter Free Subscription

Report an Invasive Pest in Utah

Report a Pest | Report Brown Marmorated Stink Bug | Report Emerald Ash Borer

Report a Brown Marmorated Stink Bug (BMSB) Sighting

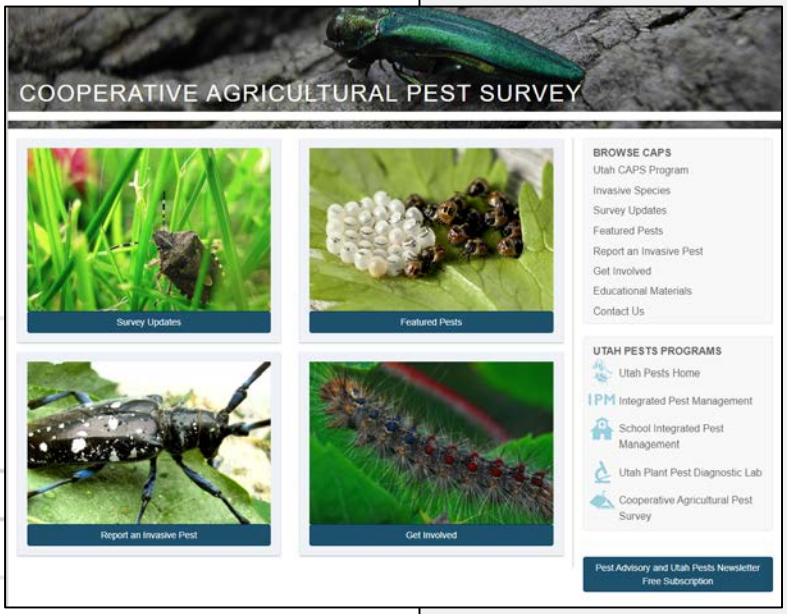
Where was the pest found?

- [ ] In or around a home or structure
- [ ] In an orchard, field, or crop
- [ ] In a vehicle or other place

Date found (mm/dd/yyyy)

Life stage(s) observed

- [ ] Adult



Acknowledgments

Participating Growers

Funding

- WSARE / Utah IPM
- Utah Agricultural Experiment Station
- USDA NIFA, USDA AFRI, USDA APHIS PPQ
- Utah Specialty Crop Block Grants
- Western IPM Center
- USU Extension

Management of BMSB in US Specialty Crops

This material is based upon work that is supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, Specialty Crop Research Initiative under award number 2016-51181-25409.

Funding

USDA United States Department of Agriculture National Institute of Food and Agriculture
Specialty Crop Research Initiative

Collaborators

Attracting and Conserving Wild Pollinators in Urban Vegetable Farms

Learn about the myriad of different types of wild pollinators, and how to attract and conserve them, either for pure vegetable production, or for diverse farms. This presentation will not cover honey bees.

David Lowenstein

Research Associate Post Doc

Oregon State University

David is an ecologist and entomologist at Oregon State University whose primary responsibility is to manage the Brown Marmorated Stink Bug Project, including potentials for biological control using the Samurai wasp. Before coming to OSU, David worked in IPM of vegetable crops in the Midwest and studied pests and pollinators in urban agriculture. He holds a PhD in Ecology and Evolution from University of Illinois-Chicago, and an MS in Entomology from University of Wisconsin.

Back to Top

Attracting and conserving wild pollinators in urban vegetable farms

David M. Lowenstein

Feb 22, 2018

Overview

- What makes a bee?
- Bees of the Mountain West

Melissa & Doug
Melissa & Doug Sunflower Snack Bee and Flower Jigsaw Puzzle (100 pcs)

- Impacts of urbanization
- Urban pollination projects

- Recommendations to attract wild pollinators

Overview

- What makes a bee?
- Bees of the Mountain West

Melissa & Doug
Melissa & Doug Sunflower Snack Bee and Flower Jigsaw Puzzle (100 pcs)

- Impacts of urbanization
- Urban pollination projects

- Recommendations to attract wild pollinators

Importance of bees

- Approximately 20,000 species worldwide
- 900+ identified species in Utah
- Pollination for economically valuable crops
  35% of crops depend exclusively on animal pollination

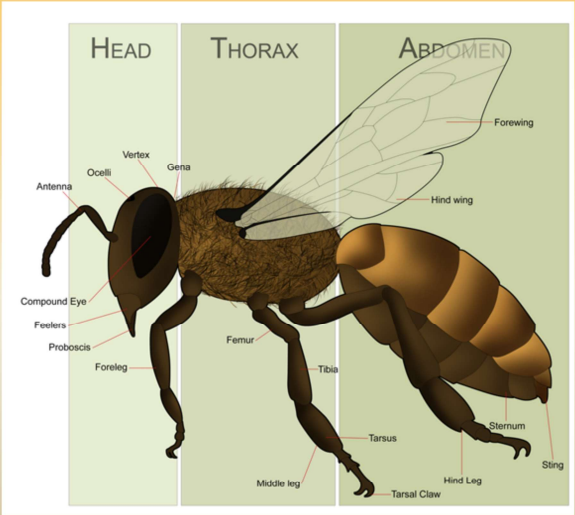
More dependent on bees



Less dependent on bees



What's a bee?


HEAD
THORAX
ABDOMEN
Forewing
Vertex
Ocelli
Gena
Antenna
Hind wing
Compound Eye
Feelers
Proboscis
Foreleg
Femur
Tibia
Sternum
Tarsus
Sting
Middle leg
Hind Leg
Tarsal Claw

What's a bee?

- **Branched hairs**
- 2 pairs of wings
- Long, thin antennae (longer in males)
- Mandibles (chewing) and a proboscis (mouthpart used for sucking nectar)

Branched hairs

Bees are hairier, especially on legs

- Hairs used for collecting pollen

What's a bee?

- Branched hairs
- **2 pairs of wings**
- **Long, thin antennae (longer in males)**
- Mandibles (chewing) and a proboscis (mouthpart used for sucking nectar)

Pairs of wings

- Bee – 2

Wasp - 2

Fly - 1

May not be apparent when still but watch during flight.

Unformed hindwing

What's a bee?

- Branched hairs
- 2 pairs of wings
- Long, thin antennae (longer in males)
- **Mandibles (chewing) and a proboscis** (mouthpart used for sucking nectar)

Mouthparts

Who's visiting flowers?

The Honey bee

- Common managed pollinator
- Lives in hives of 10,000-50,000 bees
- Heart shaped head with black to amber brown body

Not native to USA

Threats to Honey bees

- Colony Collapse Disorder (CCD)
- Mites and pathogens
- Pesticides

Mid at

The case for wild bees

- Offset losses from CCD or other honey bee concerns
- Free pollination service
- $3 billion value in global pollination services

Maybe money sign? Or other picture of bees in vegetable crop. ADD SUMMER PHOTO

Some bees more efficient at pollination

Cucumber

Bee type	# visits	Fruit abortion (%)
Honey	1	60
Bumble	1	50
Honey	6	45
Bumble	6	20
Honey	18	20
Bumble	18	15

Stanghellini et al. 1997

Fewer bumble bee visits results in improved fruit set

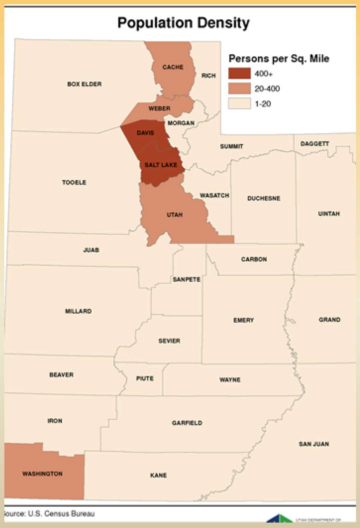
What's a wild bee?

