Key Insect Pests of Raspberry:

Horntail, European Paper Wasp, and Spider Mites

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UtahState University

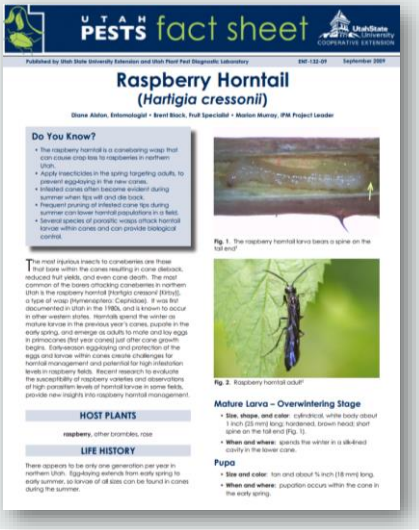
Urban & Small Farms Conference
March 5, 2020
Utah Cultural Celebration Center

Raspberry Horntail

6 years of Utah research

1) Biology & Life Cycle
2) Predict Adult Emergence/Egg-Laying Period
3) Natural Enemies
4) Raspberry Cultivar Resistance

USU Fact Sheets



UTAH PESTS fact sheet

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Raspberry Horntail
(*Hartigia cressonii*)

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

Do You Know?

- The raspberry horntail is a coneboring 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 spine on the tail end.

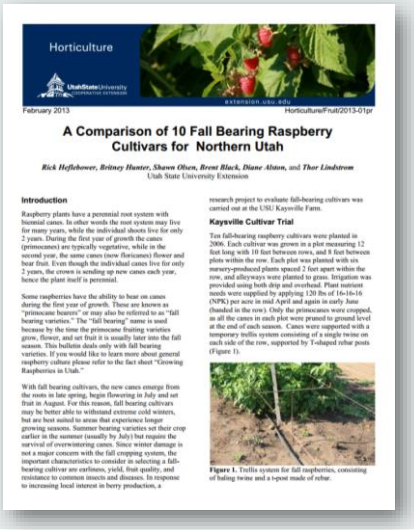
Fig. 2. Raspberry horntail adult.

Mature Larva – Overwintering Stage

- **Size, shape, and color**: cylindrical, white body about 1 inch (25 mm) long; hardened, brown head; short 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.



Horticulture

extension.usu.edu

February 2013 — Horticulture/Fruit/2013-01pr

A Comparison of 10 Fall Bearing Raspberry Cultivars for Northern Utah

Rick Heflebower, Britney Hunter, Shawn Olsen, Brent Black, Diane Alston, and *Thor Lindstrom*
Utah State University Extension

Introduction

Raspberry plants have a perennial root system with biennial canes. In other words the root system may live for many years, while the individual shoots live for only 2 years. During the first year of growth the canes (primocanes) are typically vegetative, while in the second year, the same canes (now floricanes) flower and bear fruit. Even though the individual canes live for only 2 years, the crown is sending up new canes each year, hence the plant itself is perennial.

Some raspberries have the ability to bear on canes during the first year of growth. These are known as "primocane bearers" or may also be referred to as "fall bearing varieties." The "fall bearing" name is used because by the time the primocane fruiting varieties grow, flower, and set fruit it is usually later into the fall season. This bulletin deals only with fall bearing varieties. If you would like to learn more about general raspberry culture please refer to the fact sheet "Growing Raspberries in Utah."

With fall bearing cultivars, the new canes emerge from the roots in late spring, begin flowering in July and set fruit in August. For this reason, fall bearing cultivars may be better able to withstand extreme cold winters, but are best suited to areas that experience longer growing seasons. Summer bearing varieties set their crop earlier in the summer (usually by July) but require the survival of overwintering canes. Since winter damage is not a major concern with the fall cropping system, the important characteristics to consider in selecting a fall-bearing cultivar are earliness, yield, fruit quality, and resistance to common insects and diseases. In response to increasing local interest in berry production, a research project to evaluate fall-bearing cultivars was carried out at the USU Kaysville Farm.

