Utah Berry Growers

How-to's on Spider Mite Scouting, Threshold and Management in Raspberries
Diane Alston, USU Extension

Status of the Invasive Brown Marmorated Stink Bug and Spotted Wing Drosophila in Utah
Lori Spears, USU Extension

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Jennifer Werlin, University of Idaho Extension

How-to's on Spider Mite Scouting, Thresholds and Management in Raspberry Plantings

I will review the fundamentals on how to monitor for spider mites in small-scale raspberry plantings. Information on how to determine when economic thresholds have been reached, and best management practices to reduce outbreaks of spider mites will be included.

Diane Alston

Professor and Entomologist

Utah State University

diane.alston@usu.edu

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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Spider mite leaf 'burn'

Twospotted spider mite

How-to's on Spider Mite Scouting, Thresholds and Management in Raspberry

Diane Alston, Entomologist, Utah State University

Utah State University

Urban & Small Farms Conference
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New Fact Sheet

UTAH PESTS fact sheet — EXTENSION UtahStateUniversity

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Spider Mites in Raspberry

Diane Alston, Entomologist

Quick Facts

- 'Mite burn', a golden to brown bronzing of leaves, caused by spider mite feeding can be severe in raspberry plantings; it is typically first observed on the lower leaves.
- Spider mites overwinter at the base of canes, under organic duff, and on weeds; mites climb into raspberry plants as conditions becomes hot and dry.
- An integrated management approach includes planting hardy grasses in alleyways, avoiding dust on leaves, avoiding plant stress from insufficient water and nutrients, shading, cooling with overhead sprinklers, and proactive application of chemical miticides, when needed.

Spider mites can be a challenging pest of raspberry. The twospotted spider mite (*Tetranychus urticae* Koch) is the most common mite to attack raspberry in Utah (Fig. 1). Spider mites are small eight-legged arthropods (adult females are only 1/60 inch, 0.5 mm, long), but populations can build quickly to high numbers during hot, dry conditions. Spider mites typically feed on the underside of leaves and form colonies with webbing to protect the eggs and nymphs. They overwinter as females (dormant females are orange in color) at the base of canes, under organic duff, and on adjacent weeds and ground cover plants. Mites suck the sap from leaves which causes a fine, white to gray stippling (very fine dots), and they can complete a generation in as little as 10-14 days during the summer.

Fig. 1. Twospotted spider mite adults and eggs.

PLANT INJURY

The hot, dry summer conditions of Utah promote spider mite populations that can cause 'mite burn', a golden bronzing, typically seen on the lower leaves first (Fig. 2). Mites begin feeding on ground vegetation in the spring, and then climb into the raspberry plants as the ground cover dries out and the mite numbers increase. Raspberry leaves are highly sensitive to mite feeding. Mites cause damage to raspberry through reduced photosynthesis that leads to reduced cane vigor and berry yield, and weakened primocanes that are predisposed to winter injury.

Fig. 2. 'Mite burn' on lower raspberry leaves.

MONITORING

It is important to scout for mite and predator populations during the season to determine if chemical control is necessary, and if so, to optimally time treatments. Sampling should begin when mites first climb into canes and visual feeding injury (white to gray stippling on leaves) is observed. Effective methods include shaking lower canes and leaves (where mites show up first) over a light-colored sheet or tray. Look for 'moving specks'. Use a hand lens (10-30× magnification) (Fig. 3) to observe mites and natural enemies (see Biological Control section). Scout for early leaf bronzing on lower canes.

utahpests.usu.edu

Twospotted Spider Mite (TSSM)

Main pest mite in Utah caneberries

TSSM populations can quickly increase if predator mites are not sufficiently abundant to suppress them

Multiple applications of Pyganic for Spotted Wing Drosophila (Dr. Rufus Issacs, Michigan State University) killed predator mites causing an outbreak of TSSM (left photo)

Spider Mites: How Do They Make a Living?

Twospotted Spider Mite, *Tetranychus urticae*

- Prefer undersides of leaves
- Form colonies, webbing: eggs, nymphs & adults
- Very small (1/10 inch length)
- Overwinter as dormant females (orange color) at base of canes & on weeds/ground cover
- 10-14 day life cycle in summer
- Suck plant sap: fine, gray stippling on leaves

Spider Mites: Caneberry Symptoms

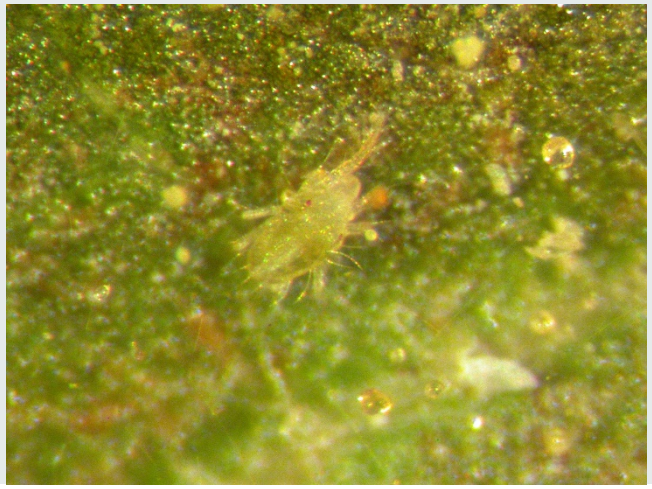
"Mite Burn"

- Hot, dry conditions promote mites
- "Mite burn": yellow, brown bronzing, begins on lower leaves first
- Mites move up from (broadleaf) weeds on the ground
- Raspberry leaves are highly sensitive to mite feeding
- Fruiting canes: reduces vigor & berry yield
- Primocanes: weakens, predisposes to winter injury

Mite Sampling

Use 10-30 x magnification hand lens to closely observe mites & natural enemies

Look for small spherical translucent eggs & slow-moving immatures (below) or adults with two dark spots (right), and early leaf bronzing (above)



Shake leaves over light-colored sheet or tray; look for 'moving specks'

Western predatory mites eating spider mites & mite eggs – predators move quickly

TSSM Thresholds

(Rufus Issacs, Michigan State University: Managing mites in raspberry & blackberry)

- 'Predator Mite Rule':
  - If Predator to Pest Mite Ratio is 1:10 or higher, predators should keep spider mites in check
- Treat if TSSM present on 50% of leaves or more, and predator mites are below the 1:10 ratio
- Above threshold (and with too few predators), severe leaf bronzing can develop & spread

Spider Mite Management: Cultural Control

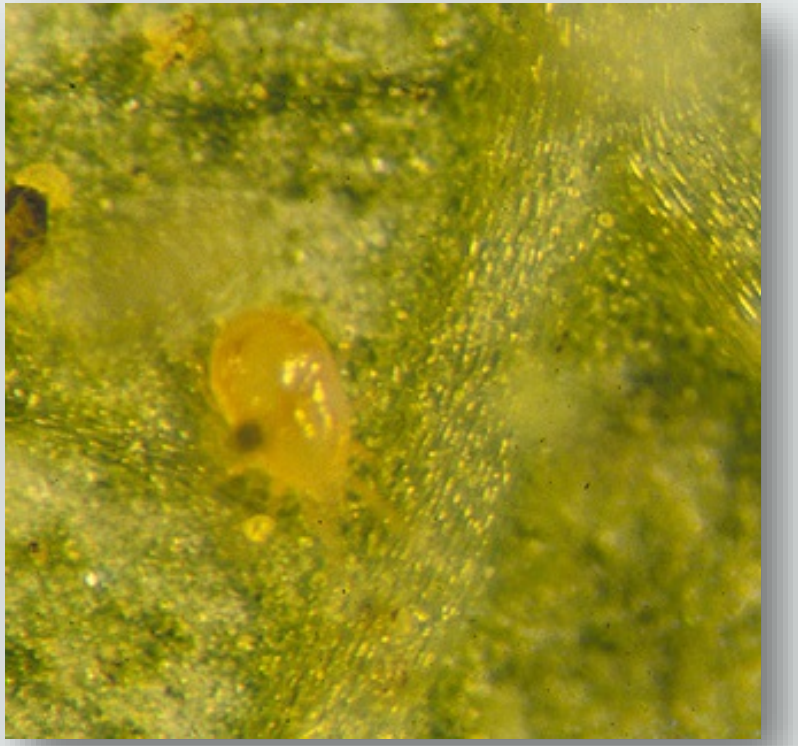
- Plant vegetation in alleyways (grass)
  - Minimize broadleaf weeds
    - field bindweed, common mallow, knotweed
  - However, a low level of broadleaf weeds/ground cover can provide habitat for predator mites
- Overhead sprinklers (cool & wet)
- Avoid disturbing ground cover (avoid dust)
- Avoid plant stress – water!
- Macro-tunnels:
  - Good venting, temperature mgmt.
  - Avoid hot, dry conditions

Grass alleyways & overhead sprinklers

Spider mite-induced defoliation

Spider Mite Management: Biological Control

- Predator mite
  - *Galendromus* (*Typhlodromus*) *occidentalis*
  - western predatory mite
- Other predators:
  - thrips, pirate & big-eyed bugs, ladybeetles, lacewings
- Naturally occurring
  - Supplemental releases – predatory mite (strawberry)
    - Success in macro-tunnels & greenhouses
- Avoid insecticides & miticides toxic to beneficial insects & mites

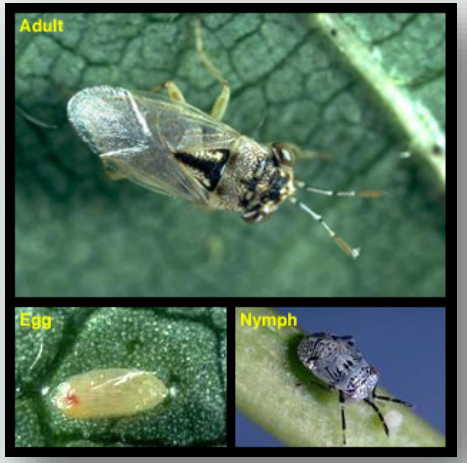


Western predatory mite, note tear-drop-shaped body

Common Natural Enemies of Mites

Western flower thrips (omnivore: pollen, flowers, prey)

Minute pirate bug: adult (left) & nymph (right)



Big-eyed bug

Lacewing larva

Mite destroyer lady beetle

Spider Mite Chemical Control

- Activity on immature & adult spider mites
  - Acramite
  - Vendex
  - Kanemite
  - Insecticidal soap* (M-Pede, Safer)
    - Potassium salts of fatty acids
  - Horticultural oil* (SunSpray, PureSpray)

- Activity primarily on eggs & immatures
  - Savey
    - Can be used when honey bees are active
    - Still avoid direct application to bees
      - Early morning or late evening application
  - Zeal
  - Insecticidal soap
  - Horticultural oil

Soap and oil: 0 day PHI
All miticides: 1 to 3 day PHI

*Intervene early; requires thorough coverage; avoid applications >80°F

Spider Mite Management: Chemical Control

Least Disruptive & Organic Miticides*

- insecticidal soap (M-Pede, others) – physical
- horticultural oil (JMS Stylet Oil, others) - physical
- azadirachtin / neem oil (Trilogy, others) – Unkn^
- cottonseed+clove+garlic oil (GC-Mite) – physical
- sulfur (do not use above 90°F or within 1 month of an oil spray)

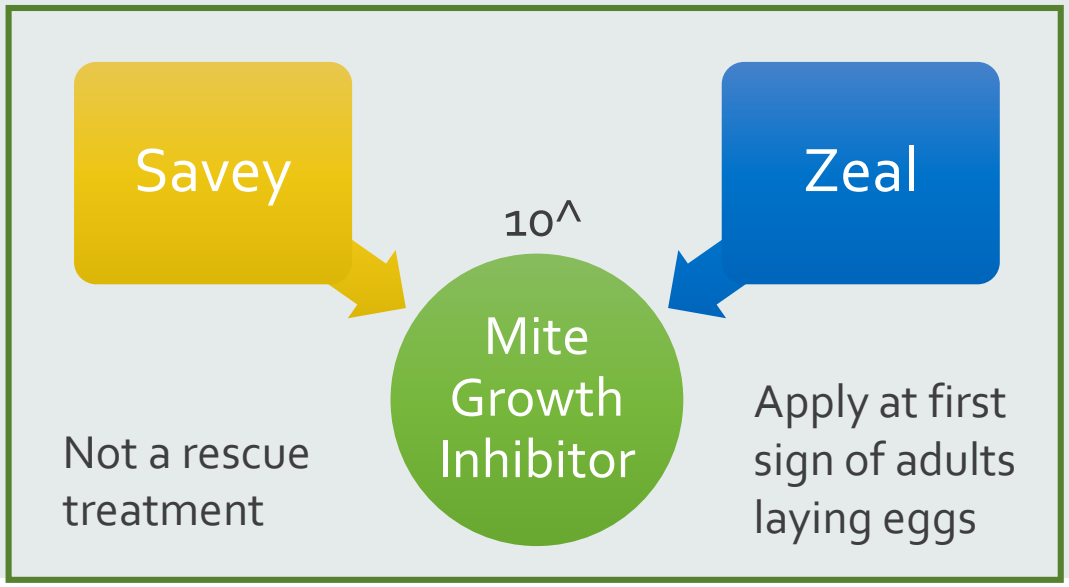
Commercial Miticides

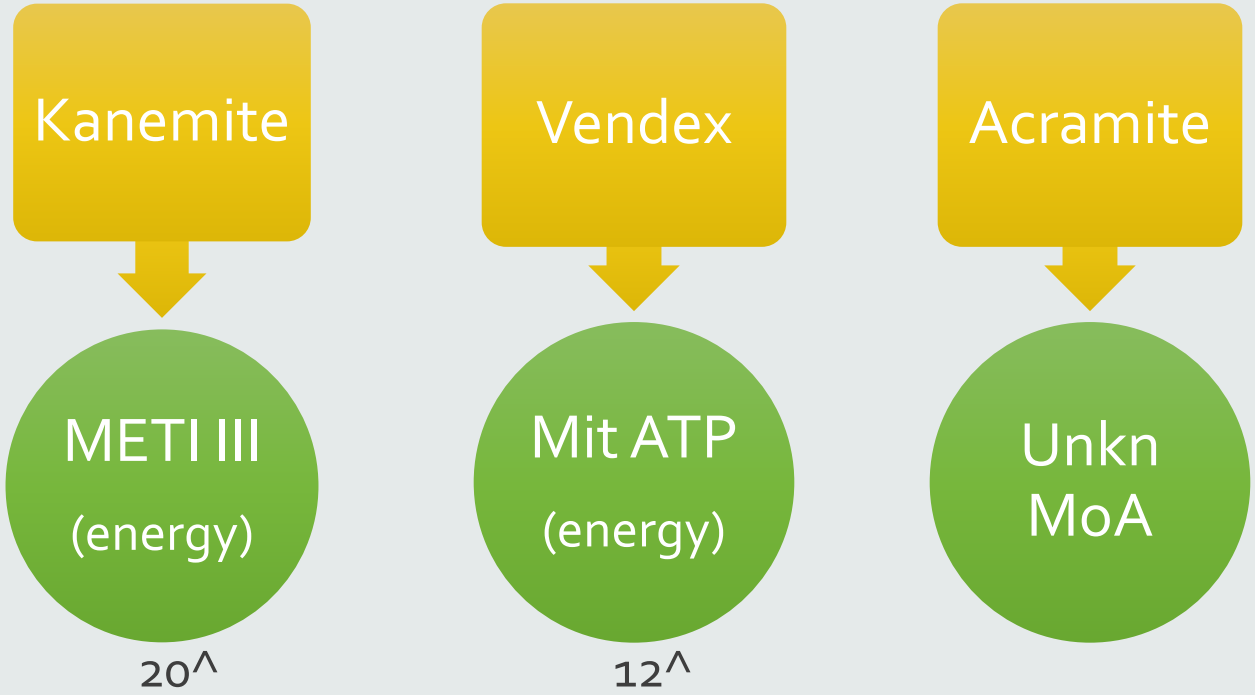
- etoxazole (Zeal) – 10B^
  - eggs, early nymphs; 1 day PHI
- hexythiazox (Savey) – 10A^
  - eggs, nymphs; 3 d PHI
- acequinocyl (Kanemite) – 20B^
  - adults, eggs, nymphs; 1 day PHI
- bifenazate (Acramite 50WS) – Unkn^
  - adults, eggs, nymphs; 1 day PHI
- fenbutatin-oxide (Vendex 50WP) – 12B^
  - adults, nymphs; 3 day PHI (raspberry only)

*Some formulations are OMRI-listed; ^IRAC MoA groups

Rotate Chemical Groups to Manage Resistance

- Rotate Modes of Action (MoA)
- Rotate MoA between mite generations (≥ 2 wk) & seasons
- Check label for # applications allowed per season





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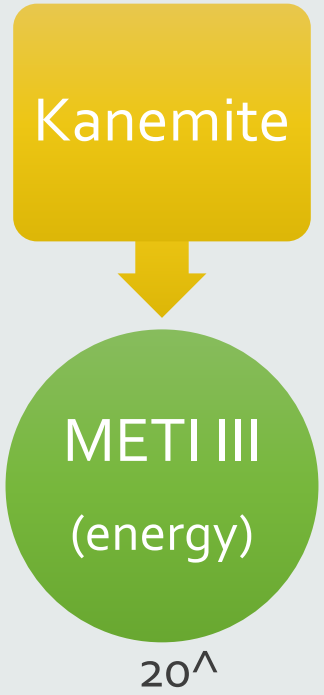

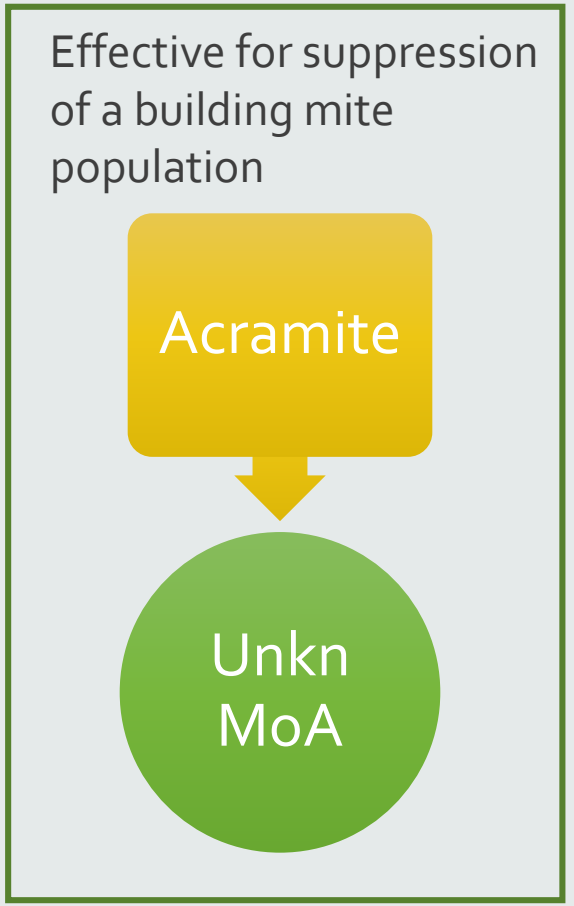

^IRAC MoA groups

Berry Spider Mite IPM

Scout leaves on lower canes for mite injury when temperatures rise

- Avoid plant stress
- Adequate water! Including ground cover
- Good plant nutrition
- Limit broad leaf ground cover vegetation
- Scout for early signs of mite feeding
- Intervene early:
  1. irrigate & cooling, prevent mite dispersal & dust
  2. apply less disruptive miticide early in mite population increase
     e.g., horticultural oil or Savey
  3. Apply stronger miticide, if needed
     e.g., Acramite
- Observe Pre-Harvest Intervals

Utah Pests Fact Sheets: utahpests.usu.edu

UTAH PESTS fact sheet — EXTENSION — UtahStateUniversity

Published by Utah State University Extension and Utah Plant Pest Diagnostic Laboratory — ENT-179-15 — December 2015

Raspberry Crown Borer
[Pennisetia marginata]

Diane Alston, Entomologist

Quick Facts

- The raspberry crown borer attacks raspberry plants in northern Utah, causing cane-wilt and death.
- Crown borer has a 2-year life cycle; it spends much of it as a grub (larva) tunneling in the lower cane, crown and roots of raspberry plants.
- To prevent infestation, use only clean planting stock, don't transplant canes between fields, and maintain healthy, non-stressed plants.
- Once a raspberry planting is infested with crown borer: 1) dig and destroy infested crowns and roots, and 2) apply an insecticide as a heavy drench/soak to the lower cane and crown for at least 2 consecutive years in mid-October to target first year larvae, and in the spring before bud break to target overwintered larvae before they tunnel deeply into crowns.