- Unmanaged bees other than honey bees

To ask: What kinds of plant

Wild bees of Utah

- Bumble bees
- Sweat bees
- Leafcutter bees
- Long horned bees
- Yellow faced bees
- Cuckoo bees
- Squash bees



Change to in order of occurence

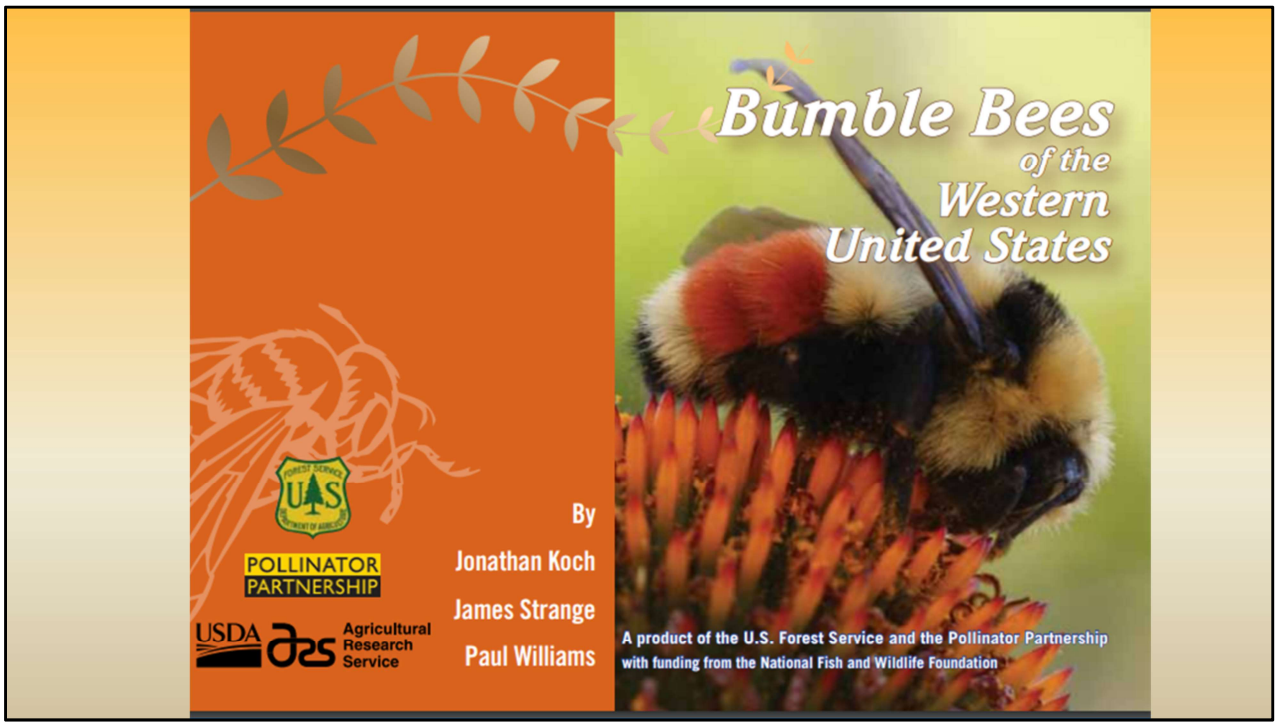
Bumble bees

- Black and yellow, fuzzy looking bees (0.4 – 1.1 inches)
- Social species that nest underground or in woody debris
- Buzz-pollination of eggplants and tomatoes
- Active for most of day (dawn-dusk)

Bombus griseocollis

Bombus rufocinctus

12 species in Utah, https://www.fs.fed.us/wildflowers/pollinators/documents/BumbleBeeGuideWestern2012.pdf


Bumble Bees
of the
Western
United States
POLLINATOR
PARTNERSHIP
USDA
Agricultural
Research
Service
By
Jonathan Koch
James Strange
Paul Williams
A product of the U.S. Forest Service and the Pollinator Partnership
with funding from the National Fish and Wildlife Foundation

Sweat bees

- Small, metallic colored bees (0.25 – 0.5 inches)
- Solitary or social
- Found in natural and developed areas
- Different degrees of specialization

X to indicate green bee

Leafcutter bees

- Variable body types with common feature: Pollen collecting hairs beneath abdomen

Leafcutter bees

- Solitary bees that nest in logs, soil, trees
- Rapid flight and unique side-side pattern
- Valuable for orchard crop pollination

Wool carder bee

Osmia – Mason bee

Long horned bees

- Solitary, ground-nesting bees (0.3-0.75 inches)
- Dense pollen collecting hairs on legs
- Males with antennae nearly as long as body
- Visit many flowers including Asters

Yellow faced bees

- Very small (0.2-0.3 inches) with yellow marks on face
- Hairless and carry pollen internally
- Nest in stems and twigs
- Limited value for commercial pollination

Mention carrot and daucus carota

Cuckoo bees

- Lay eggs in nest of other bees, stealing nest and food
- Lack pollen collecting hairs
- Often brightly colored
- Occasionally encountered in cities

Squash bees

- Specialist pollinator of cucurbits
- More efficient than bumble and honey bees
- Nest in soil

Bee or wasp?

Yellow jacket

Bee

Bee or fly?

Hover Fly

Drone Fly

Batesian mimicry – Harmless species imitates harmful species

Characteristics of urban bees

- Most are cavity nesting
- Nest in opportune areas (soil, siding, cracks in wall)
- Small sweat bees common to most areas

Persistence of urban bees

- Active area of research in North America and Europe
- Influenced by municipal and private management
- “Weedy” plants as food source

Persistence of urban bees

City	# Species	Source
Chicago, IL	60	Tonietto et al. 2011, Lowenstein et al 2014
New York City	54	Matteson et al. 2008
San Luis Obispo, CA	40	Pawalek et al. 2009
Tucson, AZ	92	Cane et al. 2006

Scientists have asked why we have less bees in urban areas. One reason suggested is the effect of urbanization on the landscape.
No studies of SLC

How does urbanization affect the landscape?

- Fragmentation – Breaking apart of one habitat area into multiple areas
- Habitat loss – Removal of a habitat area and replacement with different use

Face of urbanization

Increase in sprawl of urban areas

Conversion of forests, shrubland, prairies

Concern for organisms with specialist food and habitat requirements

Circles around fragmented areas to show distance and fact that they are fragmented. On duplicate slide

How does this impact bees?