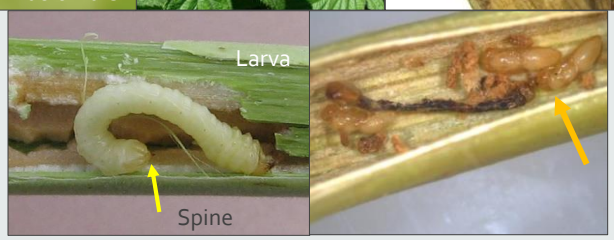
Kaysville Cultivar Trial

Ten fall-bearing raspberry cultivars were planted in 2006. Each cultivar was grown in a plot measuring 12 feet long with 10 feet between rows, and 8 feet between plots within the row. Each plot was planted with six nursery-produced plants spaced 2 feet apart within the row, and alleyways were planted to grass. Irrigation was provided using both drip and overhead. Plant nutrient needs were supplied by applying 120 lbs of 16-16-16 (NPK) per acre in mid April and again in early June (banded in the row). Only the primocanes were cropped, as all the canes in each plot were pruned to ground level at the end of each season. Canes were supported with a temporary trellis system consisting of a single twine on each side of the row, supported by T-shaped rebar posts (Figure 1).

Figure 1. Trellis system for fall raspberries, consisting of baling twine and a t-post made of rebar.

Raspberry Horntail, *Hartigia cressonii*

- Major cane-boring pest in Utah
- Wasp (Hymenoptera)
  - Stem sawfly (Cephidae)
  - Attacks first-year primocanes
  - Intermountain West & CA
- Infested canes
  - Lower yield
  - Lower vigor
  - Lower winter survival

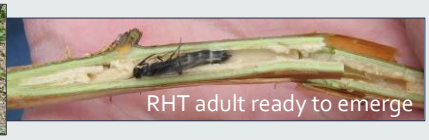


Natural parasitoid wasps kill RHT larvae

Raspberry Horntail Biology

- One generation per year (late May – early Sep)
- Overwinter in canes within a silk-lined chamber
  - Mature larva
- Pupate within the chamber in the spring
- Adults chew a hole, emerge
  - Temperature dependent
- Eggs inserted under epidermis of young primocanes
- Young larva (winding) tunnels upwards in cambium just under epidermis
  - At cane tip, consumes pith – tip wilting
  - One larva per cane tip
  - U-turn and tunnels down in pith
- Mature larva forms overwintering chamber 1 – 1.5 ft above cane base

Adult Emergence

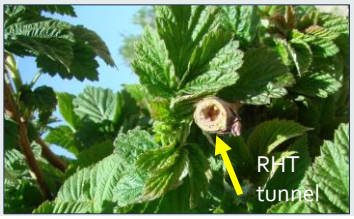


Degree-Day Model to predict timing of egg-laying

Predict emergence of RHT adults from overwintering chambers in canes

Study sites (3 years):
Laketown, Richmond, Paradise, Wellsville, Kaysville, & Alpine

Emergence:
Base 50°F since Jan 1
500 to 1800 DD
Average dates:
June 12 to August 3



Natural Enemies (Biological Control)

- 3 species of parasitic wasps attacking horntail larvae
- Parasitism occurred near cane tip (smaller diameter, horntail larva consumes pith, softer cane tissue facilitates insertion of the parasitoid's ovipositor, space for parasitoid to develop)
- Some cane injury already occurs before parasitism

Parasitism of RHT Larvae

Percentage of horntail larvae parasitized, Kaysville, UT (Davis Co.), 2009 & 2010

Date	Summer Cultivars		Fall Cultivars	
	2009	2010	2009	2010
June 24	0	-	9.1	-
July 1	-	0	-	25.6
Jul 15	35.1	25.8	41.7	20.0
Jul 22	-	73.1	-	47.1
Jul 29	98.4	59.1	100	33.3
Aug 5	61.5	80.0	25.0	0
Aug 13	70.0	-	40.0	-

Parasitoid I

- Ichnuemonidae
- Long ovipositor
- Ectoparasite
- Solitary

Parasitoid II

- Pteromalidae
- Ectoparasite
- Gregarious
- ~3-20 larvae/horntail

Parasitoid III

- Less common
- Eurytomidae
- *Tenuipetiolus* sp.
- This genus known to parasitize gall midges & gall wasps

Summer (Floricane-Fruiting) Raspberry Cultivar Resistance Trials

USU Research Farm, Kaysville, UT (Davis Co.)