The raspberry crown borer is a st… winged moth (Lepidoptera: Ses… yellow jacket wasp (Fig. 1). It is na… and was first reported from New Er… mid-1800s. Today, it is a common … of raspberry in northern Utah. Alth… cludes all brambles in the genus Ru… cause damage to raspberry in Uta… lower cane, crown, and upper roo… entire canes to wilt and break off … Raspberry crown borer infestations … but populations build up slowly ov… ing vigor and yield of plantings by … 1962). In a recent survey of raspbe… ern Utah, crown borer was found i… plant infestation levels were low, … unpublished data).

HOST PLA…

Raspberry (red and black) is the p… Utah; however, all *Rubus* spp. are … ing blackberry, loganberry, boyse… and salmonberry.

Fig. 1. Adult female raspberry crown borer. Black and yellow bands on the body mimic a paper wasp to ward off predators. Females have smooth antennae[1].

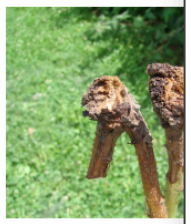

Fig. 2. Raspberry plant crowns dar… crown borer larval tunneling. Note … and sawdust-like frass from larva[2].

UTAH PESTS fact sheet — COOPERA…

Published by Utah State University Extension and Utah Plant Pest Diagnostic Laboratory — ENT-132-09 — S…

Raspberry Horntail
(Hartigia cressonii)

Diane Alston, Entomologist • Brent Black, Fruit Specialist • Marion Murray, IPM Project Leader

Do You Know?

- The raspberry horntail is a caneboring wasp that can cause crop loss to raspberries in northern Utah.
- Apply insecticides in the spring targeting adults, to prevent egg-laying in the new canes.
- Infested canes often become evident during summer when tips wilt and die back.
- Frequent pruning of infested cane tips during summer can lower horntail populations in a field.
- Several species of parasitic wasps attack horntail larvae within canes and can provide biological control.

The most injurious insects to caneberries are those that bore within the canes resulting in cane dieback, reduced fruit yields, and even cane death. The most common of the borers attacking caneberries in northern Utah is the raspberry horntail [*Hartigia cressonii* (Kirby)], a type of wasp (Hymenoptera: Cephidae). It was first documented in Utah in the 1980s, and is known to occur in other western states. Horntails spend the winter as mature larvae in the previous year's canes, pupate in the early spring, and emerge as adults to mate and lay eggs in primocanes (first year canes) just after cane growth begins. Early-season egg-laying and protection of the eggs and larvae within canes create challenges for horntail management and potential for high infestation levels in raspberry fields. Recent research to evaluate the susceptibility of raspberry varieties and observations of high parasitism levels of horntail larvae in some fields, provide new insights into raspberry horntail management.

HOST PLANTS

raspberry, other brambles, rose

LIFE HISTORY

There appears to be only one generation per year in northern Utah. Egg-laying extends from early spring to early summer, so larvae of all sizes can be found in canes during the summer.

Fig. 1. The raspberry horntail larva bears a spir… tail end[1]

Fig. 2. Raspberry horntail adult[2]

Mature Larva – Overwintering St…

- **Size, shape, and color:** cylindrical, white b… 1 inch (25 mm) long; hardened, brown he… spine on the tail end (Fig. 1).
- **When and where:** spends the winter in a silk-lined cavity in the lower cane.

Pupa

- **Size and color:** tan and about ¾ inch (18 mm) long.
- **When and where:** pupation occurs within the cane in the early spring.

UTAH PESTS fact sheet — EXTENSION — UtahStateUniversity

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Rose Stem Girdler
[Agrilus cuprescens]

Diane Alston, Entomologist

Quick Facts

- Rose stem girdler is a common cane-boring beetle of raspberry and blackberry in central and northern Utah.
- Larval feeding in the cambium under the cane bark causes spiral grooves and gall-like swellings; injured canes may wilt and break off.
- Severe infestations in ever-bearing and first-year canes of vigorous summer-bearing cultivars can kill out plant stands.
- Avoid planting raspberries and blackberries near infested roses (wild and cultivated), prune and destroy infested canes, use proper fertility and water management to minimize stress to berry plantings, and apply insecticides during adult beetle activity in May and June.

The rose stem girdler is a small flat-headed, metallic beetle (*Coleoptera*) in the Family *Buprestidae* (Fig. 1). It was first introduced into the eastern U.S. from Europe in the early 1900s in infested roses. It was first reported in Utah in American Fork in 1955. Today, it is a common cane-boring pest of raspberry, blackberry, and wild rose in central and northern regions of the state. It has been observed in Rich, Cache, Box Elder, Weber, Davis, Salt Lake, Utah, Wasatch, and Sanpete counties. Larvae tunnel in the canes causing gall-like swellings and cane breakage (Fig. 2). The rose stem girdler can dramatically reduce stands of red raspberry canes, and even kill out a planting.

HOST PLANTS

Raspberry (red and black), blackberry, related brambles (*Rubus* spp.), and wild and cultivated roses (*Rosa* spp.) are host plants.

Fig. 1. The rose stem girdler adult is a small, r… per flatheaded beetle. Note the chewing i… of the raspberry leaf[1].

Fig. 2. A raspberry cane with damage from … a rose stem girdler larva. The cane broke a… site[2].

LIFE HISTORY

The rose stem girdler has a single generation… Utah. The winter is spent as a 4th instar (4th … within the pith of canes (Fig. 3). Pupation o… spring when daytime temperatures average … adult beetles emerge from infested canes i… Adults rest on plant foliage at night and bed… during mid-morning hours as temperatures …

UTAH PESTS fact sheet — EXTENSION — UtahStateUniversity

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Spider Mites in Raspberry

Diane Alston, Entomologist

Quick Facts

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Fig. 1. Twospotted spider mite adults and eggs.

PLANT INJURY

The hot, dry summer conditions of Utah promote spider mite populations that can cause 'mite burn', a golden bronzing, typically seen on the lower leaves first (Fig. 2). Mites begin feeding on ground vegetation in the spring, and then climb into the raspberry plants as the ground cover dries out and the mite numbers increase. Raspberry leaves are highly sensitive to mite feeding. Mites cause damage to raspberry through reduced photosynthesis that leads to reduced cane vigor and berry yield, and weakened primocanes that are predisposed to winter injury.

Fig. 2. 'Mite burn' on lower raspberry leaves.

MONITORING

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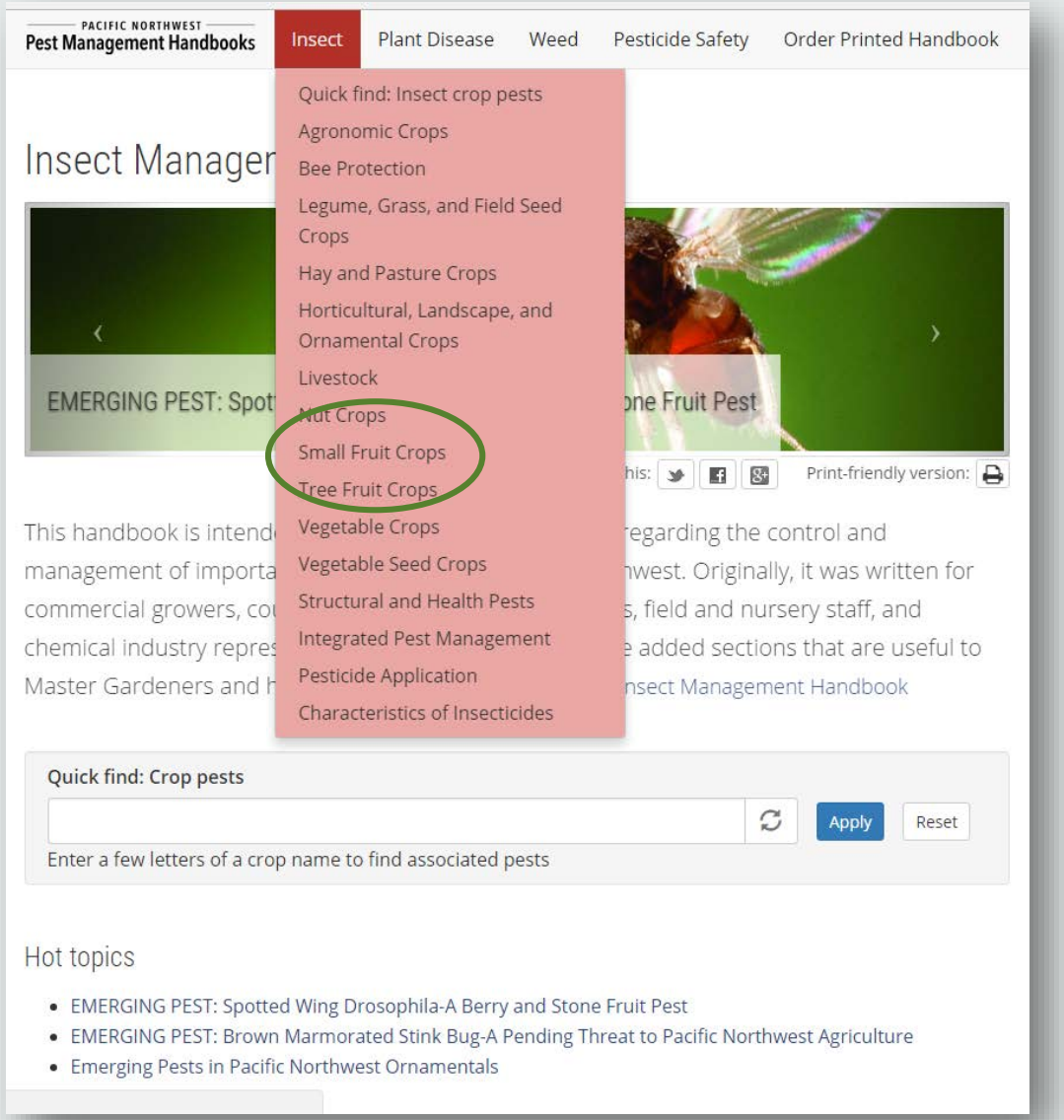
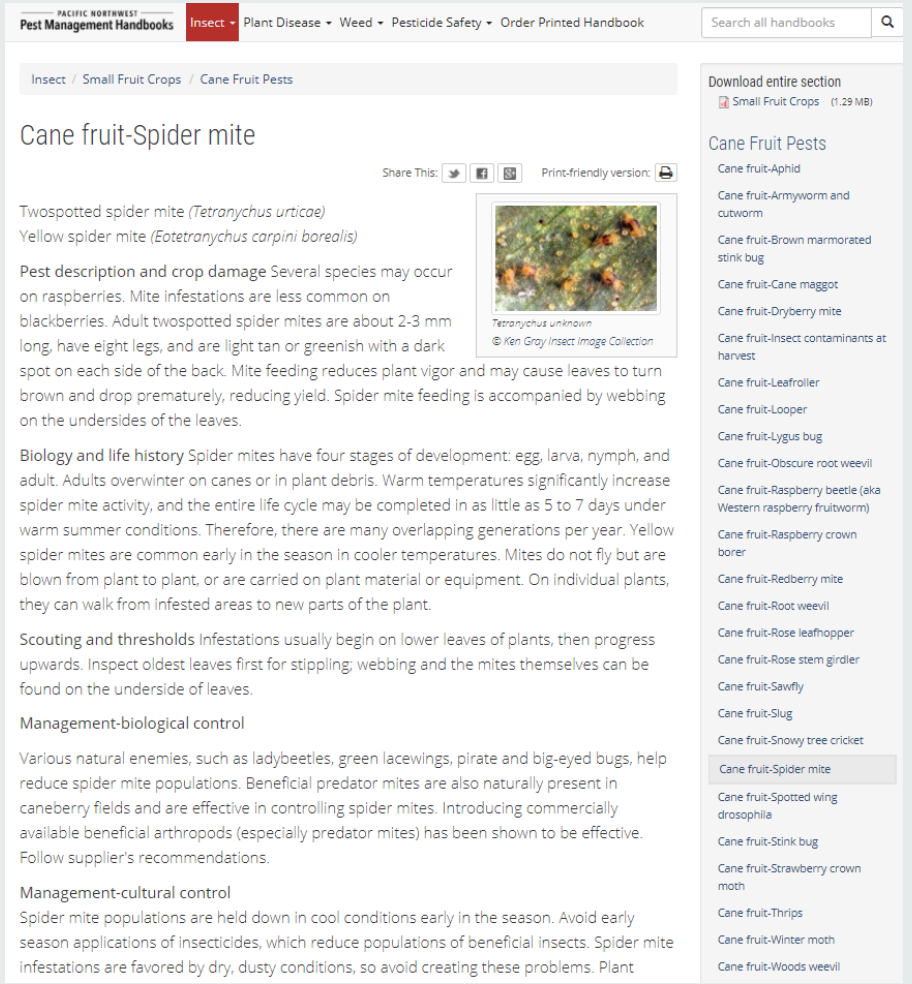
Pacific Northwest Insect Management Handbook

pnwhandbooks.org/insect






Questions?

Status of the Invasive Brown Marmorated Stink Bug and Spotted Wing Drosophila in Utah

Brown marmorated stink bug and spotted wing drosophila are two newly introduced pests that can destroy fruit and vegetable crops in Utah. Learn about their distribution and how to monitor for them.