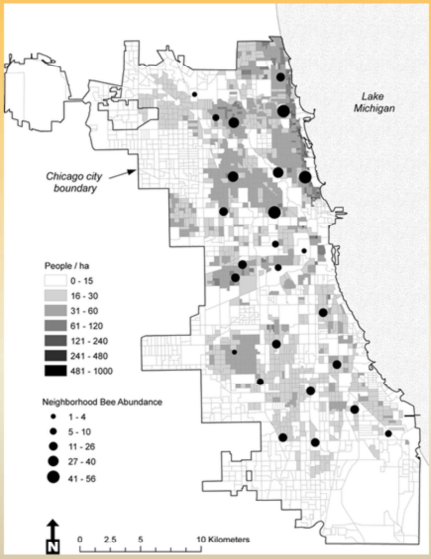
Impacts Resources and Nesting:

- Increased search distance for flowers
- Change in most common flowering plants
- Impervious surface reduces nesting locations

Transition into my own work. Mitigate urbanization;s impact on bees and I'm studying that

Pollinator abundance can vary between neighborhoods

- More bees in more densely populated Chicago, IL neighborhoods
- But Pop density far lower in Wasatch Front



Lowenstein et al. 2014 Biodiv Conserv

Previous research

- Bee diversity across Chicago, IL neighborhoods
- Floral characteristics of residential yards
- Pollination services of vegetables, wildflowers in urban areas

Measuring pollination in residential gardens

- Most of Chicago's food production is on residential property
  (Taylor and Lovell 2012)

This is a segway slide.. Put a photo of a vegetable farm PUT picture of site 55

Measuring pollination in residential gardens

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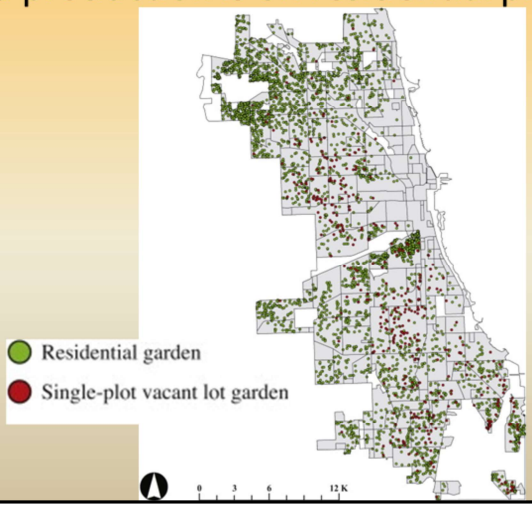


This is a segway slide.. Put a photo of a vegetable farm PUT picture of site 55

Evaluating pollination services in gardens

- Are plants visited by unique pollinator assemblage?
- Does pollinator activity enhance plant yield?
- Do adjacent flowers facilitate or compete with pollination of focal plants?

Pollinator activity:
Number of visits to garden
Number of visits to plant species
Pollinator species richness

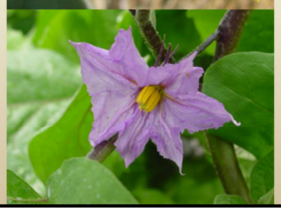
Pollinator activity as
Are plants visited by unique pollinator assemblae

Mobile garden of 3 plant species

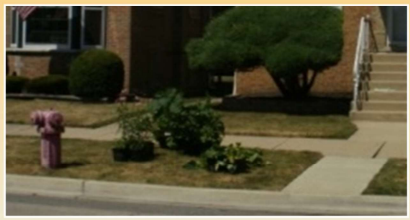
Purple coneflower

Cucumber

Eggplant



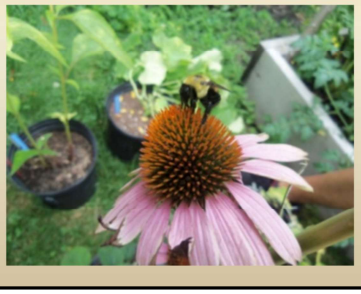
Standardize floral display across multiple sites

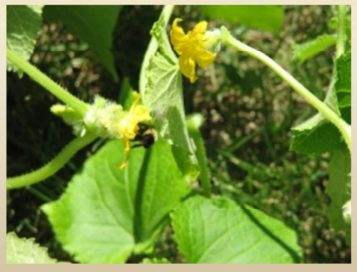


Get better picture

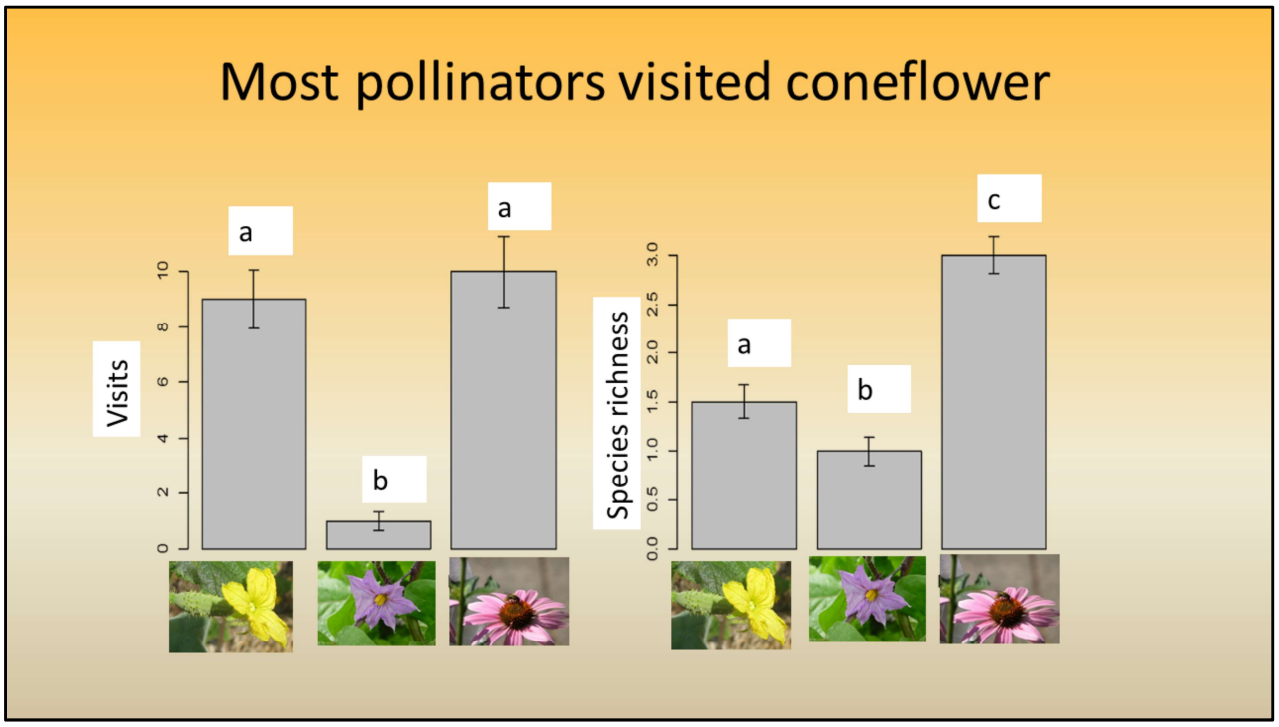
Mobile garden in 30 yards

Commonly observed pollinators





Mention that toxomerus and bees were the target pollinators. Say richness as "number of species." Mention coneflower and fruiting plants



Need to replace this slide with the accurate avg of dates 1 and 2.

