Change is the Norm with Woody Plant Insects in Colorado

2015 CALCP Spring Training Conference

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What changes?

• Pest problems change
  – New pests come – and go
  – Weather patterns may cause periodic eruptions

• Pest management options change

• Public concerns about pests change
  – Increased interest in protecting plants
  – Increased concern about methods used to control insects (e.g., insecticides)
European Elm Flea Weevil

*Orchestes alni*
It is a snout beetle/weevil.

It jumps.

Larvae make leafmines.
European elm flea weevil injury – a combination of leafmining and shothole wounds to elm leaves
Overwintered adults move to new growth in spring.

Mating, feeding (shotholes), and egg laying occur at this time.
Larval mines initially are serpentine and meander. They then terminate as a blotch at the leaf edge.
Larvae develop within the leaf mine
Adults emerge in early summer and feed heavily (shotholes) for several weeks.
Adults chew shothole wounds in leaves
European Elm Flea Weevil

This insect, unknown from the western US until 2006, quickly became the dominant elm insect defoliator in much of the region.
European Elm Flea Weevil – are natural enemies finally catching up?
Adults and their parasitoids emerge in early summer for several weeks.
Tentative identification of primary parasitoid: *Eupelmus vesicularis* (Hymenoptera: Pteromalidae)
European Elm Flea Weevil – are natural enemies finally catching up? – Yes!
Elm leaf beetle – No Show
Mystery of the Elm Leaf Beetle Disappearance

- Twenty years ago elm leaf beetles were the dominant defoliator of Colorado’s urban forests
  - The insect was similarly abundant through much of the midWest
- In recent years outbreaks have been limited to isolated pockets
  - The population crash has occurred over a broad area of the central US
- Natural enemies are present, but do not appear to be in high enough numbers to explain the population crash.
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Northern tamarisk beetle

*Diorhabda carinulata*
Trirhabda nitidicollis

Northern tamarisk beetle

Elm leaf beetle

Trirhabda lewisii

Rabbitbrush

Trirhabda nitidicollis

Rabbitbrush
Elm leaf beetle adults often move to and may enter buildings for winter shelter.

Tamarisk beetles can be the “new elm leaf beetles” that occur as nuisance invaders of buildings.
Elm bark beetle hand-off
Smaller European elm bark beetle

*Scolytus multistriatus*

SEEBB
Banded elm bark beetle,
*Scolytus schevyrewii*

BEBB
Most behaviors and aspects of life history of the BEBB are similar to SEEBB.
Banded elm bark beetle vs. Smaller European elm bark beetle

- Both species occupy same ecological niche
- BEBB spring emergence is ahead of SEEBB
- BEBB summer generation is ahead of SEEBB

- *Banded elm bark beetle wins!*
Within ten years after its discovery, this new bark beetle of elm seems to have locally exterminated the old invasive bark beetle of elm through competitive displacement.
Serious New Fruit Pest Spreading Rapidly in the US

Spottedwing drosophilidae

*Drosophila suzukii*

aka “spottedwing drosophilid”
Most *Drosophila* feed on yeasts – the common “fruit flies” of overripe fruit.
Spotted wing dropspHild attacks ripening fruit
Males of *Drosophila suzukii* can be distinguished by a spot on the wings.
Fall bearing strawberries and raspberries appear to be the fruits at greatest risk in Colorado.
Spottedwing Drosophila – What To Look For

• Small maggots in ripening fruit
  – Rapid fruit softening results from injury
  – Raspberries, strawberries most likely to be noticed as infected

• Adult male has a spot on the wings
Cups filled with apple cider vinegar (or merlot wine!) effectively capture SWD
Management of Spottedwing Drosophild

• Thoroughly and frequently pick ripening fruit
  – Store in refrigerator/rapidly use fruit
  – Destroy culled fruit in manner that kills developing larvae
• Shift to early bearing cultivars
• Mass trapping?
• Netting?
• Insecticide?
Control of SWD

Thoroughly pick all ripe fruit regularly (2-3X weekly)
Many fruits are hosts of spottedwing drosophila.

Question: How important are the fruits produced by trees/shrubs as food sources for this new insect pest of berry crops?
Host Range Survey of SWD Hosts – Preliminary Results

• **Highly susceptible**
  – Raspberries, strawberries, blackberries

• **Support some SWD**
  – Honeysuckle, elderberries, yew, ripe apples/crabapples, hawthorn, at least some cotoneaster, ........