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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Brown Marmorated Stink Bug *and* Spotted Wing Drosophila

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

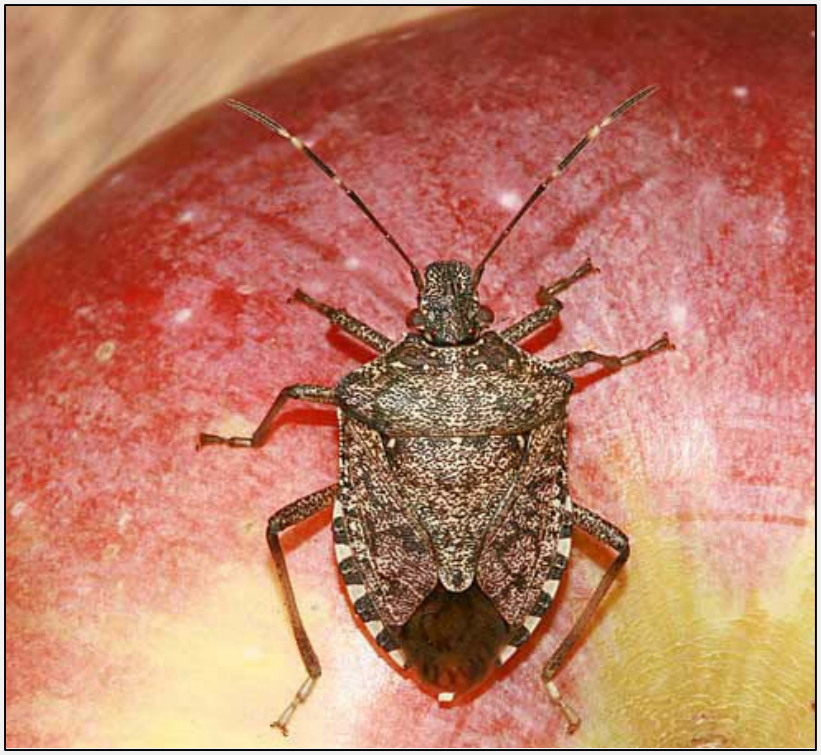
Utah State University - Biology

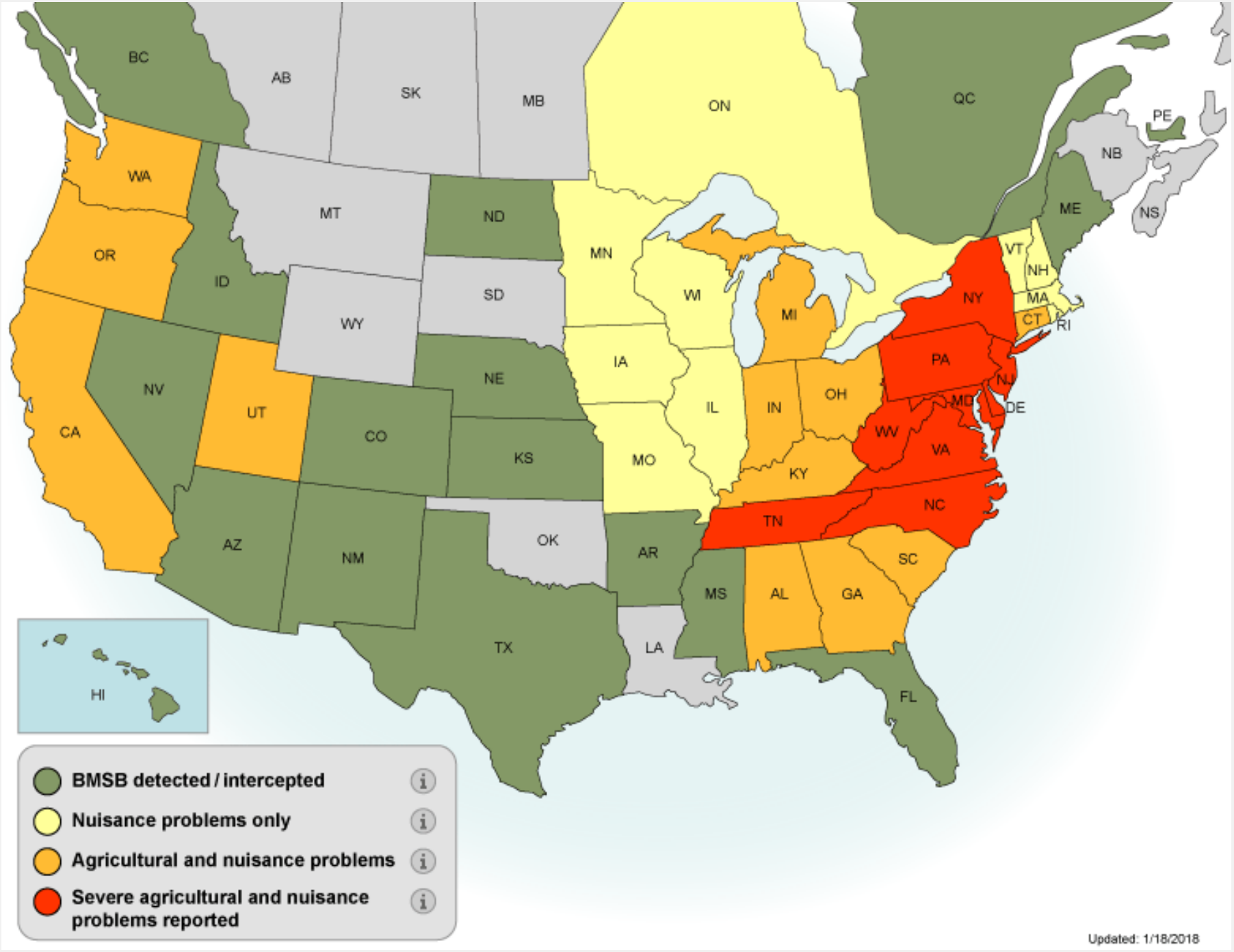
Urban and Small Farms Conference

February 23, 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

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NC
VA
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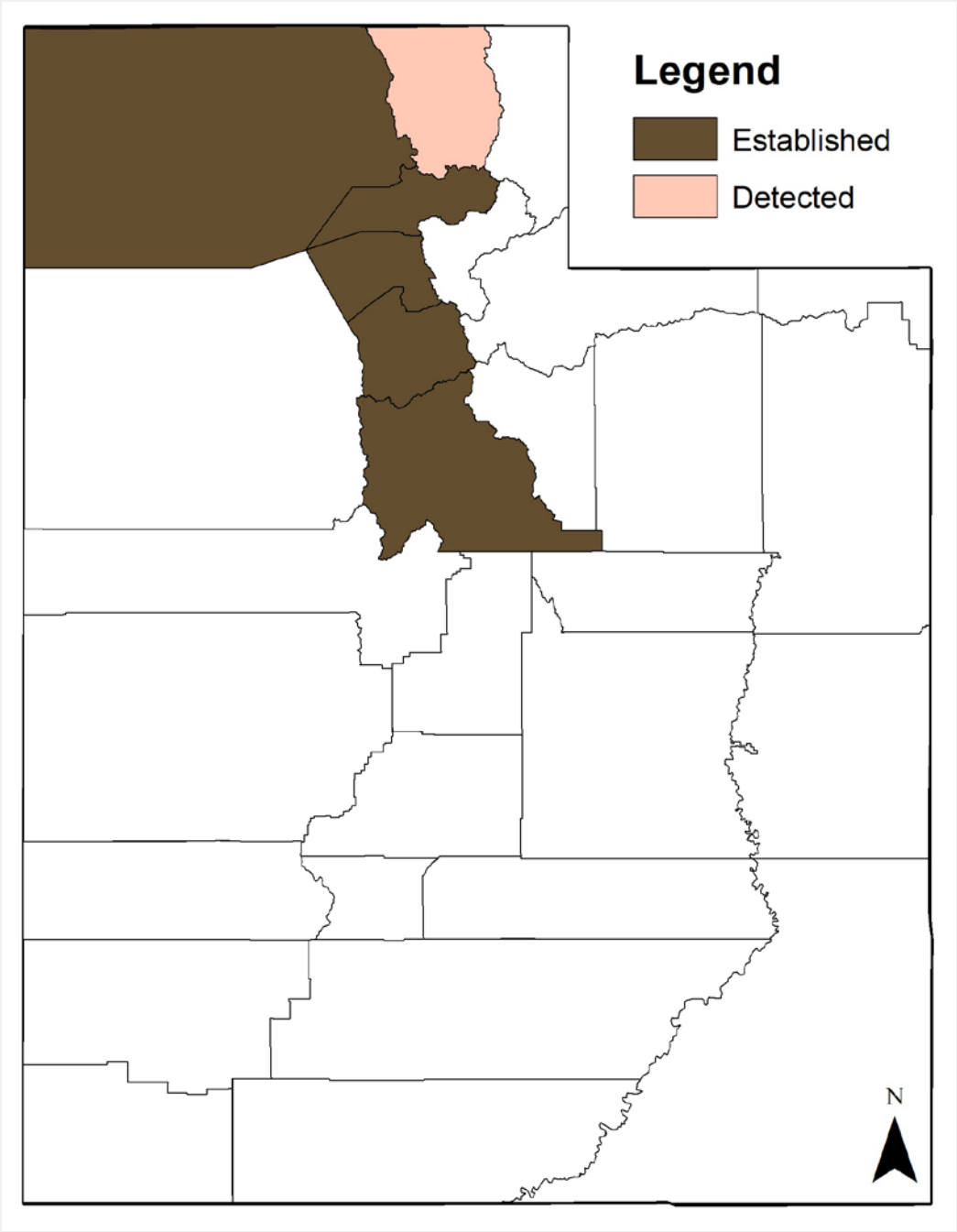
BMSB detected / intercepted
Nuisance problems only
Agricultural and nuisance problems
Severe agricultural and nuisance problems reported
Updated: 1/18/2018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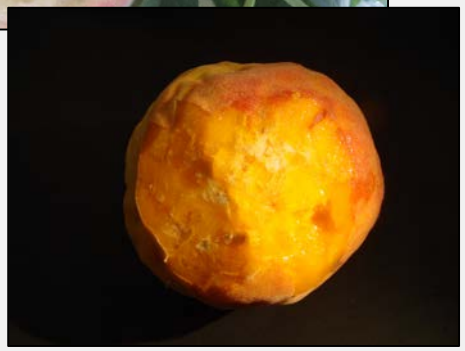
CROP DAMAGE (1ST CONFIRMATION)

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 (BSMB) 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.

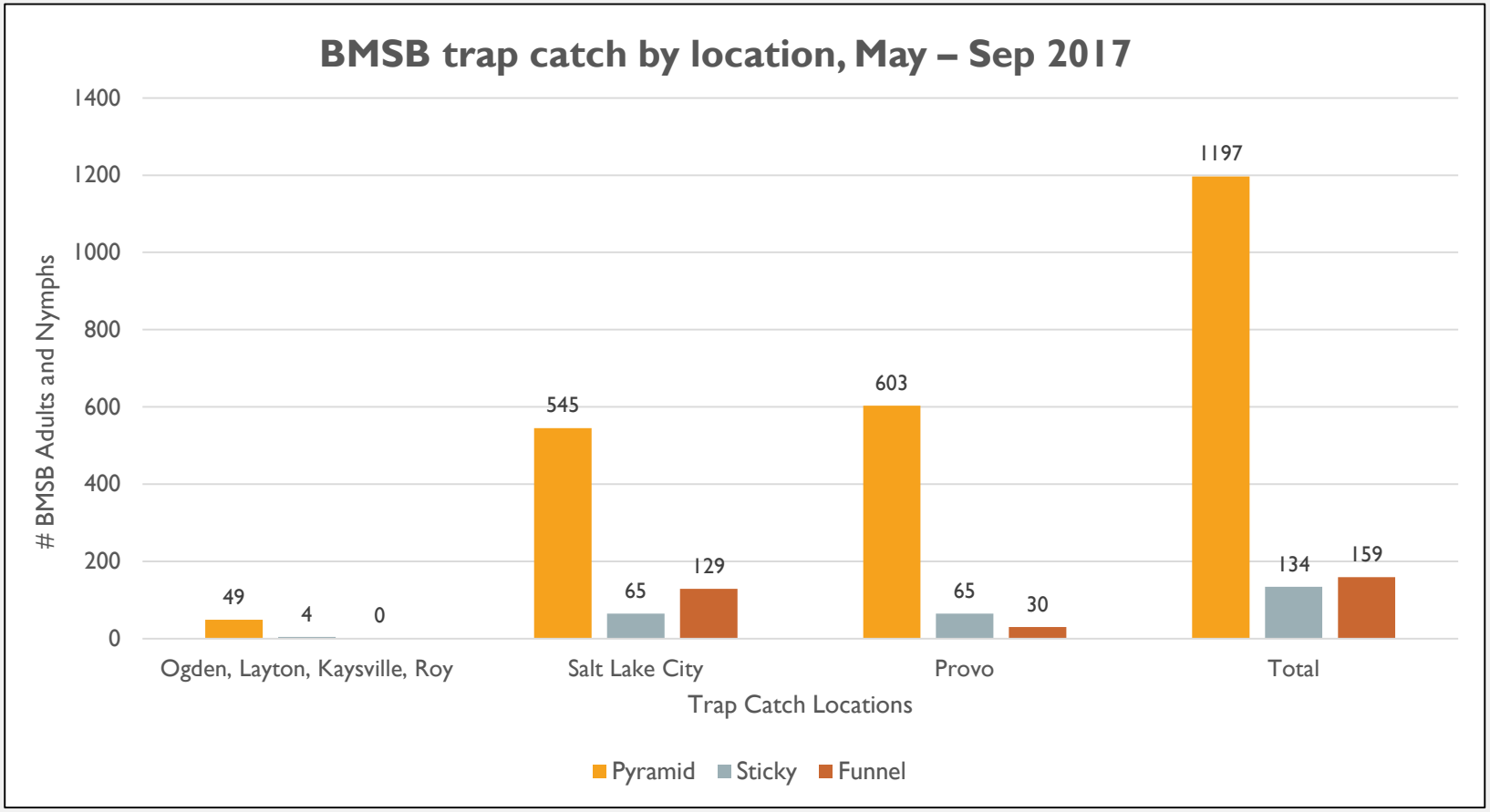
BMSB MONITORING

- 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?