2009-2011

Mean no. RHT per row-ft

Cultivar	RHT	Cultivar	RHT
Royalty	0.25 a	Reveille	2.85 abc
Moutere	0. 80 a	Chemainus	2.95 abc
Cascade Dawn	1.25 ab	Canby	3.25 bc
Cowichan	1.55 abc	Georgia	3.65 c
Coho	1.60 abc	Cascade Bounty	3.75 cd
Cascade Delight	1.75 abc	Titan	4.10 cd
Lauren	1.85 abc	Willamette	5.10 cd
Tulameen	2.20 abc	Saanich	5.95 d

2013-2014

Mean no. RHT per row-ft

Cultivar	RHT	Cultivar	RHT
Octavia	0.01 a	Prelude	0.26 ab
Cascade Gold	0.05 a	Cascade Bounty	0.68 ab
1142-1	0.12 a	Nova	1.07 b
Chemainus	0.18 a		

Horntail population pressure declined in 2013-2014 as compared to 2009-2011: successive years of cane removal as part of the sampling process. Suggests that frequent pruning is an effective management tactic.

In general, cultivars with greater winter hardiness, cane vigor, & yields were more resistant to horntail.

Fall (Primocane-Fruiting) Raspberry Cultivar Resistance Trials

USU Research Farm, Kaysville, UT (Davis Co.)

2009-2011
Mean no. RHT per row-ft

Cultivar	RHT	Cultivar	RHT
Polana	0.4	Joan J	0.7
Caroline	0.6	Ruby	0.7
Polka	0.6	Himbo Top	0.8
Summit	0.6	Heritage	0.9
Jaclyn	0.6	Anne	1.0

2013-2014
Mean no. RHT per row-ft

Cultivar	RHT	Cultivar	RHT
Autumn Treasure	0.03	Polana	0.23
Josephine	0.06	Autumn Bliss	0.30
Brice	0.08	Joan J	0.34
Vintage	0.14	Dinkum	0.50
Autumn Britten	0.18		

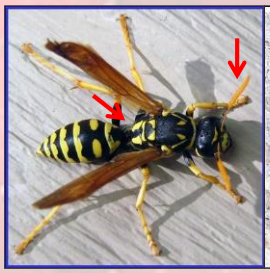
For fall-bearing cultivars, horntail infestation $\leq$ 1 larva per row-ft, and there were no statistical differences among cultivars.

Horntail infestation was substantially lower in fall- than summer-bearing cultivars:
- fall-bearing canes were removed at ground level in the spring before overwintered horntail adults emerged
- horntails seem to avoid thin canes which are more common in fall-bearing cultivars

Raspberry Horntail IPM

- Select cultivars with more resistance
  - Fall-bearing are less susceptible than summer-bearing cultivars
- Prune out infested canes before adults emerge (by May)
  - Remove fall-bearing canes at ground level
  - Remove floricane-fruiting canes with a horntail tunnel in pith
- If warranted, apply insecticide beginning at 500 DD to prevent egg-laying; repeat based on protection interval of product (emergence ends by 1800 DD)
  - Carbamate: carbaryl (Sevin)
  - Pyrethroids: bifenthrin (Brigade, Capture), esfenvalerate (Asana), fenpropathrin (Danitol), zeta-cypermethrin (Mustang Max), pyrethrin
  - Organophosphates: diazinon (Diazinon, RUP), malathion (Malathion)
  - Don't spray when bees are active! Follow all product label protections for pollinators
- Frequent pruning of infested cane tips during summer can lower the horntail population in a field
- Conserve parasitoid wasps by avoiding unnecessary insecticide applications

European Paper Wasp
Polistes dominula



European paper wasp (left) has a more slender waist than a yellow jacket (right)

E. paper wasp likes to feed on ripe fruit, but is also a predator

Deformed wing disease
EPW in Utah since 1990s

European Paper Wasp Management

Spring and early summer: beneficial predator of caterpillars

Treat nests with aerosol wasp sprays & remove nests to eliminate larvae developing in cells

Mid summer to early fall: feed on ripe fruit
Trap: fruit juice/yeast bait in pop bottle
Protect fruit with insecticide sprays (same as earwig & SB)

Yellow jacket traps ineffective

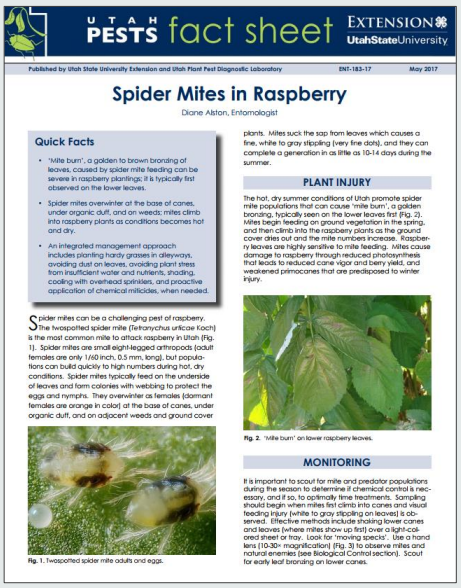
USU Extension video fact sheet

utahpests.usu.edu slideshows

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

UtahState University

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.