40-50% fruit set at mobile gardens

- Unique pollinator assemblage on each species ($H=41.8$, $P<0.01$)
- Significant association between pollinator visits to eggplant and cucumber and yield

Lowenstein et al. (2015) Oecologia

Mention that toxomerus and bees were the target pollinators. Say richness as "number of species." Mention coneflower and fruiting plants

Modeling pollination services

Response	Pollinator activity	Floral	R^2
Cucumber fruit set	+	0	0.35
Cucumber seed set	+	0	0.13
Eggplant fruit set	+	0	0.10
Eggplant seed set	+	0	0.25
Coneflower	+	+	0.35

7.2 flowers / sq meter in yards

Flowers facilitate coneflower pollination

- More bees in yards with greater floral resources
- Increased probability of locating coneflower - most attractive mobile garden resource

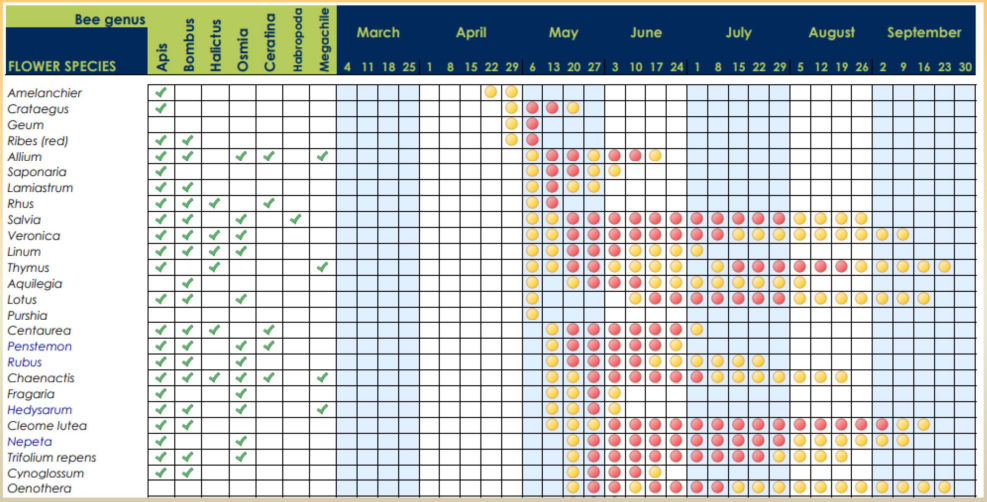
Attracting bees - flowers

- Native or attractive garden plants
- Resources when crops not blooming
- Variation in bloom times and flower shapes
- Consider soil/water needs



Search: Xerces society Mountain region
Possible cost-shares through NRCS EQIP for pollinator habitat

Gardening for Native Bees in Utah and Beyond



https://digitalcommons.usu.edu/cgi/viewcontent.cgi?article=1907&context=extension_curall

Attracting bees – lawn/grass

1) Less areas that need mowing

- Plant nectar-rich flowers
- Richer floral display attracts more bees

2) Mow weeds less

- Provides low-maintenance, economical food source for bees
- Early-season resource

Attracting bees – lawn/grass

- Field borders and hedgerows

- Cover crops
  - Soil, erosion benefits too!

https://digitalcommons.usu.edu/cgi/viewcontent.cgi?referer=https://www.google.com/&httpsredir=1&article=2610&context=extension_curall

Attracting bees – lawn/grass

- Get to know your neighbors!
- Wild bees on small veg farms may nest in residential sites

Urban bee nests

Attracting bees – soil nesting

- Leave undisturbed areas near field edges
- Reduce tillage or disturbance along field edges
  - 50% of squash bees don't survive deep tillage (Ullmann et al. 2016)

Attracting bees – cavity nesting

- Bee condos for cavity nesting bees
- Using block of wood, drill 3-5 inch deep hole
- Line holes with paper or straws to prevent spread of disease

U. Nebraska extension

Attracting bees – cavity nesting

- Leave undisturbed areas near field edges
- Old wood and logs as nesting substrate
- Availability of season-long flowering sources

Bumble bee nests hard to spot.

Final thoughts

- Keep observing to learn the bees of your farm
- Gardens and farms add structural complexity and habitat for insects

Incorporate this into research questions.

Acknowledgements

Funding

University of Illinois at Chicago

THE CERES TRUST

NSF

Field/Lab Assistants

Pictures?

NRCS Funding for Pollinators and Insect Habitats

I will be talking about several opportunities to use government funding sources and technical advice to improve your pollinator and insect habitat. These programs and practices are available through the Natural Resources Conservation Service (NRCS) which is an agency of the U. S. Department of Agriculture.

Dave Hanson

District Conservationist

NRCS

david.hanson@ut.usda.gov

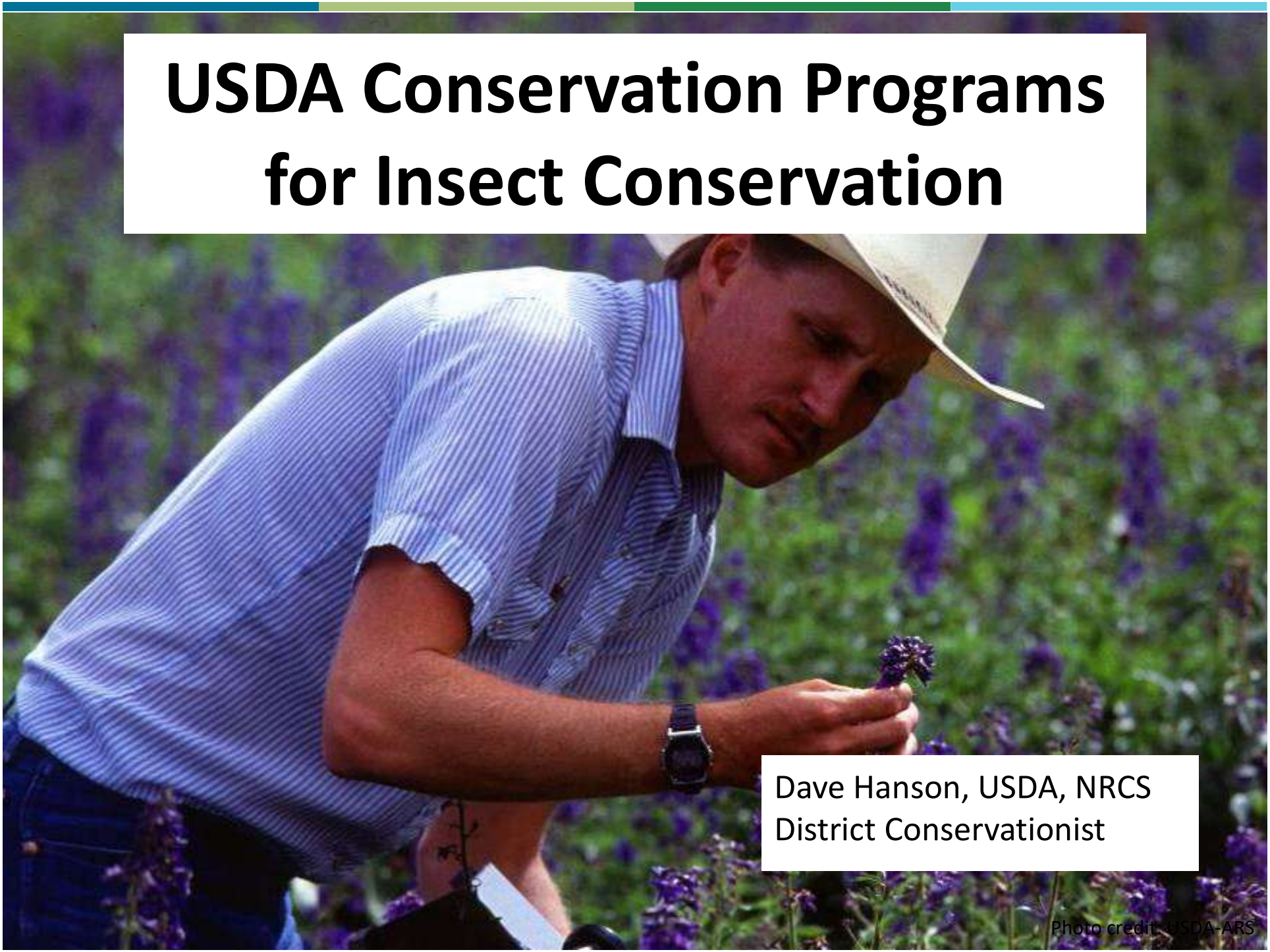
Dave is a native of the mid-west. He graduated from the University of Wisconsin – Stevens Point in 1983 with a Bachelor's Degree in Resource Management. He moved to Utah for a year to work for the US Forest Service. He married a local lady also working for the Forest Service. Later, Dave and his wife moved to Texas A&M University and Dave received his Master's Degree in Range Science.