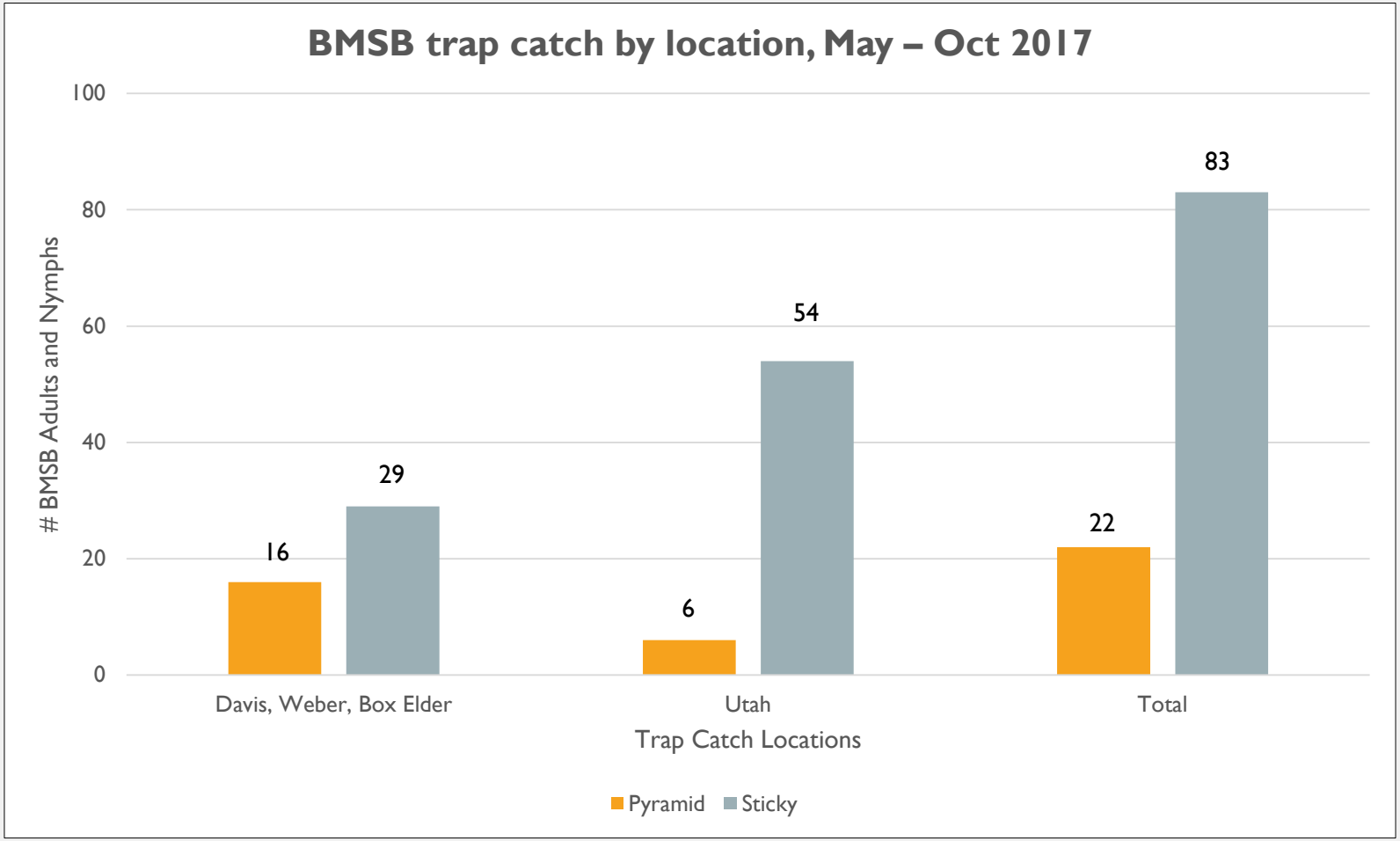
TRAP EFFICIENCY

Residential Ornamental Sites

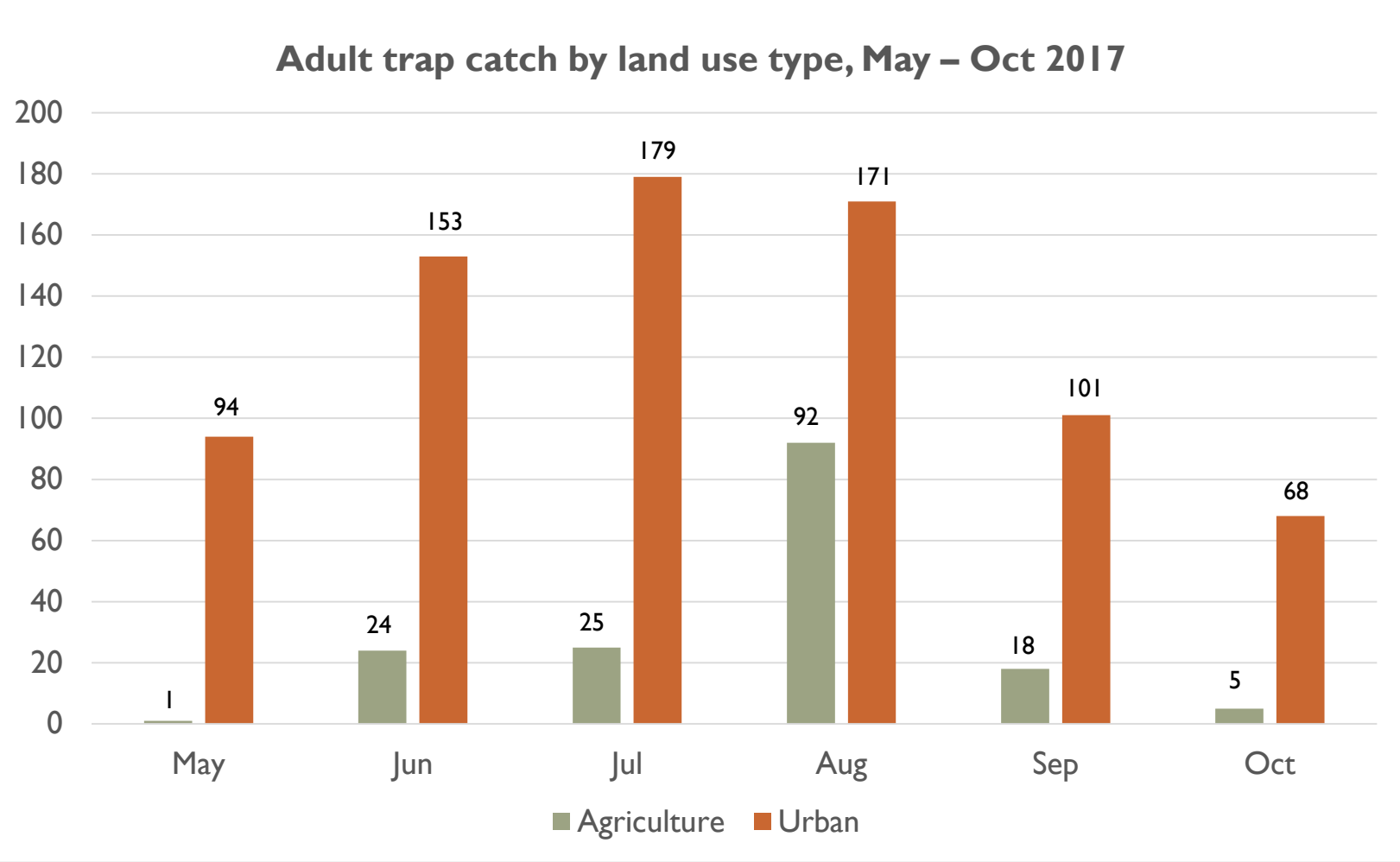


TRAP EFFICIENCY

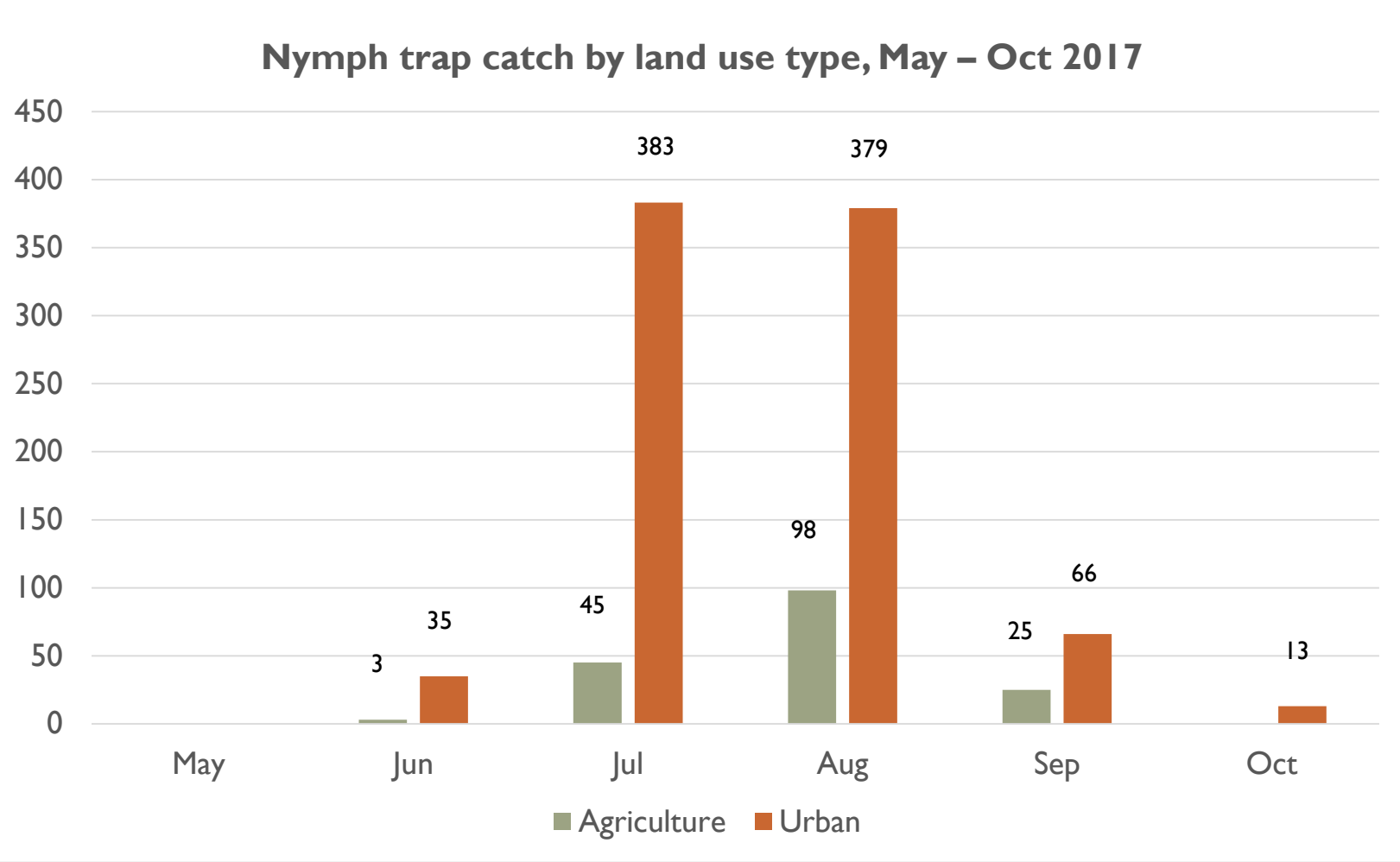
Commercial Orchard Sites



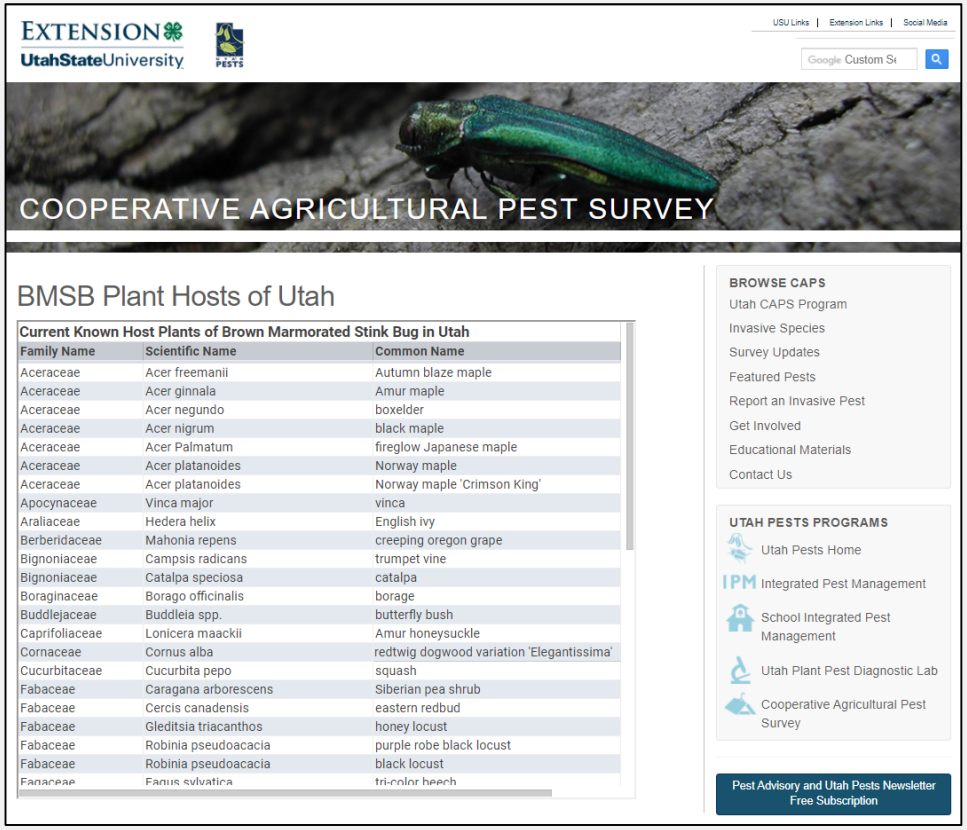
PHENOLOGY


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

GOOD FRUIT GROWER

Meet the stinkbug's worst nightmare

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

Anastatus mirabilis

Trissolcus sp.

T. euschisti

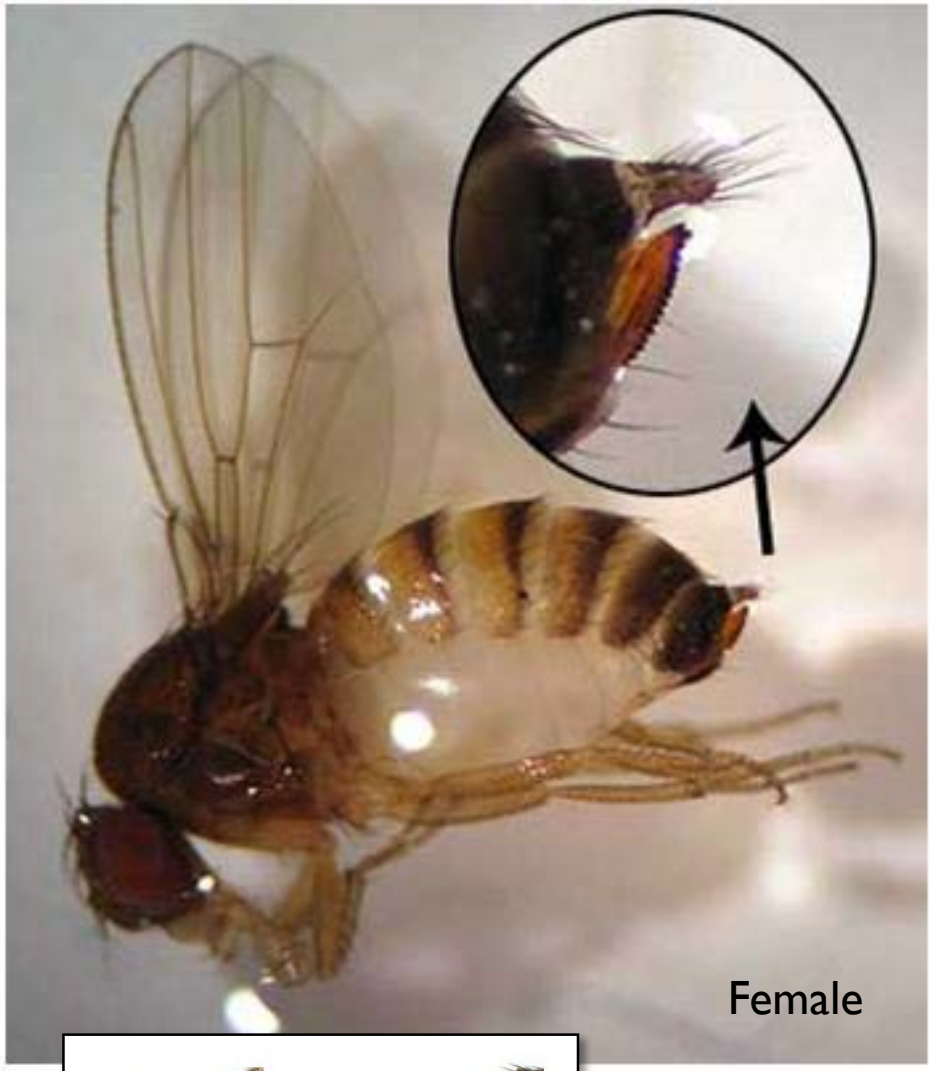
T. erugatus

Telenomus sp.

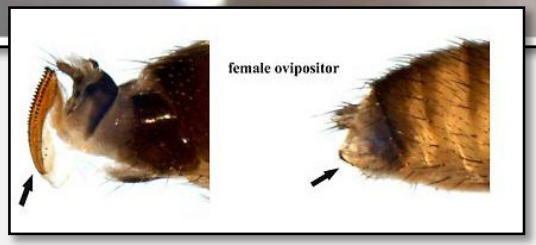
T. utahensis

SPOTTED WING DROSOPHILA

- Native to southeast Asia
- SWD infests ripening and ripe fruit
- Detected in the U.S (CA) in 2008
- First detected in Utah in 2010
  - Utah, Davis, Weber, Box Elder, Cache, Rich Counties
  - Commercial orchards, backyard gardens, wild habitats
  - No confirmed reports of damage


Female


Male

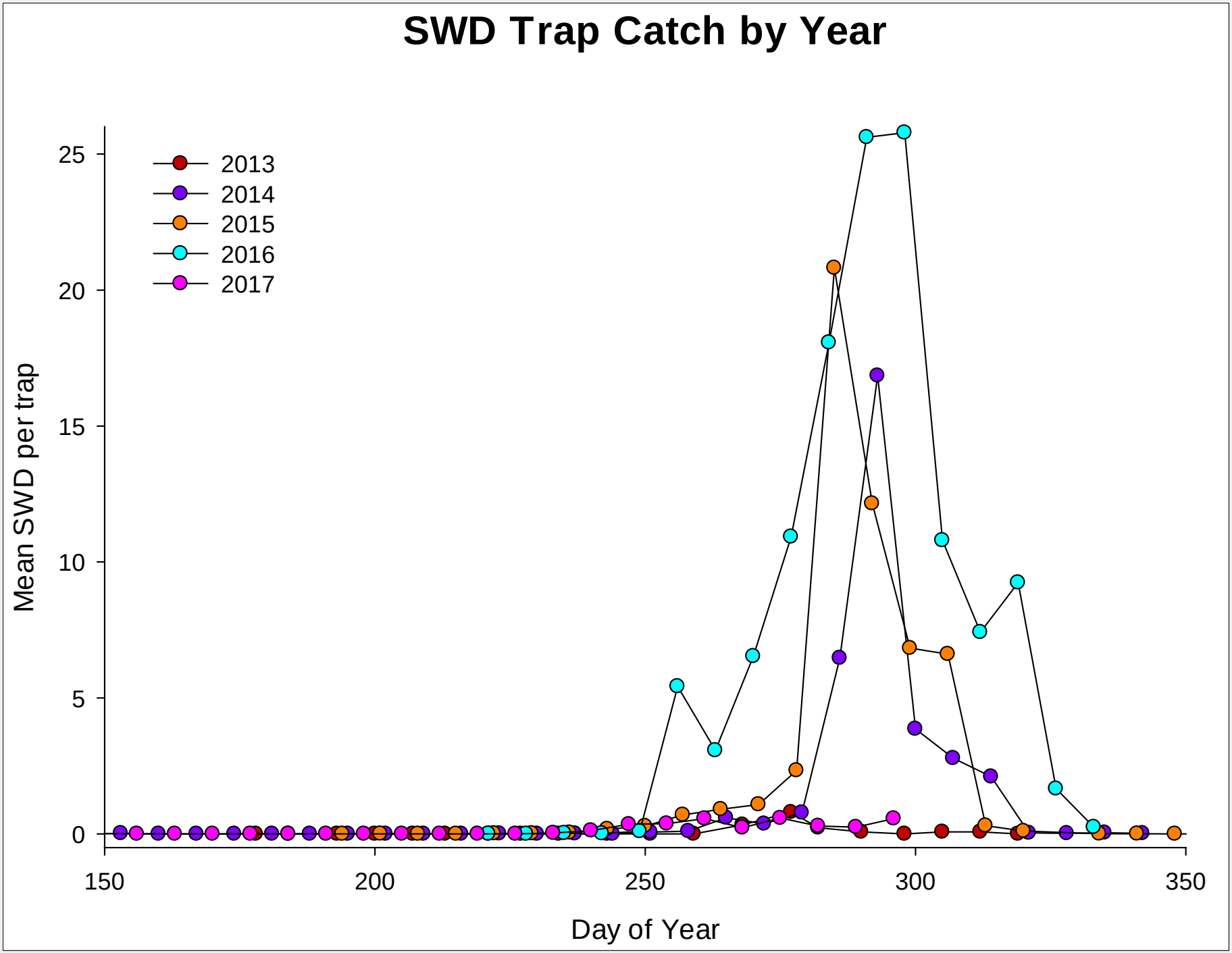

female ovipositor

SWD MONITORING

- Begin monitoring before fruit ripens
- Place traps in cool, shaded areas of the orchard
- Check traps frequently
- Confirm suspected SWD
- Replace bait weekly

Adults are first detected in traps in late summer or early fall

Year	First trap catch
2010	Aug 18
2011	Sep 8
2012	Sep 17
2013	Sep 25
2014	Jun 2 / Aug 12
2015	Jul 20
2016	Aug 8
2017	May 29 / Aug 21


SWD Trap Catch by Year
2013
2014
2015
2016
2017
Mean SWD per trap
0
5
10
15
20
25
150
200
250
300
350
Day of Year

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

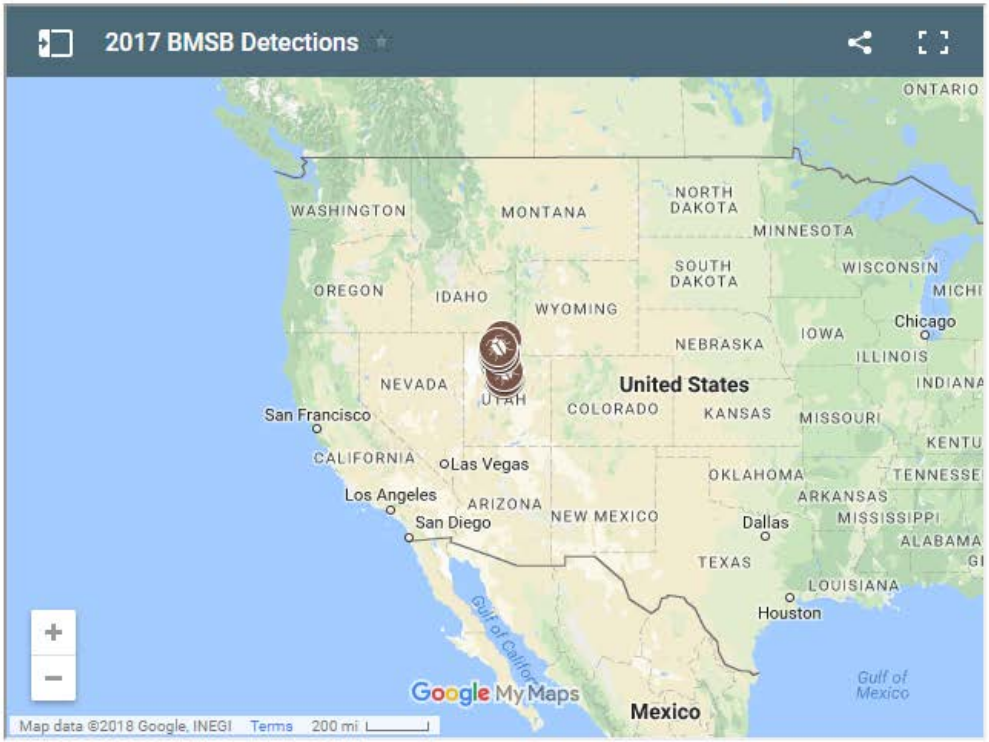
Pest Advisory and Utah Pests Newsletter Free Subscription

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

- Utah CAPS Program
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Acknowledgments

Participating Growers

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- 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

ATV Small Acreage Mist Sprayer

Demonstration of a small acreage sprayer that we purchased in the spring of 2017 to spray a small demonstration orchard (90 trees). This sprayer could also be used on urban and small farms to spray vegetable crops for insect control.