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Latest News

In Search of Soybeans Resistant to the Brown Marmorated Stink Bug

The invasive brown marmorated stink bug "will eat almost anything." Among its targets is soybean, the number-two crop in the United States. Researchers at the U.S. Department of Agriculture's Agricultural Research Service are working to identify soybean breeds that exhibit resistance to the pest.

Read More

Butterfly Color Patterns Reveal Clues About the Genes That Build Insect Wings

Researchers at the University of Manitoba studied color patterns in various species of butterflies, including painted ladies (Vanessa cardui), and the underlying genes that drive those patterns, revealing a previously undetected compartment boundary that may exist in the wings of all holometabolous insects.

Read More

Are cities affecting evolution?

In the first study to take a comprehensive look at the way urbanization is affecting evolution, researchers say they've found a 'wake-up call for the public, governments and other scientists.'

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

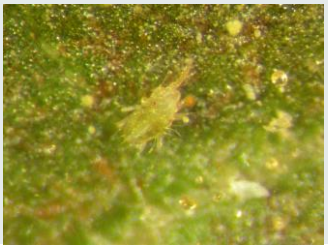
"Mite Burn"

- 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

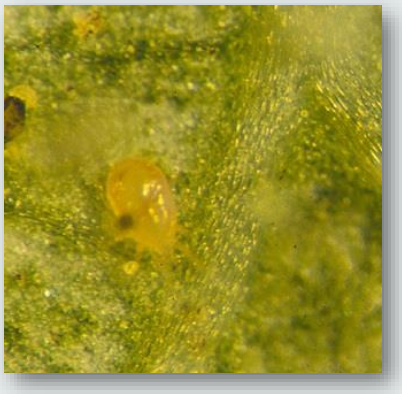
- Plant vegetation in alleyways (grass)
  - Minimize broadleaf weeds
    - field bindweed, common mallow, knotweed
  - However, a low level of broadleaf weeds/ground cover can provide habitat for predator mites
- Overhead sprinklers (cool & wet)
- Avoid disturbing ground cover (avoid dust)
- Avoid plant 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

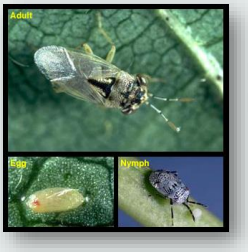


Western predatory mite, note tear-drop-shaped body

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)

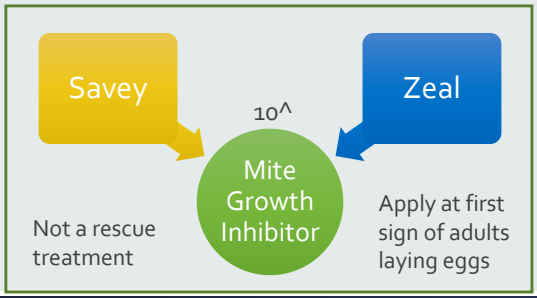
*Some formulations are OMRI-listed; ^IRAC MoA groups

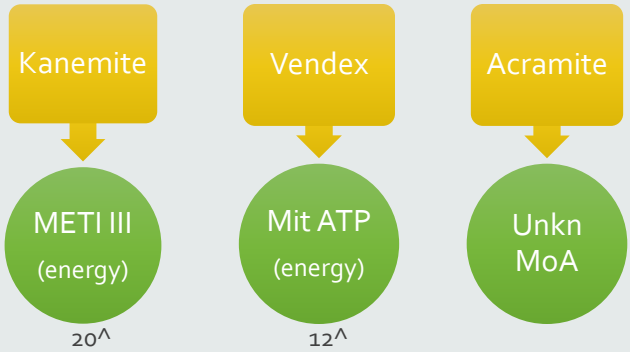
Commercial Miticides

- 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)