Dave was a commissioned officer in the Army National Guard for a few years and earned the rank of Captain while "playing" with the Field Artillery.

Dave has worked for the NRCS for 28 years in Ohio, Minnesota and currently in Utah. He and his family moved to the Provo area in early 2002. He is currently the District Conservationist or office manager. He and his staff are responsible for the NRCS programs in Utah, Wasatch, Tooele and Salt Lake Counties.

Back to Top

USDA Conservation Programs for Insect Conservation



Dave Hanson, USDA, NRCS
District Conservationist

Photo credit: USDA-ARS

Natural Resources Conservation Service
Utah Service Centers

Beaver
Castle Dale
Cedar City
Coalville
Ephraim
Fillmore
Monticello
Nephi
North Logan
Ogden
Panguitch
Price
Provo
Randolph
Richfield
Roosevelt
Tooele
Tremonton
Vernal

U.S. Department of Agriculture

*https://**www.nrcs.usda.gov***

Farm Bill: Beneficial Insect Habitat Provisions

2008 Farm Bill

- Made pollinator habitat a priority for every USDA land manager and conservationist (NRCS & FSA)
- Encouraged the inclusion of pollinator habitat in USDA conservation programs

2014 Farm Bill

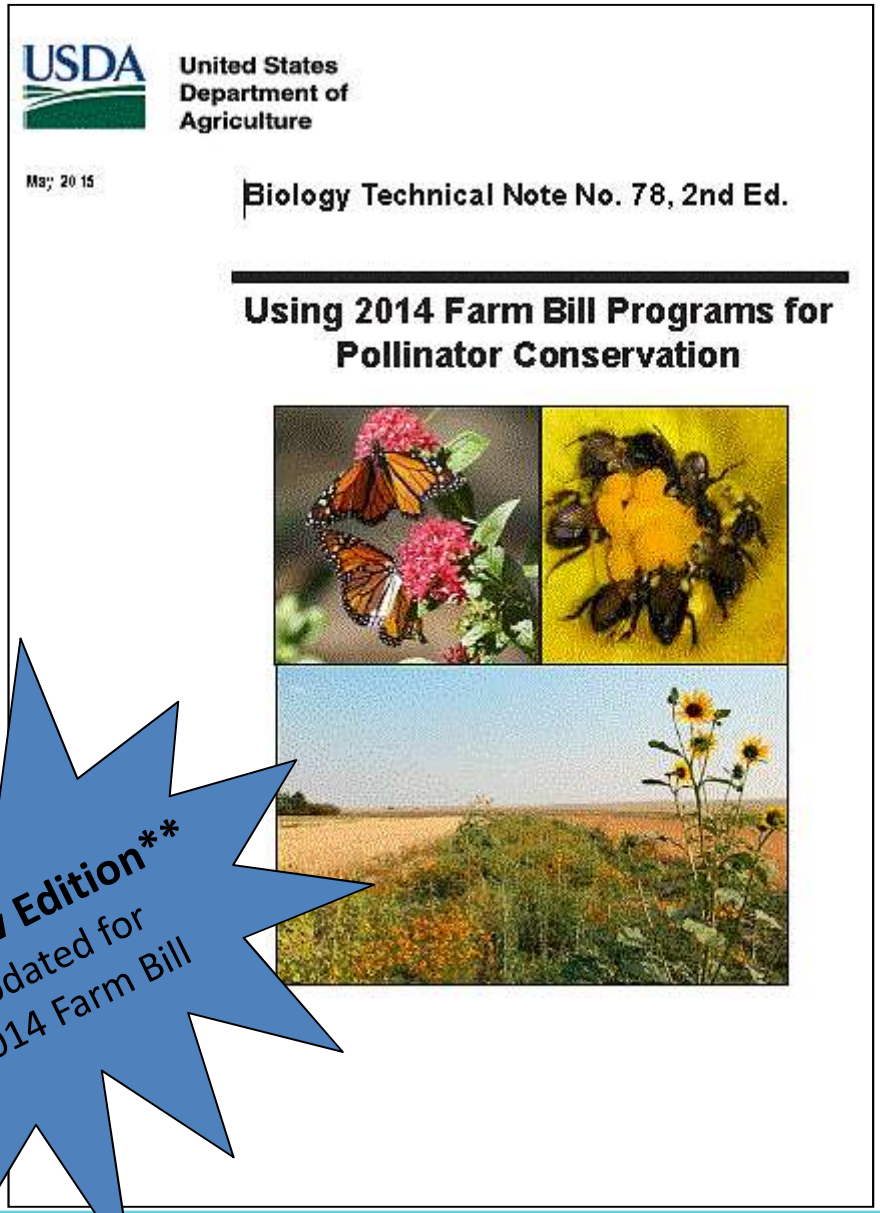
- Maintained provisions for pollinators from 2008
- Added provisions on the creation of habitat to support beekeepers

Photo credit: Thelma Heidel-Baker

Farm Bill: Programs for Beneficial Insects

NRCS Technical and Financial Assistance Programs

- Conservation Technical Assistance (CTA)
- Conservation Stewardship Program (CSP)
- Environmental Quality Incentives Program (EQIP)
- Conservation Reserve Program (CRP) (FSA)
- Conservation Reserve Enhancement Program (CREP) (FSA)
- Agricultural Conservation Easement Program (ACEP)



Farm Bill: Programs for Beneficial Insects

<u>Conservation Technical Assistance (CTA)</u>

- Technical assistance for Farm Bill programs
- Planning and installing pollinator habitat

Photo credits: USDA-NRCS, USDA-ARS

Farm Bill: Programs for Beneficial Insects

Conservation Stewardship Program (CSP)

Maintain and Improve Conservation Systems

5-year Program with Annual Payments

Some practices and incentives will:

- Pollinator and beneficial insect habitat enhancement
- Protect pollinator habitat from adjacent insecticide use

Farm Bill: Programs for Beneficial Insects

<u>Environmental Quality Incentives Program (EQIP)</u>

- Addresses natural resource concerns on agricultural land and private forestland
- Includes improving or creating wildlife habitat

Photo credit: Jessa Kay Cruz

Farm Bill: Programs for Beneficial Insects

Conservation Activity Plans (CAPs)

- Funded through EQIP
- Financial assistance to hire Technical Service Provider (TSP) to develop specialty plants

Integrated Pest Management Plan

$1,400 - $1700

Pollinator Habitat Plan

$2,500 - $3,000

(2018 Payment Estimate)

USDA-NRCS: Conservation Practices for Beneficial Insects

Conservation Cover (327)

Establish permanent cover with forbs and bunch grasses adjacent to crop fields or beneath perennial crops.