Mike Pace

Extension Agent

USU Extension

Mike.Pace@usu.edu

Mike developed a 1.5 acre demonstration orchard and vineyard at the Utah State University Botanical Center (USU BC) in Kaysville, UT that has heirloom and modern apple varieties, peaches, rootstock demonstrations, grapes and misc. fruits. The site contains early, mid and late season grape varieties in red, green and blue colored grapes. A majority of the grapes at the demonstration site are table grapes (30 varieties). In 2017 he purchase a small mist sprayer that can be towed behind an ATV to spray the orchard to provide insect control. In his spare time, he enjoys teaching fruit tree grafting classes along the Wasatch Front.

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Weed Management

This talk will address basic weed management principles and practices. Management strategies and limitations in berry production will be discussed.

Corey Ransom

Associate Professor and Extension Weed Specialist

Utah State University

corey.ransom@usu.edu

Dr. Corey Ransom is an Associate Professor and Extension Weed Specialist in the Department of Plants, Soils, and Climate at Utah State University in Logan. He has conducted research in a variety of crops and in wild land settings. Current projects include the development of effective control strategies for invasive plants and landscape scale approaches to weed management as well as weed management in agronomic crops. Corey was raised in Pocatello, Idaho and received degrees from Idaho State University, Utah State University, and Michigan State University.

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Developing Effective Organic Soil Fertility Plans

JENNIFER REEVE

UTAH STATE UNIVERSITY, DEPT. PLANT SOILS AND CLIMATE

Overview

- What is organic nutrient management?
- How do we promote soil health and fertility?
- Preparing the soil for organic production
- Types of Organic Inputs
- Estimating nitrogen mineralization

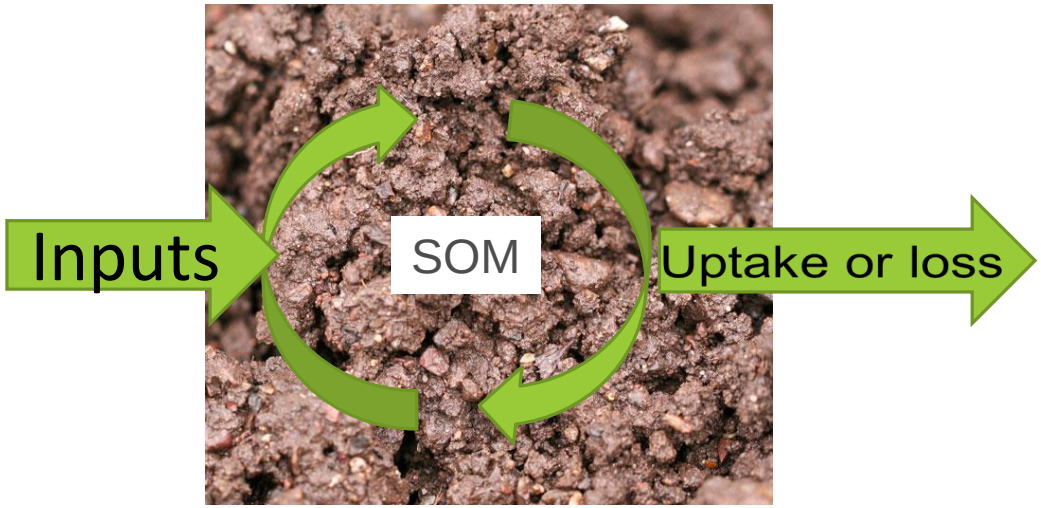
High quality fruit is associated with proper nutrient management

- Deficiency inhibits plant growth processes and uptake of other essential nutrients
- Excess nutrients can interfere with uptake of other essential elements
  - High rates of N limit Ca uptake and reduce apple quality
  - High soil P, K and Na interfere with uptake of Ca, Mg, Fe and Zn

http://cmf-mm.meistermedia.net/32789/Liebigs-Law-of-the-Minimum.jpg?width=400&height=400

What is organic orchard nutrient management?

As simple as translating conventional fertilizer recommendations?



Soil Test Report
and
Fertilizer Recommendations

USU Analytical Labs
Utah State University
Logan, Utah 84322-4830
(435) 797-2217
(435) 797-2117 (FAX)

Date Received: 5/12/98
Date Completed: 5/12/98

Name: Homeowner
Address:

County:

Lab Number: 98011000
Identification:
Crop to be Grown: Garden

Grower's Comments:

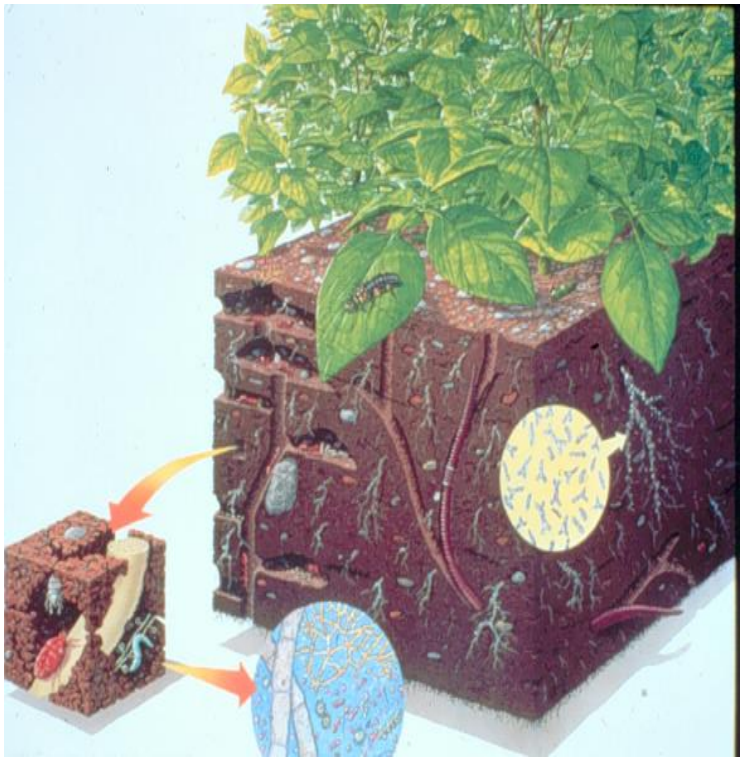
Acres in Field:

Soil Test Results			Interpretations	Recommendations
Texture		Sandy Loam		
Lime		++	Normal	
pH		7.7	Normal	
Salinity - ECe	mmhos/cm	0.4	Normal	
Phosphorus - P	ppm	11	Low	1-2 lbs P2O5/1000 sq ft
Potassium - K	ppm	82	Low	2 lbs K2O/1000 sq ft
Nitrate-Nitrogen - N	ppm	1.5		2-4 lbs N/1000 sq ft
Zinc - Zn	ppm	1.2	Adequate	0 oz Zinc/1000 sq ft
Iron - Fe	ppm	7.9	Adequate	
Copper - Cu	ppm	0.4	Adequate	
Manganese - Mn	ppm	1.8	Adequate	
Sulfate-Sulfur - S	ppm	13.0	Adequate	0 lbs Sulfur/1000 sq ft
SAR				
Organic Matter	%	3.2		

Notes

What is organic orchard nutrient management?

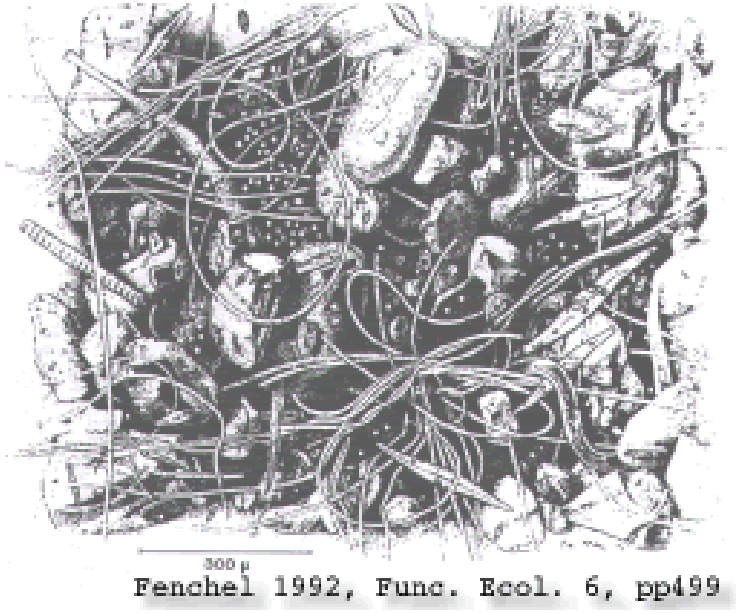
- Select practices that promote soil health and fertility:
- Increase soil organic matter, microorganisms and soil nutrient cycling
- Improve soil structure



What is organic orchard nutrient management?

Microorganisms catalyst for nutrient cycling

- Convert nutrients in organic matter to usable form for plants
- ’glue’ holding soil particles together



Fenchel 1992, Func. Ecol. 6, pp499

How do we promote soil health and fertility?

Mineralization

Immobilization

- Moisture and temperature
- Soil texture
- Soil organic matter content
- C:N ratio of the of inputs
- Input diversity

How do we promote soil health and fertility?

Long-term soil building

- combination of compost and N fixing cover crops

Short-term nutrient supply

- added expensive readily soluble organic amendments?

The Best Time to Transition from Conventional to Organic?

At least 1 yr before planting

Pre-Plant Cover Crops

- Annual Rye or winter wheat good for weed suppression
  - Can plant directly into mowed rye once it is flowering
- Mustards suppress nematodes
- Leguminous plants fix atmospheric N

Soil Fertility

- Soil test and pre-prepare soil
  - Incorporate compost
  - Correct any deficiencies
- Maintain with surface applied compost + feather meal
- Or use fish emulsion or compost tea through drip system
- Mow and blow cover crop system
- Raspberry nitrogen requirements
  - Summer bearing 40-80lb available N
  - Fall bearing 70-100lb available N

Cascadian Farm, Washington

Mow and Blow Cover Crop System

Alleyway planted cover crops

- Leguminous plants fix atmospheric N
- build soil organic matter
- roots less dense than perennial grass

Lotus corniculatus

Orchard Floor Management

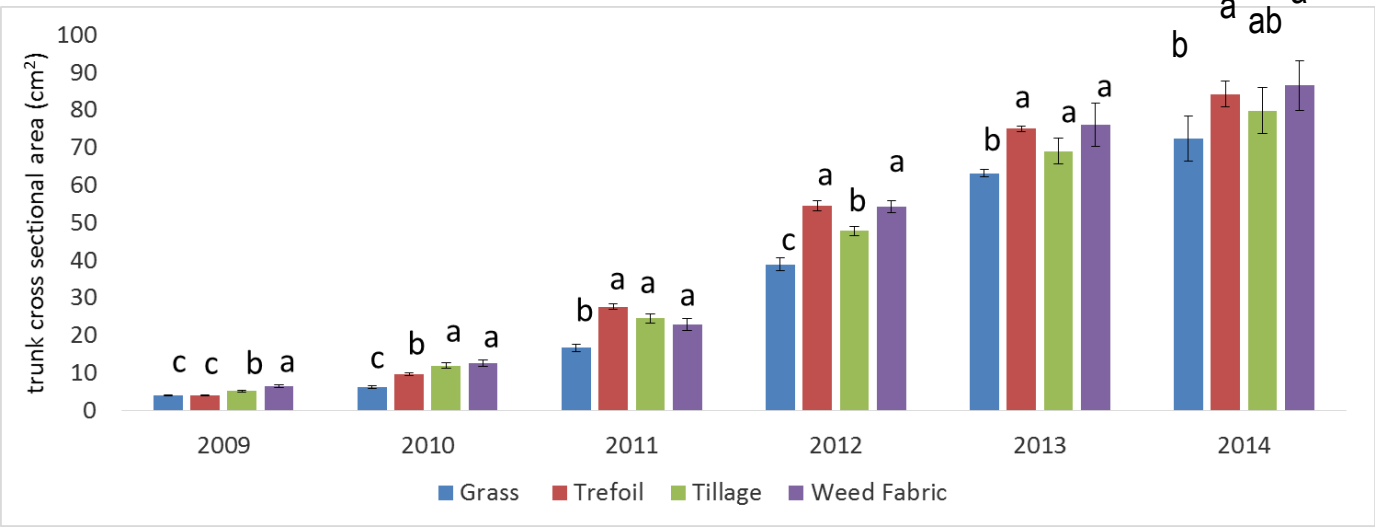
Peach orchards planted 2008 and 2009

Organic orchard		Conventional orchard	
In-row	Alley	In-row	Fertility
Straw mulch	Grass	Bare-ground	NPK
Straw mulch	Legume	Bare-ground	Compost
Living mulch	Grass	Paper	NPK
Living mulch	Legume	Paper	Compost
Tillage	Grass	Transition	
Weed Fabric	Grass		

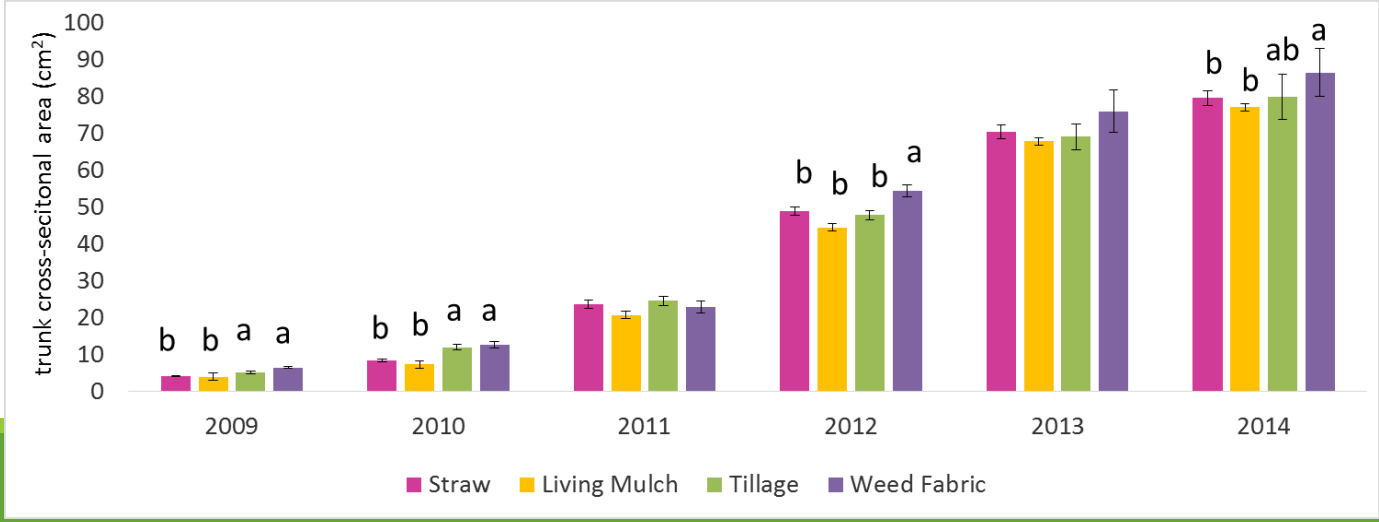
Reeve et al. 2017. Scientia Horticulturae. 214:242-251.