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





^IRAC MoA groups

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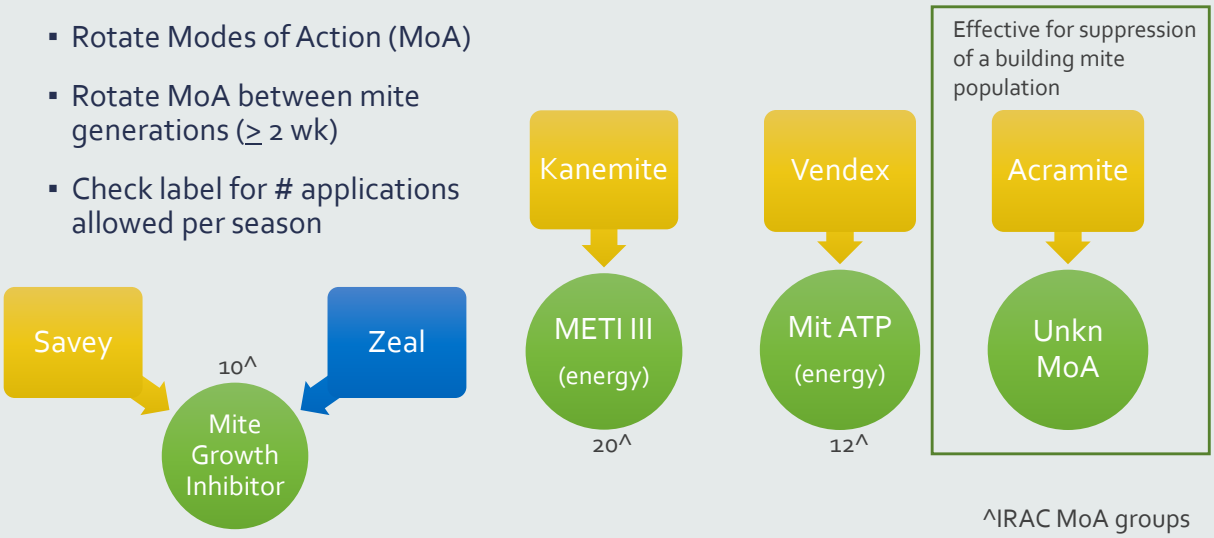
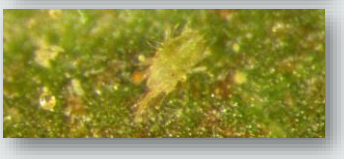


^IRAC MoA groups

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

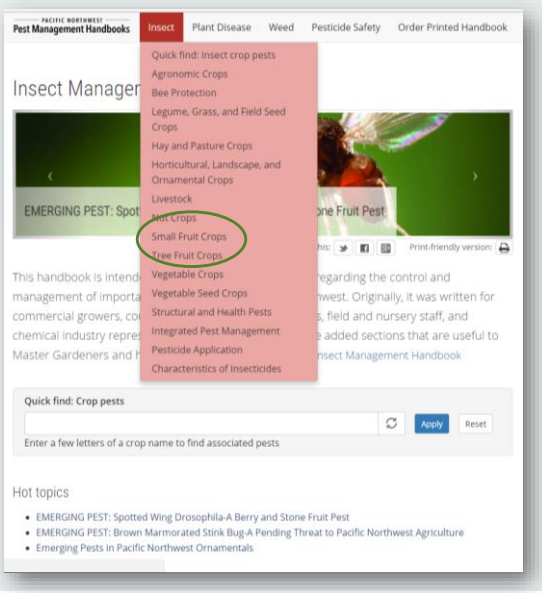
Intervene early:

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

Pacific Northwest Insect Management Handbook



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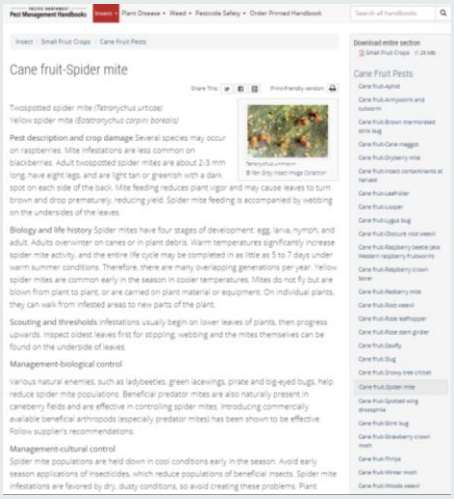


Questions?