(2018 Payment Estimate

$70 - $1300/acre)

Photo credit: Eric Lee-Mader

USDA-NRCS: Conservation Practices for Beneficial Insects

Cover Crop (340)

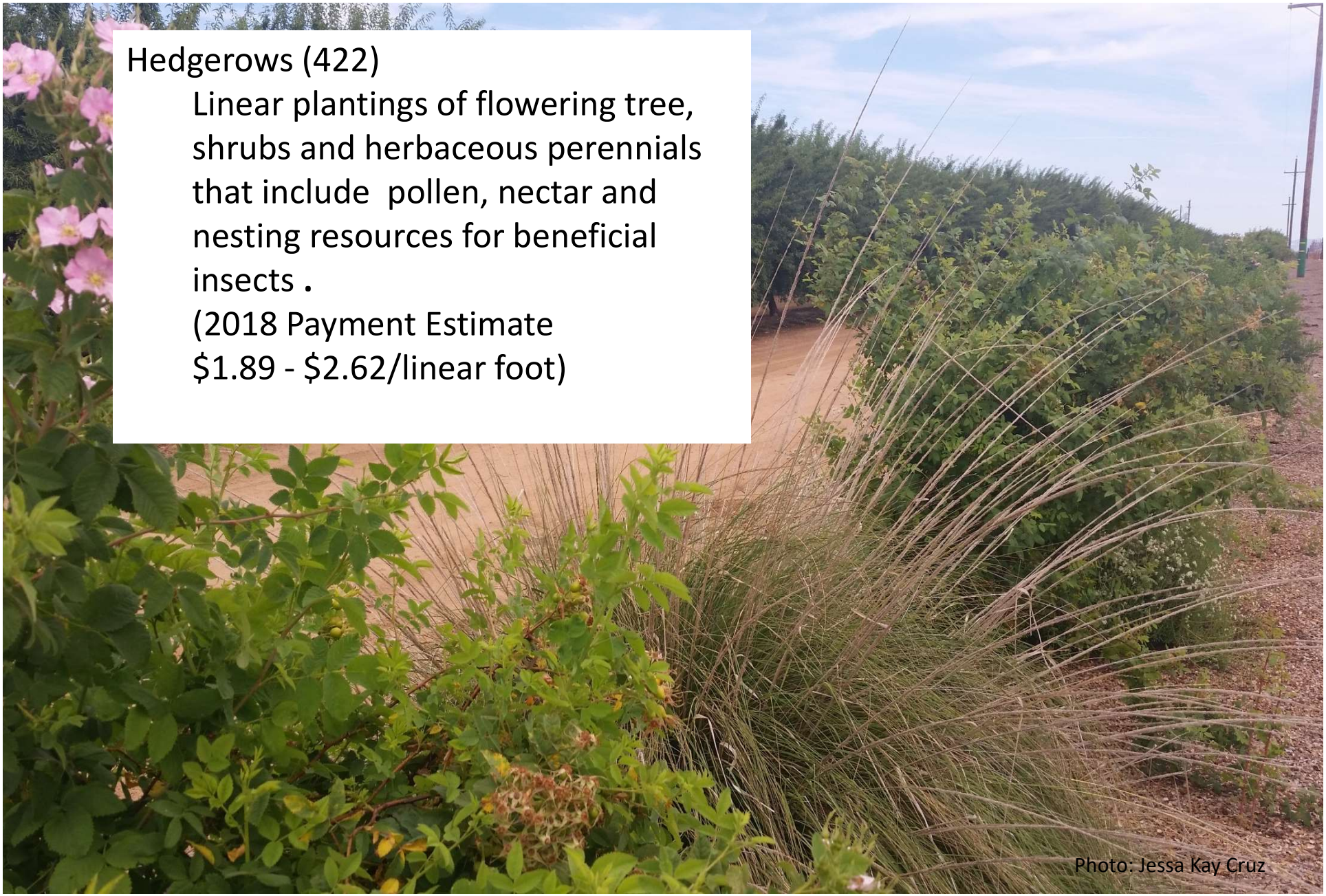
Can include a mixture of flowering forbs such as clover, mustard, buckwheat, phacelia, partridge pea, or sunflower.

(2018 Payment Estimate

$50 - $80/acre)

Photo credit: Jessa Kay Cruz

USDA-NRCS: Conservation Practices for Beneficial Insects



Hedgerows (422)

Linear plantings of flowering tree, shrubs and herbaceous perennials that include pollen, nectar and nesting resources for beneficial insects .

(2018 Payment Estimate $1.89 - $2.62/linear foot)

Photo: Jessa Kay Cruz

USDA-NRCS: Conservation Practices for Beneficial Insects

Integrated Pest Management (595)

Protect beneficial insects and other natural resources from pesticides and establish beneficial insect habitat.

(2018 Payment Estimate $70/acre)