Organic Orchard: Tree growth

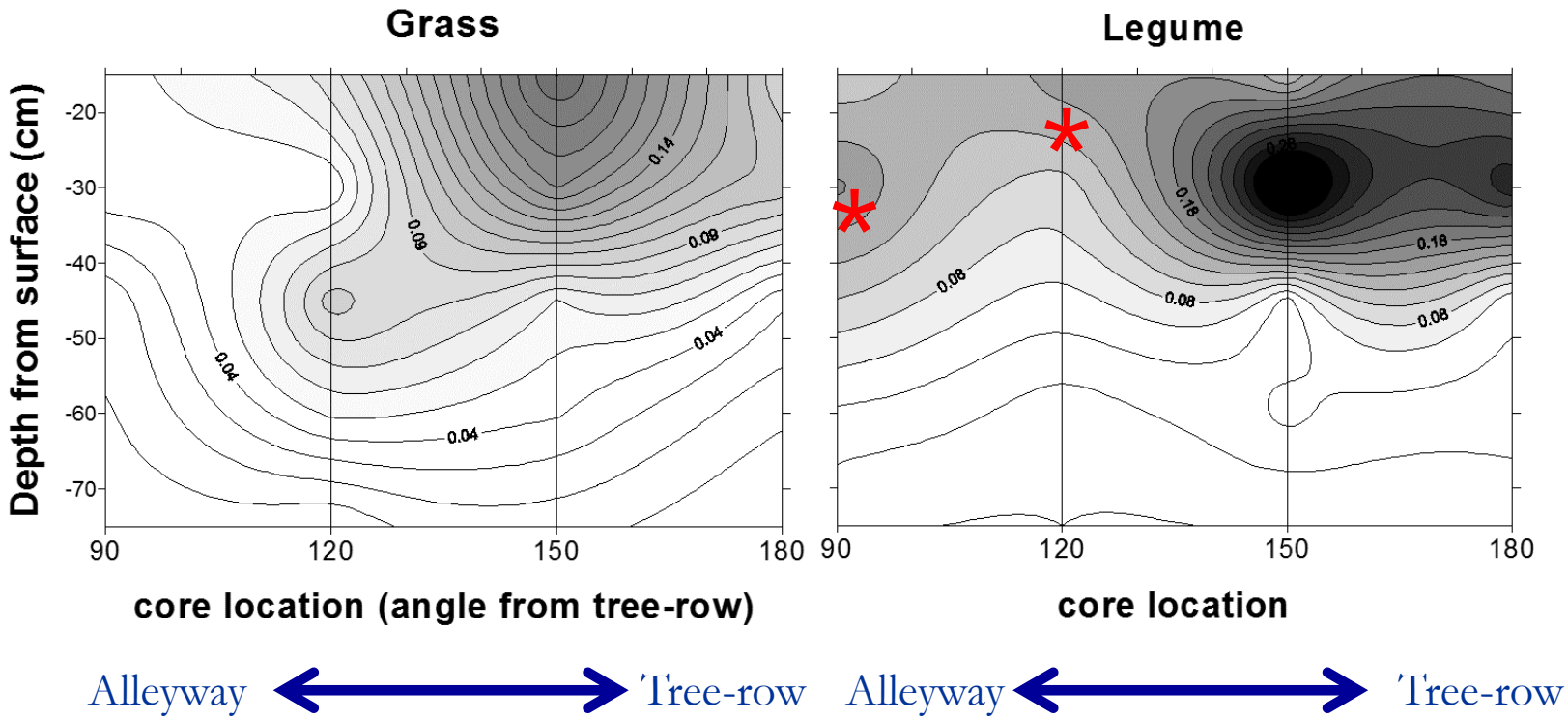
Alleyway



Tree-row



Organic Orchard: Tree Roots (g cm ^{3})



Organic amendment	% N	C/N	$ / lb N	release rate	N-P-K
fresh dairy manure	0.5	18	**$0.72**	medium	0.5-.1-.5
Fresh cage layer manure	1.5	7	**$0.50**	rapid	1.5-1-0.5
Poultry manure compost	4	15	**$3.13**	slow	3-4-3
Finished compost	1.2	17	**$1.04**	slow	1-1-1
Legume hay	2.5	16	**$**	medium	
Grass hay	1.2	32	**$**	medium	
Alfalfa meal	2.7	15	**$6.44**	medium	3-0.5-3
Soybean meal	6	7	**$2.62**	medium	6-1-2
Blood meal	13	3	**$4.41**	medium	13-2-0
Cottonseed meal	6	7	**$6.13**	slow	6-2-2
Crab meal	5	4	**$6.28**	meal	5-2-0.5
Fish meal	9	4	**$6.42**	rapid	9-3-0
Feathermeal	13	4	**$4.84**	very slow	13-0-0
Chilean nitrate	16		**$1.56**	rapid	16-0-0
Pro-Gro	5	3	**$3.40**	medium	5-3-4
Pro-Gro Booster	10	2	**$1.87**	medium	10-0-0

Compost

Compost most commonly used organic amendment

- Cheap on a per unit nitrogen basis
- Slow nutrient turnover
- Weed seeds and pathogens reduced

% Available N generally low and difficult to estimate (~25%)

Look for compost with high total N (1.5-2.5%) and low C:N ratio ~ 15

The higher the C:N ratio the lower the available N

Compost with a C:N ratio above 18 will likely immobilize N in short term

Calculating compost inputs

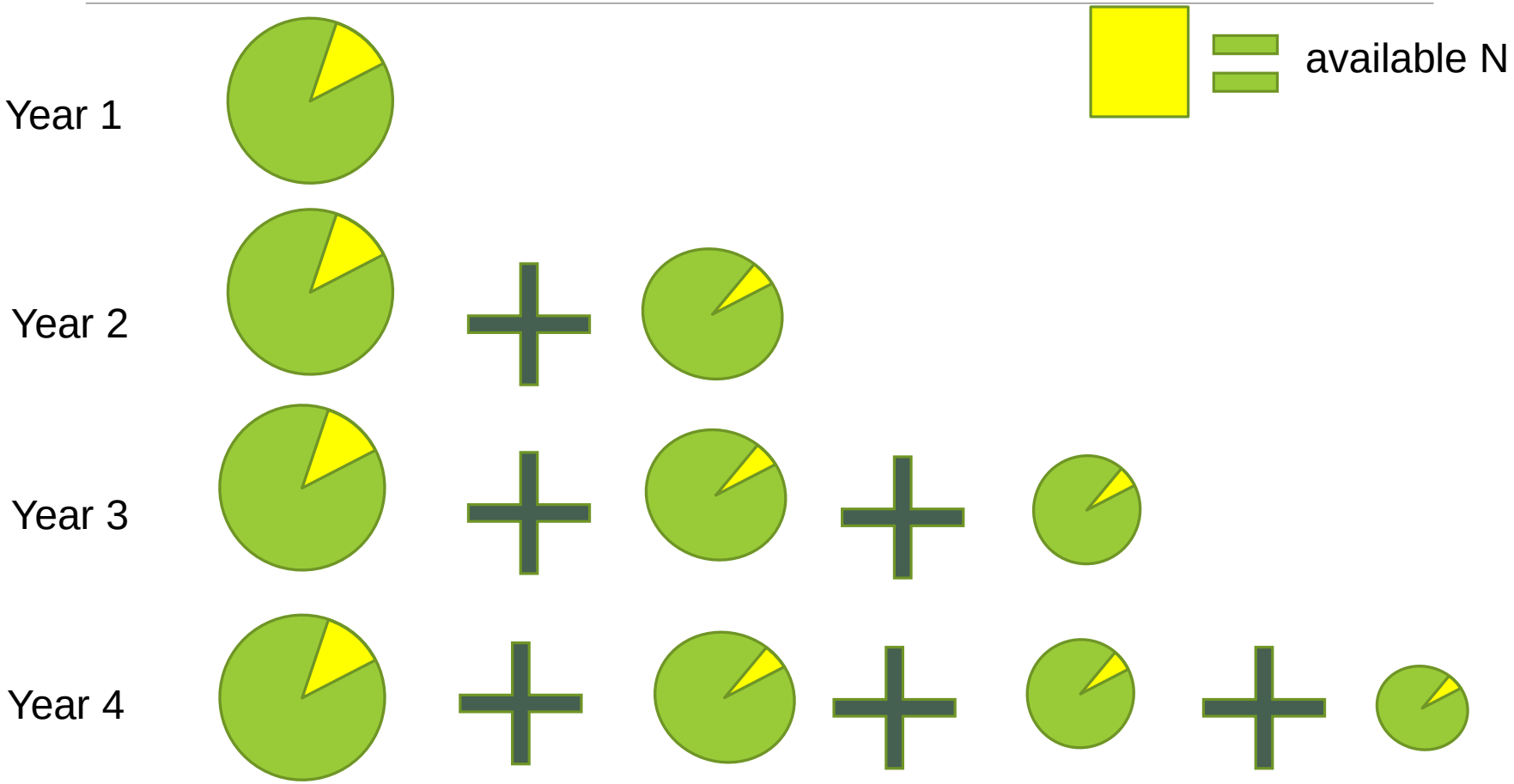
$$(0.25\ acres)\left(\frac{200\ lbs\ total\ N}{acre}\right)\left(\frac{100\ lbs\ DM}{1.6\ lbs\ N}\right)\left(\frac{100\ lbs\ wet\ compost}{45\ lbs\ DM}\right)\left(\frac{cu.yd.}{850\ lbs}\right) = 8.2\ cu.yd.wet\ compost$$

Total N is not all available in first season!

Multiply end result by estimated N mineralization i.e. 25%

DM = Dry Matter. Compost analysis will be on a dry weight basis but is Applied as is.

Cumulative Available N from Organic Amendments



Decrease inputs over time – soil building phase – maintenance phase.

Orchard Fertility Management: Phosphorus

N based calculations do not account for phosphorus (P) levels applied

Target N:P ratio is about 5:1 for most crops

- calculations based on N 5x too much P!

Excess P can inhibit fruit tree uptake Fe, Zn

Potential loss from runoff and leaching

http://img.ehowcdn.com/article-new/ds-photo/getty/article/34/20/78051541_XS.jpg

Resource for comparison

http://smallfarms.oregonstate.edu/calculator

the reduced-input orchard (Table 1)

Home

Organic Fertilizer and Cover Crop Calculator

This free online tool compares the nutrient value and cost of cover crops, organic and synthetic fertilizers and compost. Use this Excel Calculator to develop well balanced and cost effective nutrient management programs for your farm. Developed by Nick Andrews, Dan Sullivan, Jim Julian and Kristin Pool.

Download the Calculator

- Quick Guide & Records Sheet - the quick guide illustrates the main steps used to use the calculator, the records sheet identifies all the information needed to use the calculator.

Estimating % available nitrogen

ENTER FERTILIZER ANALYSES & SEE FERTILIZER, COMPOST AND C

Enter your information in yellow cells. Results are in green cells.

MATERIAL	FERTILIZER ANALYSIS (%) (ppn							
	Total % N from label ("as-is" basis; % of product)	Total % dry matter (% of product)	%PAN at 28 days (% of amendment total N, dry wt basis)	%PAN after full season (% of amendment total N, dry wt basis)	PAN at 28 days (lb N per 100lb amendment "as-is" basis)	PAN after full season (lb N per 100lb amendment "as-is" basis)	P_2O_5 (%)	K_2O (%)
ORGANIC FERTILIZERS								
Blood meal (12.5-1.5-0.6)	12.5	91	60	75	7.50	9.38	1.5	0.6
Bone meal (3-20-0.5)	3.0	95	17	32	0.52	0.97	20.0	0.5
Chicken manure - dried (3.5-2-2)	3.5	85	32	47	1.11	1.64	2.0	2.0
Feather meal (granulated) (13-0-0	13.0	97	60	75	7.80	9.75	0.0	0.0
Fish meal (10-6-2)	10.0	92	60	75	6.00	7.50	6.0	2.0
Meat and bone meal (7-8-0)	7.0	93	60	75	4.20	5.25	8.0	0.0
Muriate of potash (KCl) (0-0-60)	0.0	100	0	0	0.00	0.00	0.0	60.0
Soy meal (6.5-1.5-2.4)	6.5	90	60	75	3.90	4.88	1.5	2.4
Sulfate of potash (0-0-50)	0.0	99	0	0	0.00	0.00	0.0	50.0
Sulfate of potash magnesia (0-0-	0.0	99	0	0	0.00	0.00	0.0	22.0
			0	0	0.00	0.00		
			0	0	0.00	0.00		
SYNTHETIC FERTILIZERS								
Triple super phosphate (0-40-0)	0.0	N/A	100	100	0.00	0.00	40.0	0.0
Urea (46-0-0)	46.0	N/A	100	100	46.00	46.00	0.0	0.0

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Jennifer Reeve

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Chanjung Wang

Mari Lindstrom

Mark Womac

United States Department of Agriculture
National Institute of Food and Agriculture

Developing Effective Organic Soil Fertility Plans

Introduction to common soil fertility challenges in organic perennial systems and the options available to manage them.

Jennifer Reeve

Associate Professor of Organic and Sustainable Agriculture

Utah State University

jennifer.reeve@usu.edu

Jennifer Reeve is associate professor of Organic and Sustainable Agriculture in the department of Plants Soils and Climate at Utah State University (USU). Her current research focuses on nutrient management and soil health in organic and integrated tree fruit, vegetable, pasture and grain systems. She is also the faculty mentor for the USU Student Organic Farm, a student club that provides hands on learning, leadership, internship and volunteer opportunities to students in organic market gardening.
In 2012 she received an award for civically engaged scholar from the Utah Campus Compact for her work with the USU Student Organic Farm. Originally from England she earned a Bachelor of Science in Ecology from the University of Sheffield in 1995 followed by a MS in Soil Science from Washington State University in 2003 and a PhD in Soil Science from Washington State University in 2007.

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Conventional Soil Fertility Management Issues

Basic plant nutritional needs, nutrient cycling in soils, and nutrient supply and management using conventional mineral fertilizers will be covered.

Grant Cardon

Extension Soils Specialist

USU Plants, Soils and Climate Dept.

grant.cardon@usu.edu

A USU alum, Grant has had career stops with the USDA, Colorado State University, and now back at USU over his 28 years working in soil fertility, salinity and irrigation management. Grant, and his wife Kay Lyn are the parents of four married children, gracing them with 10 awesome grandchildren...and counting! Grant's interests outside of USU are sports, science fiction reading, gardening, music, and online news consumption.

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SELECTING AND USING INORGANIC FERTILIZERS

Rich Koenig, Extension Soil Specialist
Larry Rupp, Extension Horticulturist

Reviewed December 2011

INTRODUCTION

Homeowners recognize the need for timely fertilizer applications to enhance plant growth in landscapes and gardens. However, the number of different products on the market can be overwhelming. Nursery and garden supply stores commonly stock a dozen or more fertilizer products, each with a different concentration of plant nutrients. One fertilizer may be better for a specific situation than another, and different fertilizers need to be applied at different rates to supply the correct amount of plant nutrients.

Improper fertilizer application can contribute to surface and ground water pollution, may induce a plant nutrient deficiency or toxicity, or cause salt burn. Properly used, inorganic fertilizers are safe for plants and the environment. The purpose of this guide is to provide general selection and use information for inorganic fertilizers. See the related guide, *Selecting and Using Organic Fertilizers,* for similar information on organic products.

DETERMINING NUTRIENT NEEDS

Nutrient needs vary widely depending on soil conditions, previous fertilizer and organic matter additions, and the type of plants grown. The best way to determine which nutrients are needed and in what amounts is to test the soil. A comprehensive soil test (cost: $10.00 to $40.00 per sample) is recommended every two to three years for landscapes and gardens; more frequently if problems arise. See your Extension County Agent for instructions on how to collect soil samples and where to send them for analysis.

A soil test report will be accompanied by interpretations and nutrient recommendations (Figure 1). Nitrogen is the most common nutrient needed. Table 1 summarizes nitrogen recommendations for a variety of plants. Refer to your soil test report to determine if nitrogen is needed. Ornamentals such as trees and shrubs, as well as turf, will grow at slower rates if less nitrogen is used than the recommendations listed in Table 1. Slower growth rates may be desirable depending on the goal of the landscaper and the intensity of management. Vegetable nitrogen recommendations are designed to produce optimum yields in a garden setting.

Soil Test Report
and
Fertilizer Recommendations

USU Analytical Labs
Utah State University
Logan, Utah 84322-4830
(435) 797-2217
(435) 797-2117 (FAX)

Date Received: 5/12/98
Date Completed: 5/12/98

Name: Homeowner
Address:

County:

Lab Number: 98011000 Grower's Comments: Acres in Field:

Identification:

Crop to be Grown: Garden

Soil Test Results		Interpretations	Recommendations
Texture	Sandy Loam		
Lime	++	Normal	
pH	7.7	Normal	
Salinity - ECe mmhos/cm	0.4	Normal	
Phosphorus - P ppm	11	Low	1-2 lbs P2O5/1000 sq ft
Potassium - K ppm	82	Low	2 lbs K2O/1000 sq ft
Nitrate-Nitrogen - N ppm	1.5		2-4 lbs N/1000 sq ft
Zinc - Zn ppm	1.2	Adequate	0 oz Zinc/1000 sq ft
Iron - Fe ppm	7.9	Adequate	
Copper - Cu ppm	0.4	Adequate	
Manganese - Mn ppm	1.8	Adequate	
Sulfate-Sulfur - S ppm	13.0	Adequate	0 lbs Sulfur/1000 sq ft
SAR			
Organic Matter %	3.2		

Notes

Figure 1. Report from a comprehensive ($40.00) soil test with recommendations for a mixed vegetable garden.

SELECTING A FERTILIZER

The numbers on a fertilizer label refer to the concentration (percent) of three major nutrients in the material: nitrogen (or N), phosphate (or P_2O_5), and potash (or K_2O). For example, a 25-3-5 fertilizer (Figure 2) contains 25% nitrogen, 3% phosphate (P_2O_5), and 5% potash (K_2O). This means that 4 pounds of 25-3-5 would supply 1 pound of nitrogen (4 x 0.25), 0.12 pound of phosphate (4 x 0.03), and 0.2 pound of potash (4 x 0.05). Other common fertilizer formulations are listed in Table 2. Fertilizer labels have been standardized so that the concentrations of nitrogen, phosphate, and potash always appear in the same order on the front of the package. Other components such as iron, zinc, or sulfur may be specified elsewhere on the label.

The variety of fertilizers on the market means the homeowner can find a product to meet any need. Minimize the application of nutrients listed as adequate, high, or excessive on a soil test report. Further application of fertilizers containing these nutrients may create an imbalance and reduce plant growth. If a soil test report recommends only nitrogen, use ammonium nitrate (34-0-0), ammonium sulfate (21-0-0), or another fertilizer high in nitrogen (Table 2). If nitrogen and phosphorus are recommended, use a fertilizer such as 30-10-0. Assume for example that a soil test report recommends 2 pounds (lbs) of nitrogen and 1 pound of phosphate per 1000 square feet. Using the 20-27-5 formulation (Table 2) would result in the over-application of phosphate, while the 30-10-0 formulation (Table 2) would slightly under-apply phosphate. The gardener may decide to apply 20-27-5 for one year and build up soil phosphorus levels, then retest the soil and switch to a nitrogen-only fertilizer in subsequent years. Alternatively 34-0-0 or 21-0-0 could be applied to meet the nitrogen requirement and 0-45-0 to meet the phosphorus requirement.

Figure 2. Two common fertilizers sold in Utah.

Table 1. Annual nitrogen recommendations for landscape and garden plants.

Plants	General requirements	Recommendation
Ornamentals	Low: xeriscapes, natural areas	0 to 1 pound of nitrogen/1000 sq ft
	Intermediate: standard landscapes	1 to 2 pounds of nitrogen/1000 sq ft
	High: flower beds, new landscapes	2 to 4 pounds of nitrogen/1000 sq ft
Turf*	Low maintenance	0 to 1 pound of nitrogen/1000 sq ft
	Intermediate maintenance	2 to 3 pounds of nitrogen/1000 sq ft
	High maintenance	4 to 6 pounds of nitrogen/1000 sq ft
Vegetables**	Low: peas, beans	1 to 2 pounds of nitrogen/1000 sq ft
	Intermediate: asparagus, beet, carrot, melon, cauliflower, broccoli, brussels sprouts, celery, pepper, tomato, lettuce, radish, spinach, turnip, squash, pumpkins	2 to 3 pounds of nitrogen/1000 sq ft
	High: onion, sweet corn, potato	4 to 6 pounds of nitrogen/1000 sq ft

*Split the total amount of nitrogen into two or more separate applications made over the growing season. To prevent burning do not apply more than 1 ½ pounds of nitrogen/1000 sq feet in a single application.

**For high nitrogen requirement vegetables, apply the intermediate recommendation before planting, then broadcast or band additional nitrogen after plants are well established (see text under fertilizer application methods).

Table 2. Common fertilizers found in Utah landscape, garden, and farm supply stores.

	Name	Fertilizer label (Nitrogen-Phosphate-Potash)
Single nutrient fertilizers	Ammonium nitrate	34-0-0
	Ammonium sulfate	21-0-0
	Urea	46-0-0
	Triple superphosphate	0-45-0
	Potassium chloride	0-0-60
Multi-nutrient fertilizers	Ammonium phosphate	11-52-0 or 18-46-0
	Turf fertilizer	30-10-0
	Lawn fertilizer	29-3-4
	Lawn food	25-3-5
	Turf builder	32-3-2
	Starter fertilizer	20-27-5
	Winterizer	22-4-14
	Balanced fertilizer	16-16-16
Special purpose fertilizers	Vegetable food	12-12-12
	Rose food	20-10-5
	Acidic fertilizer	30-10-10

Fertilizers vary considerably in price. The cost of different fertilizers should be compared on a per pound of nutrient basis. Cost per pound depends on the package price, weight, and nutrient concentration in the fertilizer. For example, if a 36 lb bag of 29-3-4 cost $15.88 and a 20 lb bag of 21-0-0 cost $2.99, which is the least expensive source of nitrogen? The cost per pound of nitrogen is $1.52 for the 29-3-4 and $0.71 for the 21-0-0. More expensive fertilizers often contain pesticides for weed or insect control, and may have added micronutrients or slow release characteristics. Compare prices among products and purchase fertilizers with special additives only if they are needed. Most fertilizers containing herbicides are meant to be used on turf and will stress ornamental trees and shrubs, and kill most vegetables and flowers. Read and follow label instructions carefully when using fertilizers containing pesticides.

FERTILIZER RATE CALCULATIONS

Nutrient recommendations for gardens and landscapes are expressed in pounds per 1000 square feet (Figure 1; Table 1). Calculate the amount of fertilizer needed by using the soil test nutrient recommendation, the concentration of nutrients in the fertilizer selected, and the size of the area fertilized. Garden and landscape areas are usually different than 1000 square feet. Estimate the size of the area to be fertilized by pacing or using a measuring tape to determine the length and width. Multiply the length by the width to calculate area. A simple formula used to calculate the amount of fertilizer required to meet a nutrient recommendation is:

$$\textit{Fertilizer needed} = \frac{\textit{X lbs of nutrient}}{\textit{1000 sq. feet}} \times \frac{\textit{1 lb fertilizer}}{\textit{Y lb nutrient}} \times \textit{Z sq. feet area}$$

where ***X*** is the nutrient recommendation from a soil test report in lbs/1000 sq ft, ***Y*** is the percent of the nutrient in the fertilizer *divided by 100*, and ***Z*** is the square footage of the area to be fertilized.

Example: A gardener is using ammonium nitrate (34-0-0) fertilizer to supply 2 pounds of nitrogen per 1000 square feet. The garden area is 1400 square feet. How much 34-0-0 fertilizer is required in this situation? *Answer:* In the above equation, ***X*** is 2 pounds, ***Y*** is 0.34 (34% divided by 100), and ***Z*** is 1400 square feet. Entering these numbers into the equation above gives an answer of 8.2 pounds of 34-0-0 fertilizer for the garden. ***A helpful conversion for fertilizers is 1 pint volume equals approximately 1 pound of dry fertilizer.***

The amount of fertilizer calculated in the above example may not seem like much when spread over a large area (see Figure 3). Consider, however, that a high yielding crop of silage corn may require 200 pounds of nitrogen per acre, which is approximately 4 ½ pounds of nitrogen per 1000 square feet (similar to the sweet corn nitrogen recommendation in Table 1). To facilitate ease of use and keep transportation costs low, inorganic fertilizers are manufactured as highly concentrated sources of nutrients. This means that applicators need to accurately calculate and apply fertilizers at the appropriate rates to supply the correct amount of plant nutrients without damaging plants or causing adverse environmental effects.

FERTILIZER APPLICATION METHODS

Fertilizers may be broadcast on the surface then tilled or watered into soil, or banded on or beneath the soil surface (Figure 3) . Broadcasting is efficient and often the method of choice in areas with perennial plants. Two main types of broadcast applicators are available: the rotary spreader and the drop spreader (Figure 4). Drop spreaders can uniformly apply a wide range of fertilizer rates; however, the path of spread is limited to the width of the unit (normally 18 inches to 3 feet for low cost units). Rotary spreaders broadcast fertilizer in a 10 to 20 foot wide path with less uniformity and rate control than drop spreaders. Either spreader type will work well for homeowners if properly calibrated and operated.

Figure 3. Ammonium nitrate (34-0-0) applied at the rate of 2 lbs nitrogen per 1000 square feet broadcast on the soil surface (left) or banded in rows with 24 inch spacing (right).

Spreaders are adjustable for different fertilizers and rates of application. Spreader manufacturers often list calibration settings for specific fertilizers. Likewise, many fertilizer manufacturers list settings for specific spreader models. Since manufacturers cannot list calibration settings for all situations, it is good practice to calibrate the unit for your use. Set the spreader to the closest manufacturer's setting for the rate and type of fertilizer you will apply. Place 2 pints of kitty litter in the unit and spread in a continuous straight path. Note the width of the spread path and the distance traveled to broadcast the litter. Calculate the rate of application (assuming 1 pint of litter equals 1 pound of fertilizer) and compare this to the rate needed. For example, if a rotary spreader broadcasts a 10 foot wide path and you traveled 40 feet to empty 2 pints of litter from the hopper, the rate of application would be equivalent to 2 pounds per 400 square feet (10 ft x 40 ft), or 5 lbs/1000 square feet. If a different rate is needed the spreader setting should be changed and the unit calibrated again. Once a spreader is calibrated for a specific rate keep a record of the setting for future use. .

Avoid streaking caused by fertilizer skips and overlap by applying one-half of the calculated rate while traveling in one direction and the remaining one-half while traveling in a perpendicular direction. This method of application is especially useful for turf fertilization where streaking is common.

Banding (Figure 3) is a convenient way to make in-season fertilizer applications to high nitrogen requiring vegetables like corn. To band fertilizer first calculate the amount needed for an area as if you were going to broadcast the material. Divide this amount by the number of plant rows in the area to determine the amount of fertilizer to apply in each row. Make narrow furrows 8 to 10 inches away from the base of the plants, 2 to 3 inches deep. Distribute the fertilizer evenly in the furrow and cover with soil.

Foliar applications can be made with any water-soluble product and are commonly used for applying small amounts of micronutrients such as iron and zinc. There is potential for foliar burning with sprays so follow product label instructions carefully. A 2% fertilizer solution by weight is generally safe for use as a foliar spray. Mix a 2% solution by adding 0.15 lb (approximately 1.25 fluid ounces or 2 ½ tablespoons) fertilizer per gallon of water. Apply foliar sprays early in the morning or late in the evening to minimize leaf burning. Thoroughly cover foliage with the spray solution.

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Raspberry Irrigation Update

Summary of the basic principles of raspberry irrigation management, and an update on some recent irrigation research.

Brent Black

Extension Fruit Specialist

USU Extension

brent.black@usu.edu

Dr. Brent Black is a Professor and Extension Fruit Specialist at Utah State University in Logan Utah. His interests include high-tunnel berry crop production, tart cherry orchard systems, orchard irrigation management, and alternative crops for small acreage diversification. Prior to coming to USU, he studied management systems and practices for strawberry, raspberry and blueberry production at the USDA research station in Beltsville Maryland. A native of southeastern Idaho, Brent completed his undergraduate degree in Plant and Soil Science at USU, a Master's degree in Horticulture at Michigan State University, and a Ph.D. in Plant Physiology at Oregon State University.

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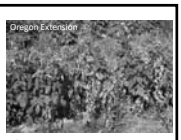
Berry Irrigation: Methods and Research Update

Brent Black,
Extension Fruit Specialist

2018 Urban and Small Farms Conference

Why worry?

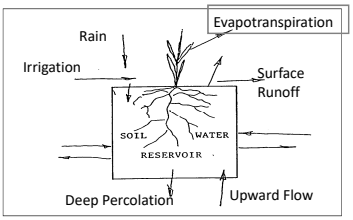
- Over-irrigation
  - Phytophthora root rot
  - Iron chlorosis (too much, too early)
  - Fruit and foliar diseases



Why worry?

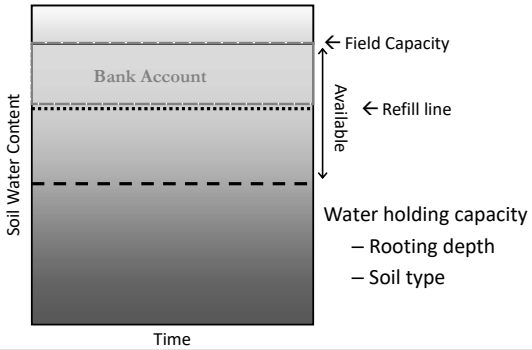
- Under-irrigation
  - Heat stress
  - Reduced cane growth
  - Drop in fruit quality
  - Sunscald
  - Fruit doubling/flower malformation

Where is the water going?



- Questions:
  - How much is there?
  - How fast is it leaving?

Soil Water Content



Water holding capacity
- Rooting depth
- Soil type

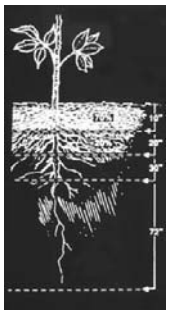
How much water is in the soil?

Soil water holding capacity

Soil Texture	Available	Readily available (*inches*)		
	(*inch/foot*)	1 ft. root depth	1.5 ft. root depth	2 ft. root depth
Sands and fine sands	0.5 - 0.75	0.25 - 0.38	0.4 - 0.6	0.5 - 0.75
Loamy sand	0.8 - 1.0	0.4 - 0.5	0.6 - 0.75	0.8 - 1.0
Sandy loam	1.2 - 1.5	0.6 - 0.75	0.9 - 1.1	1.2 - 1.5
Loam	1.9 - 2.0	0.9 - 1.0	1.4 - 1.5	1.9 - 2.0
Silt loam, silt	2.0	1.0	1.5	2.0
Silty clay loam	1.9 - 2.0	0.9 - 1.0	1.4 - 1.5	1.9 - 2.0
Sandy clay loam, clay loam	1.7 - 2.0	0.85 - 1.0	1.3 - 1.5	1.7 - 2.0

Determining Soil Moisture: Where to measure?

- Monitoring depths
  - 5-6”
  - 2/3 of the rooting depth (typically 18-20”)



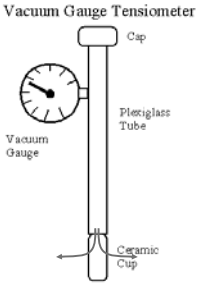
Measuring Soil Moisture: Systems

- Soil Matric Potential (tension or suction)
  - Low number = more water
  - Indicates how hard a plant has to “pull” to get water
- Volumetric Water Content
  - Indicates the amount of water needed to recharge the soil

Determining Soil Moisture: Tensiometer

- Soil matric potential (tension or suction)
- Units = Centibars
  - Range 0 to 75 centibars

  Low number = more water



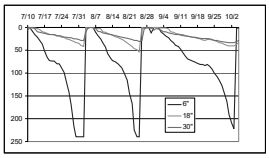
Determining Soil Moisture: Electrical resistance blocks

- Electrical conductivity

  Low number (resistance) = more water
- Units = Centibars
  - Range 0 to 200 centibars
- Price:
  - Sensors: $35 to $45 each
  - Meter: $220 to $300
- Readings vary by soil type
  - Require good soil contact
  - Salinity artificially elevates readings

Determining Soil Moisture: Automated system

- Eight sensor capacity
  - 7 soil moisture
  - 1 temperature gauge
- Price - $770



Determining Soil Moisture: Volumetric water – Sentek

- Requires access tube
- Measures volumetric water
  - Capacitance of magnetic field
  - Measures very close to the tube
  - Tube installation is critical
  - Lengths of 3 and 4.5 feet
- Price:
  - Probe $2,600 - $2,700 (in 2009)
  - Access tubes $55 - $60

Which is best?

Resistance block: water potential

Capacitance: Volumetric water

← Initial Cost – 1 system
# of Locations →
Response time →
Soil texture →
Salinity →
← Installation
Life span →

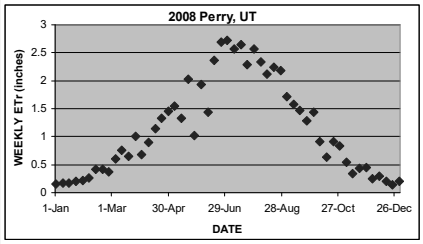
Irrigation management

- How much water is available to the plant?
- How fast is it being used up?
- How thirsty is the plant?

Irrigation

- Crop water use ≡ Evapotranspiration (ET)
- $ET_{crop} = ET_{ref} \times K$
  - ET_{ref} is "Reference ET" or evapotranspiration of a known crop (alfalfa or grass)
    - calculated based on temperature, humidity, and wind speed.
  - K is Crop Coefficient (correction for your crop)

Weekly evapotranspiration



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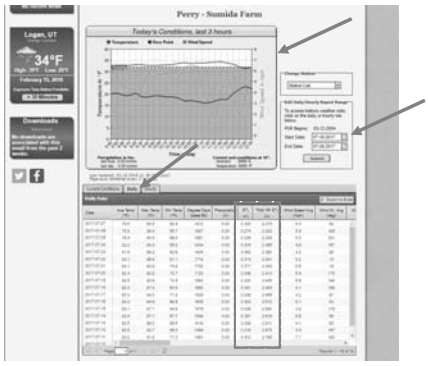
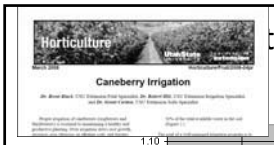
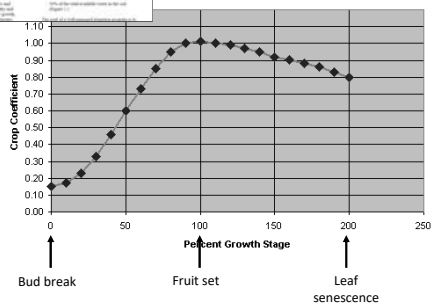


t "K" for brambles





Irrigation

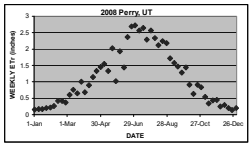
- $ET_{crop} = ET_{ref} \times K$

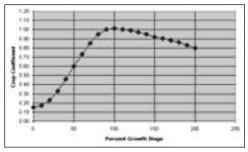
Mid summer

$ET_{crop} = 2.7'' \times 1.0$

Early spring

$ET_{crop} = 1'' \times 0.45$



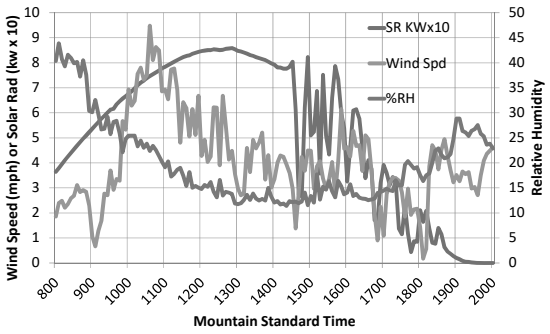


Measure the plant?

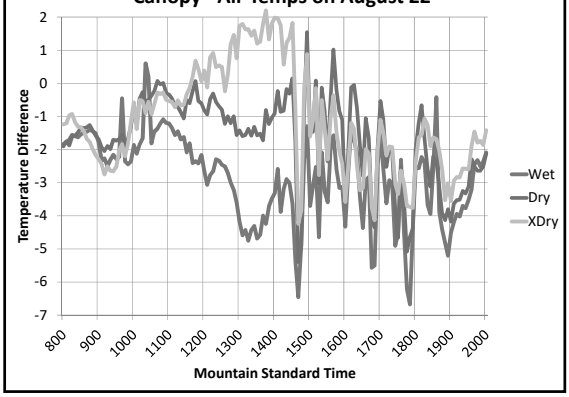
Measurement methods

- ~~Stomatal conductance~~
- ~~Leaf temperature~~
  Canopy temperature?
- ~~Leaf water potential~~
- Stem water potential

Weather Conditions on August 22

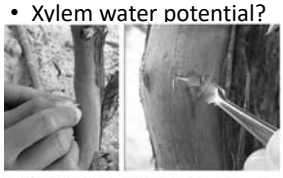


Canopy - Air Temps on August 22



Plant-based approach

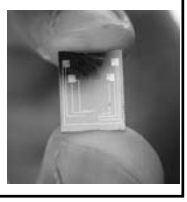
- Xylem water potential?



Dr. Alan Lakso
Plant Physiology

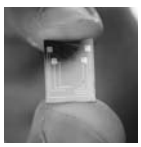
Vinay Pagay
Ph.D. Student Viticulture and Chemical Engineering

Dr. Abraham Stroock
Microfluidics Chemical Engineering



Recommendations

- Monitor your soil moisture
- Track ET demand to determine irrigation interval and amount
- Stay tuned for plant-based monitoring systems



Digital Marketing for your Berry Operation

Learn about social media and online website marketing and communications for your small farm or agriculture business. No experience necessary! This session will provide useful tips for user engagement online through social media platforms and practical ways to increase the quality and quantity of traffic to your website.