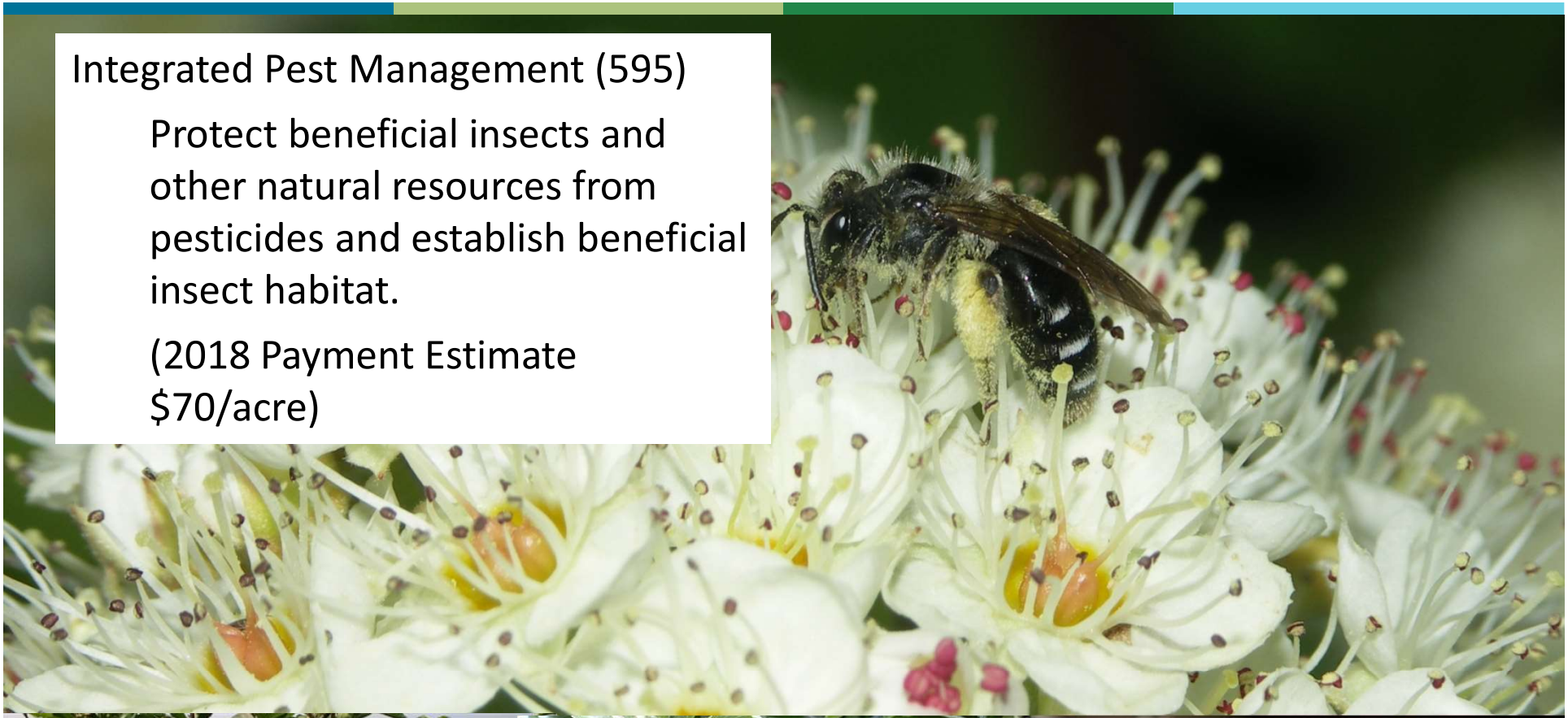
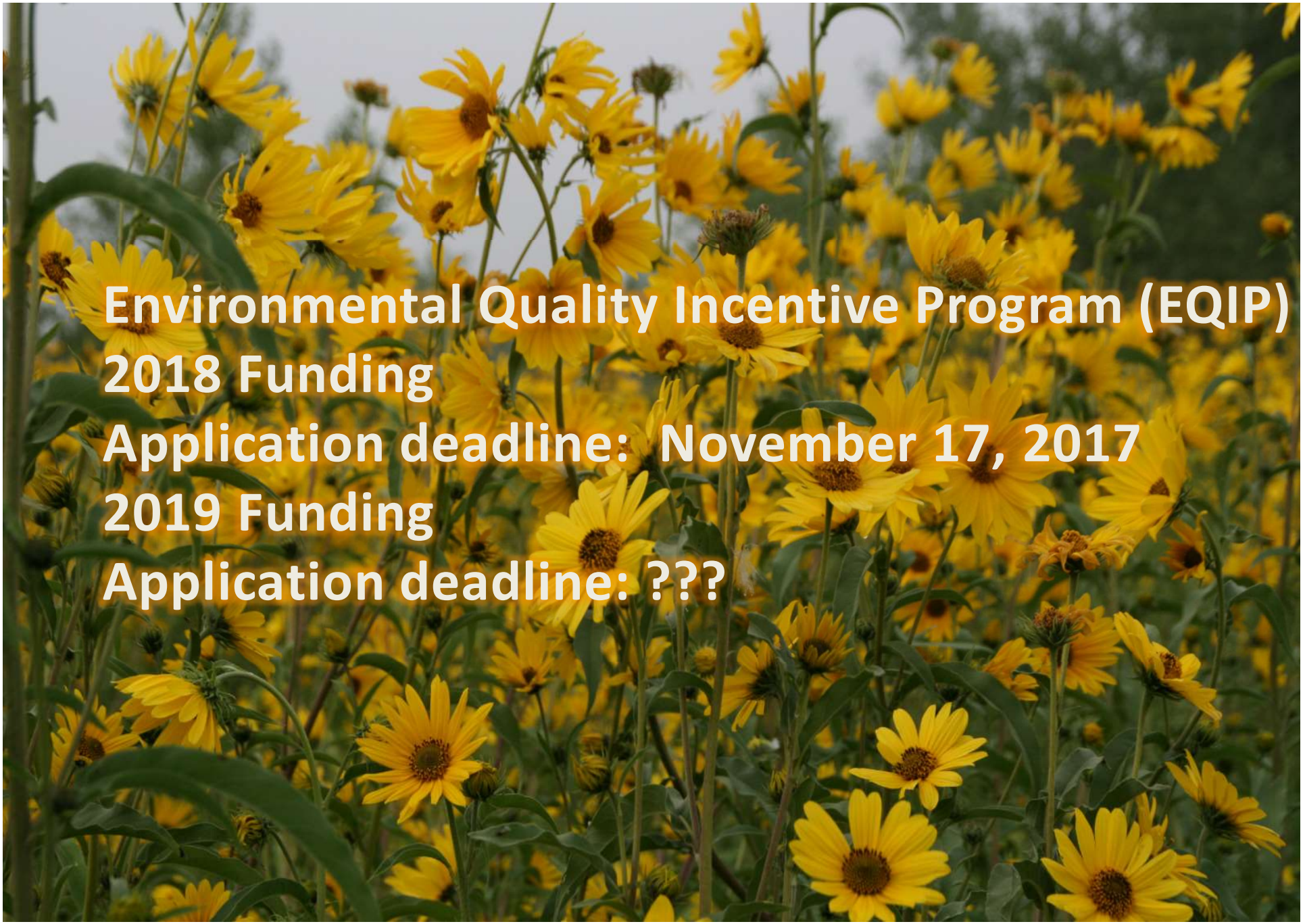


Photo credit: David Biddinger (Penn State University), Mace Vaughan (Xerces Society), and Elise Fog


Environmental Quality Incentive Program (EQIP)
2018 Funding
Application deadline: November 17, 2017
2019 Funding
Application deadline: ???

CRP and CREP

Land retirement program to convert highly erodible cropland or other sensitive acreage to long term vegetative cover.

Land retirement program to convert targeted sensitive lands to long term vegetative cover

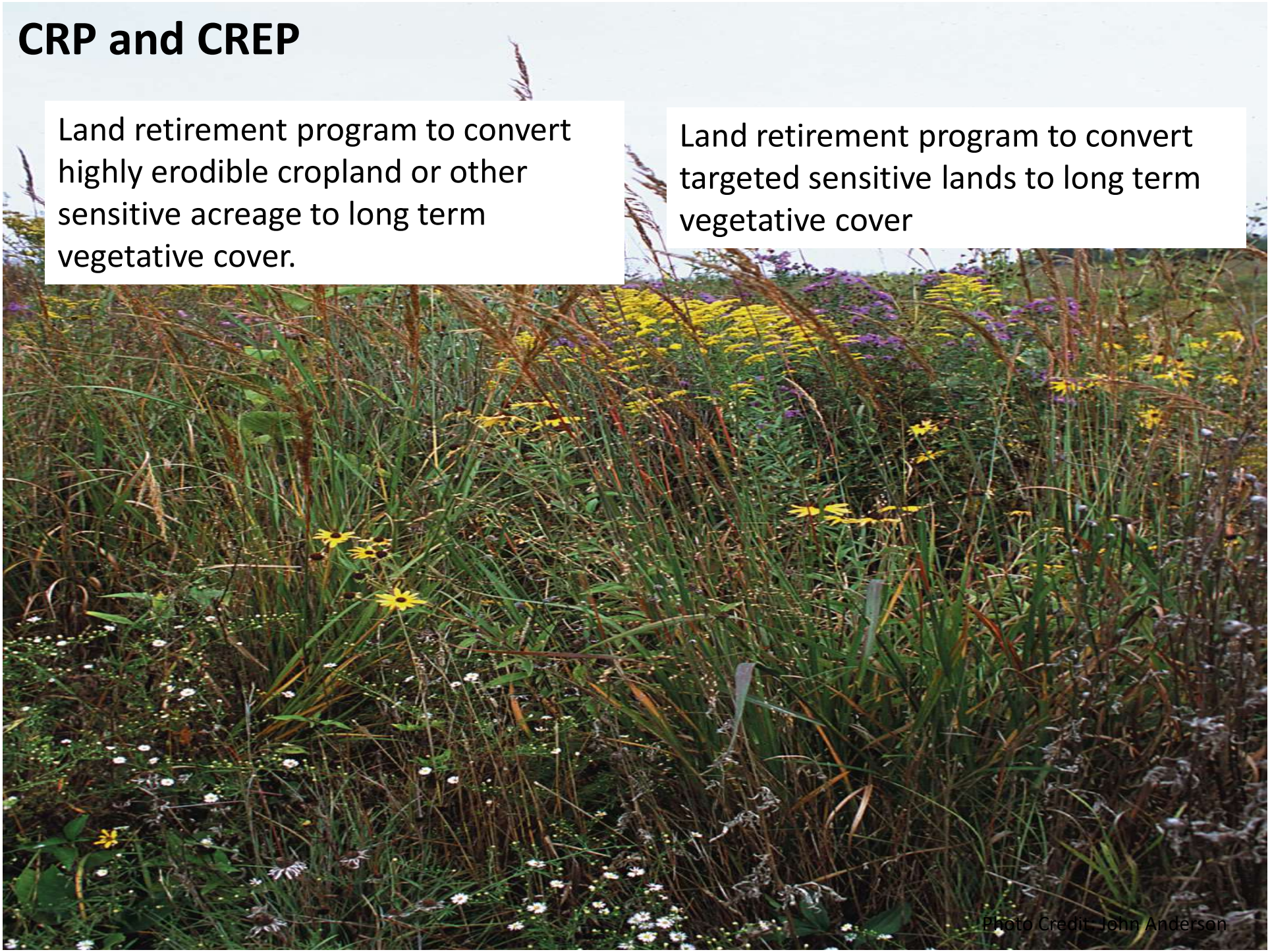


Photo Credit: John Anderson

Agricultural Conservation Easement Program

An easement program designed to keep ag. land as working farms and ranches and prevent them from being converted into non-agricultural purposes

Ownership remains; most normal farming and recreational practices continue.

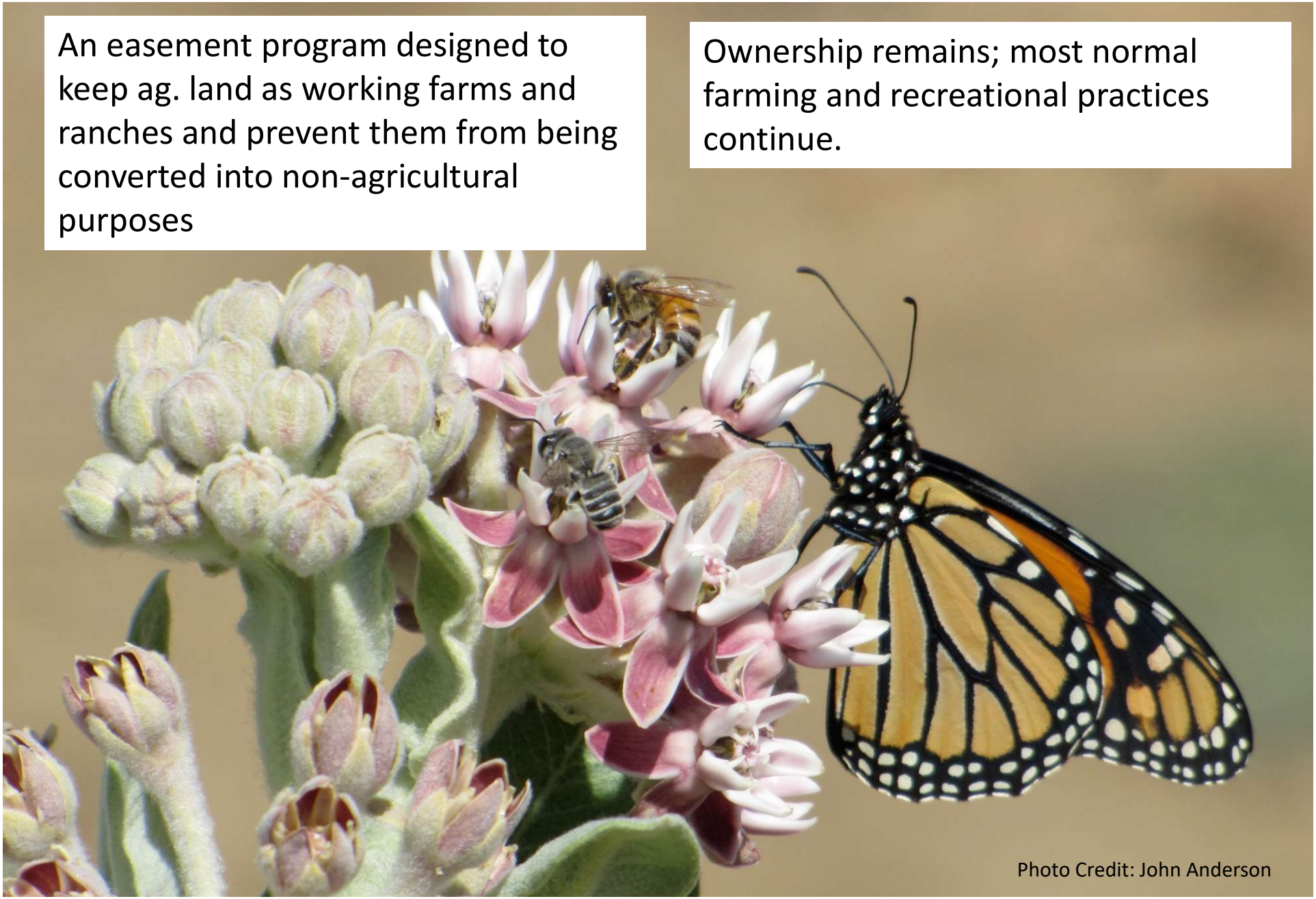


Photo Credit: John Anderson

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