Jennifer Werlin

Extension Educator, Community Food Systems

University of Idaho

jwerlin@uidaho.edu

Jennifer Werlin is a University of Idaho Extension Educator in community food systems for Teton County, Idaho. As the only extension educator in her region with a focus on community food systems, she delivers small farms, community development, and food systems education to her county and surrounding eastern Idaho communities. In addition, she supervises her county 4-H youth development programs. Through interdisciplinary education and facilitation, she delivers extension programming aimed at integrating various components of her local food system (i.e., production, distribution, consumption, and waste disposal).

Prior to working in extension, she worked for over a decade in nonprofit administration and programming, including work as an environmental educator and a communications coordinator for the Idaho-based food and farm organization Rural Roots and the University of Idaho's Sustainable Agriculture Program. Ms. Werlin is a founding member and currently facilitates a food and farm coalition in her region and serves on the board of directors for her county farmers market. She has extensive experience in delivering hands-on educational programs and working with collaborative teams, agriculture professionals, farmers, and others.

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Digital marketing for your berry production

Presented by:
Jennifer Werlin

Extension Assistant Professor in Community Food Systems,
Teton County, Idaho

jwerlin@uidaho.edu

University of Idaho Extension

February 22-23, 2018

What is your brand?

- Can start with your goals, vision, mission
- What products do you sell?
- Know your customer to reach your customer
- You are your brand and your brand is you

DEEP ROOTS farm

A SMALL FARM IN THE CITY

- Collective rather than one person
- Small scale
- Local, direct market
- Certified Naturally Grown
- Transparent
- Values driven
- LOCAL

Who is your customer?

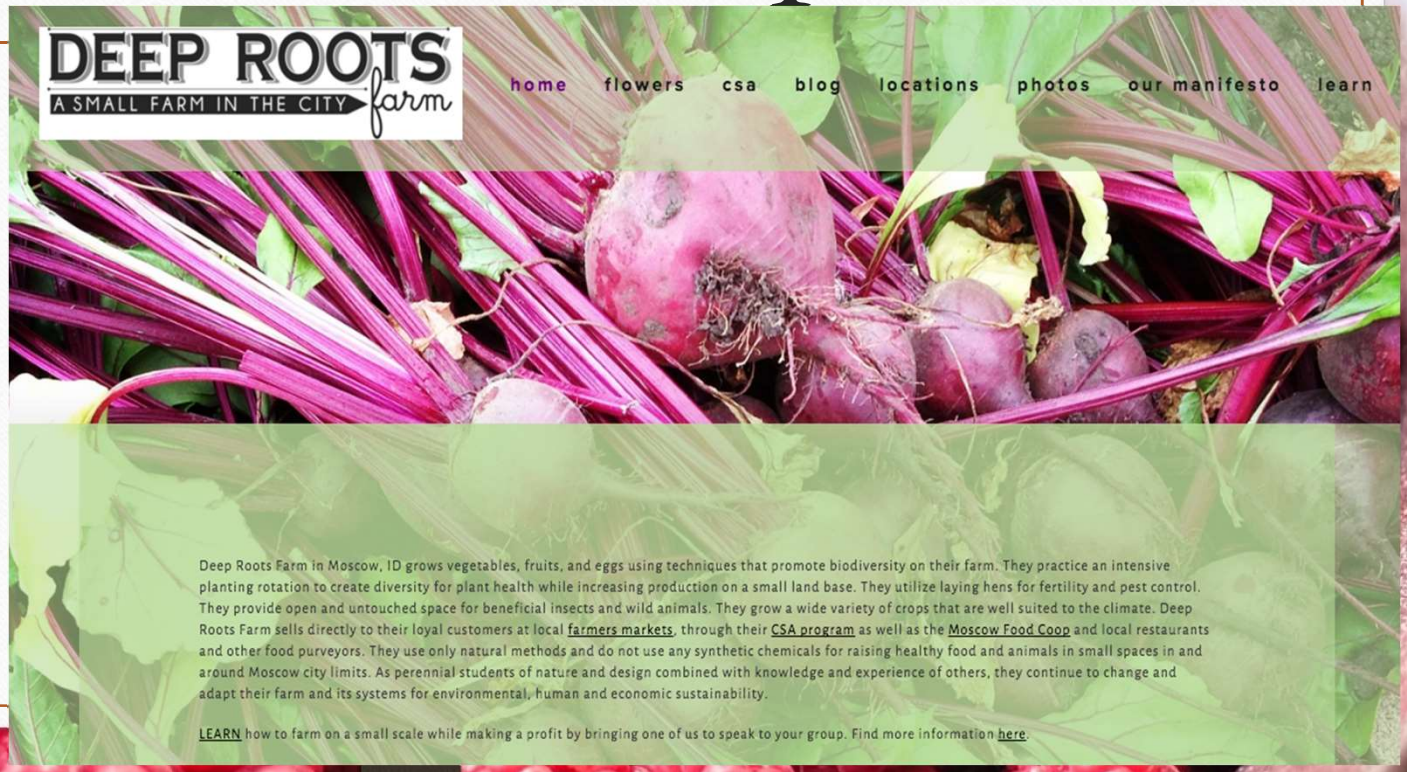
- Demographics
- Women, families, relationships
- Health conscious, etc.

Websites

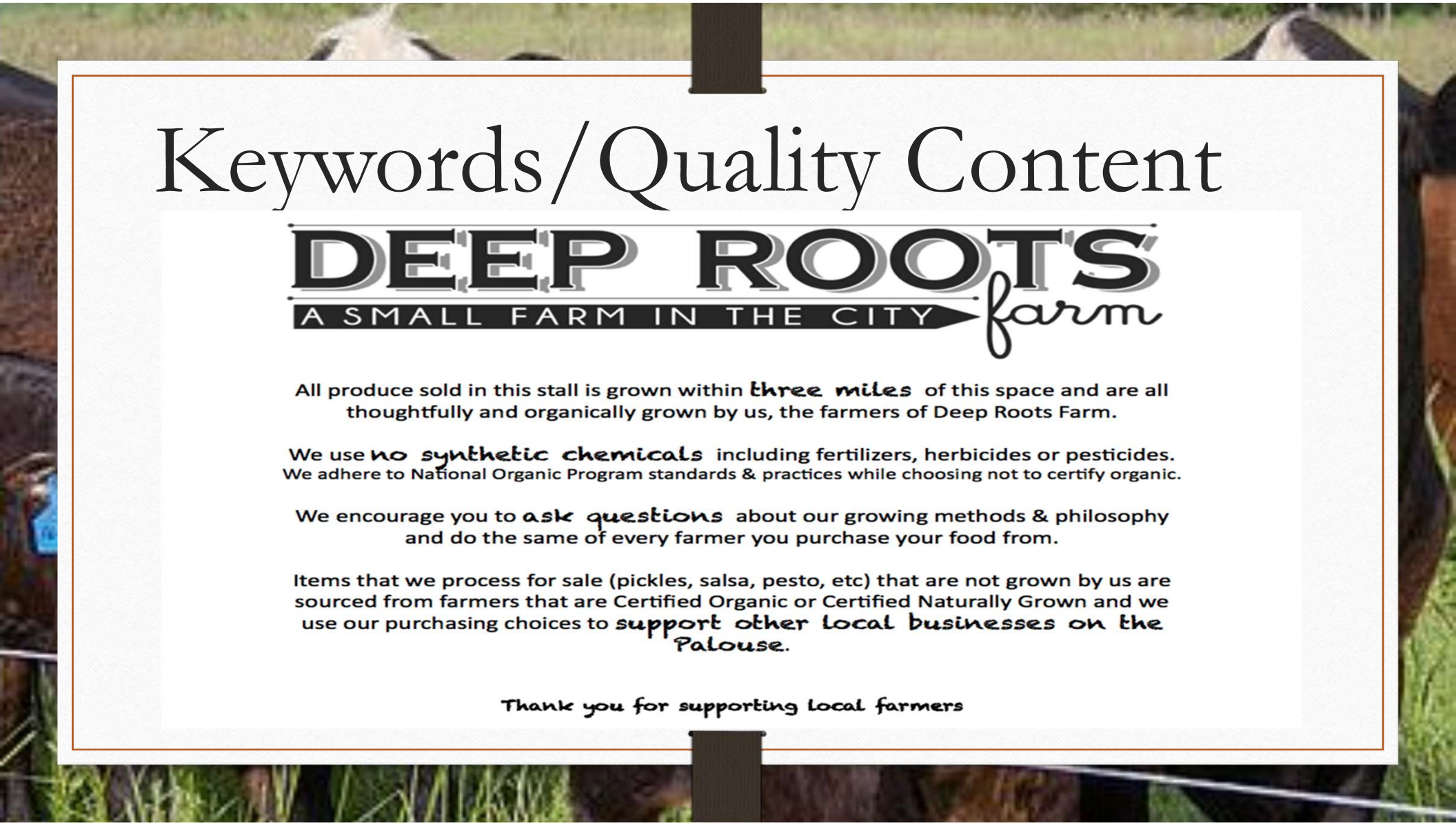
- Getting noticed→ SEO (Search Engine Optimization)
- Organic= "free" search results vs. Paid Advertising (e.g., Google AdWords)
- Quality content, clarity
- Buy your own domain. Can use free or cheaper site hosts/content management systems (e.g., Squarespace, Weebly, Word Press, Wix, etc.).
- Make sure site has cross device compatibility (smart phones, iPads, etc.)
- Include blog with keywords (Google likes blogs and helps increase your web search results)

Website Examples

- Note: Free website builders can be hard to use and may not come up in Google search



Keywords/Quality Content



Link to Local Food and Farm Directories

- Localharvest.org
- Eatlocalgrown.com
- Eatwild.com
- Localdirt.com
- agrilicious.org
- 1000ecofarms.com (online sales)
- USDA Ag Marketing Service (https://www.ams.usda.gov/services/local-regional/food-directories-listings)
- Local/regional specific directories!

LocalHarvest
real food, real farmers, real community

Local Dirt

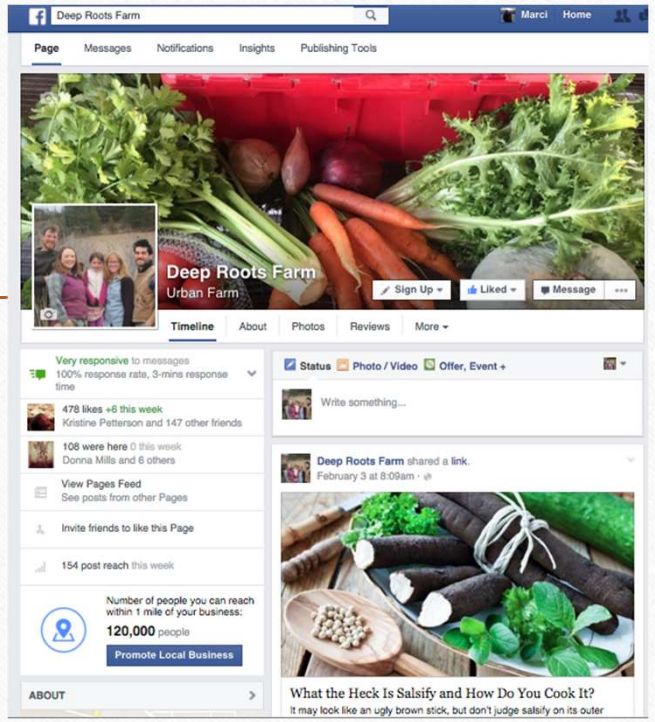
eat local grown

eatWILD

1000 ECOFARMS™

Social Media

Facebook Tips



- Facebook: (Business Page vs. Profile)
- Link to other sites:
  Website, Twitter, LinkedIn, Pinterest,Instagram, YouTube, etc.
  - Hootsuite, TweetDeck, etc.
- Post regularly (can schedule); post in Groups
- Use photos! Respond to comments and questions
- Have contests, ask questions, share other posts (80% relevant, 20% FUN)
- Sponsored Posts, aka "Boosted"

Instagram

#CNGProud
#certifednaturallygrown
#MoscowIdaho
#youngfarmers
#localfood
#pasturedpoultry
#MoscowFarmersMarket

- PHOTOS! Use hashtags
- Can share photos and content using other aps
- Can have business or personal profile
- Tag others with whom your work with
  - @(seed company you buy from)
  - @(restaurant you just sold produce to)
- Link to other platforms (Facebook, Twitter, etc.)

deeprootsfarm EDIT PROFILE

Deep Roots Farm Small scale urban ag, no chemicals, just healthy soil. Certified Naturally Grown Moscow, ID www.deep-roots-farm.com

182 posts **366** followers **259** following

Twitter

- Create custom Twitter Handle
- <180 characters, create links: *https://bitly.com/* or *https://goo.gl/*
- Keep posts relevant and short
- Retweet, use hashtags #
- Follow your followers
- Respond to posts
- Connect to other platforms

Pinterest

- Great for recipes, visually appealing images; pin regularly (can schedule)
- Create and pin images with text (include hyperlinks)
- Write keyword rich descriptions and boards:
  - Include relevant details with actions
  - <100 characters
  - No hashtags, sales promotions
  - Use multiple images in pin at proper size: 2:3 or 1:3:5 aspect ratios
    - Vertical is best

Other Media

- **LinkedIn:** Create profile and link to website
- **YouTube/Vimeo:** Videos can link to other social media sites and webpage; custom url's
- **Podcasts:** Another popular avenue, can draw attention to product/site
- **E-newsletters & Blogs:** (great for CSA's, 1-2x/mo., link to blog, social media sites)

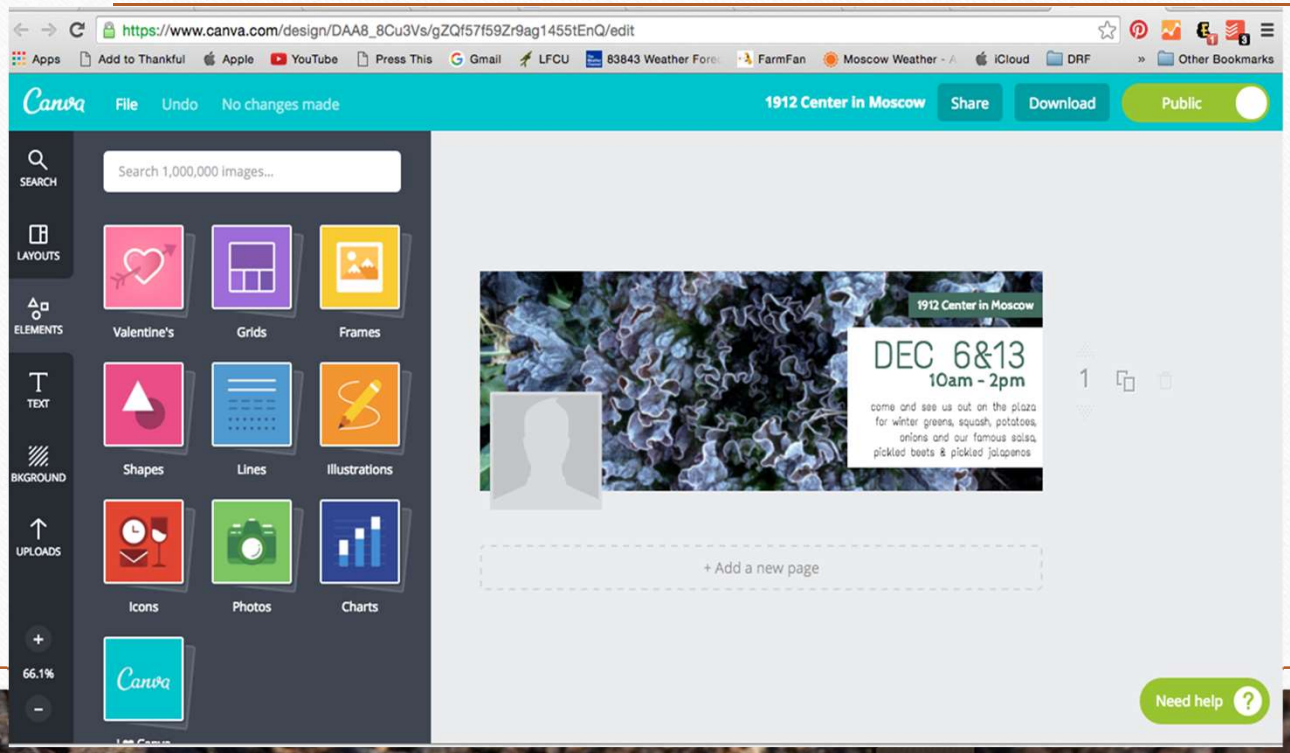
e-Newsletters

- Can use template program like Mail Chimp, Vertical Response, Emma, Constant Contact, etc.: helps track opens and click through rates
- Keep them focused on one topic/call-to-action (e.g., weekly CSA, event, etc.); No clutter; consistent branding, fonts, etc.
- 90% educational; 10% promotional
- Creative email subject lines: No sales-y pitches
- Images have Alt-text descriptions; copyrights;
- P.S.: read more frequently

Customer Service

- Especially with direct-marketing sells, have quality customer service.
- You are the GROWER and RETAILER
  - Return phone calls, emails, and messages
  - Attune to customer's needs
- Tell your story…develop relationships

Making beautiful marketing materials



www.Canva.com

- Can also use: Microsoft Publisher; Adobe Photoshop

Organization/Management Tips

1. Custom branding, fonts, color choices, etc.
2. You are your brand. Your brand is you. Avoid controversial posts. Save that for your personal profiles (even that is public and recorded in history).
3. Get listed in local food and farm guides/directories.
4. Create personalized Facebook, etc. pages and Website. Keep it simple. Track your open, site visitors, unique visitors.
5. Link Social Media sites together. Use business profiles. Post on a schedule.
6. First, Eat the Frog! Eliminate unnecessary work.

Thank you!

Jennifer Werlin

University of Idaho Extension Educator,
Community Food Systems, Teton County
jwerlin@uidaho.edu (208) 354-2961