• **Apparently do not support SWD**
  – Russian olive, viburnum
European Elm Scale – *Is resistance to neonicotinoids the status quo of the future in Colorado?*
Prior to about 1995 European elm scale was controlled by spraying elm trees with insecticides in spring to kill overwintering stages on the twigs.
European elm scale was one of the first shade tree insects against which the new insecticide imidacloprid was tested (ca 1993). The results were fantastic. Soil injection of elm was embraced rapidly by the Colorado tree care community.
Insecticide resistance develops by selecting individuals that have genetic traits that allow the insect to resist effects of the pesticide.
Insecticide Resistance is:

- Genetically based, heritable
- Develops from concentration of genes that confer ability to resist effects of the insecticide
- Is usually permanent once established in a population
Recipe for Resistance

Sustained applications of neonicotinoids have been applied to almost every scale-infested elm over large areas in Colorado for almost 2 decades.
European Elm Scale in Colorado –

A poster child example of how to develop insect resistance in a shade tree pest
Some Neonicotinoid Insecticides Used for Woody Plants

- **Imidacloprid** (Merit, Criterion, Marathon, many generics)
- **Clothianidin** (Arena, Poncho)
- **Thiamethoxam** (Flagship, Meridian)
- **Dinotefuran** (Safari)
- **Acetamiprid** (Tristar)

*If resistance develops to one of these insecticides – it develops in all of these insecticides!*
European Elm Scale Options in a Post-Neonicotinoid Period

• Soil/Trunk Injections?
  – Acephate (ACE-jet, Leptitect, etc.)

• Foliar Applications
  – Horticultural Oils
  – Insect growth regulators
    • Pyriproxifen (Distance)
    • Buprofezin (Talus)
  – Broad spectrum crawler treatments
    • Pyrethroids
Elm Scale trial at the CSU Oval
Treatments in 2014 Elm Scale Trial

- Distance – spray May 25
- Distance + Oil – spray May 25
- Talus – spray May 25
- Talus plus oil – spray May 25
- Zenith (imidacloprid) – soil drench June
- Azasol – trunk injection June
- ACE-jet – trunk injection June
- Untreated Check
Elm Scale Trial - Early Results

- **Imidacloprid** provided no control – or negative control
  - High levels of imidacloprid remained in leaves in trees treated a year earlier

- **Azasol** (azadirachtin), trunk injected, did not provide control
Elm Scale Trial - Early Results

- **Talus, Distance**, sprayed May 25, provided about 75% control
  - *Addition of oil did not seem to increase efficacy*

- **ACE-jet** (acephate), trunk injected, provided about 80% control
Where are we for options to control European elm scale?
American elms resistant to the scale insect?
Ulmus americana

‘Scale Buster’
Typical American elm
‘Scale Buster’
Observations on speed of Walnut Dying – Is there an Acute Phase and a Chronic Phase of Thousand Cankers Disease?
Thousand Cankers is produced by the combined effects of two species:

**Geosmithia morbida**

**Pityophthorus juglandis**
Walnut Twig Beetle

*Pityophthororous juglandis*
A fungus – *Geosmithia morbida*
Growth of the fungus beyond the inoculation site creates a dead region (canker) in the cambium.
Comparison of Epidemics of Dutch Elm Disease (historical) and TCD in Boulder
Thousand Cankers Activity in 2014

Red arrows – 2014 “Hot Spots”
Black arrows – 2014 Range Extension records
Walnut twig dispersal to Eads?????
December 6, 2013

First published report that thousand cankers disease was successfully exported to Europe
Observations on speed of Walnut Dying – Can there be both *Acute Phase* and *Chronic Phase* of Thousand Cankers Disease?
Acute Phase of TCD
Is there a chronic phase of Thousand Cankers Disease?
TCD progress in a tree at Rocky Ford, Colorado
Course of TCD Spread in a Rocky Ford black walnut, 2010-2014

July 2010

August 2014
Progression of TCD in Boulder, Denver (gray line)
Is there a chronic phase of Thousand Cankers Disease?

Yes, there is. In some locations disease progression seems to have greatly slowed or stabilized.

*The reasons for this are unknown.*
Wanted!

Reports of surviving, non-damaged black walnut in TCD-ravaged communities
Trees of high interest

Surviving black walnut trees in areas where TCD has been present for several years.
Two of the trees in Boulder from which nuts were collected last September
Pollinators and Systemic Treatments
Systemic insecticides and honey bees???

Where is greatest risk?
Soil Applied Systemic Insecticides and Honey Bees – Targets for Concern

• Plant is heavily used by honey bees as pollen and/or nectar source
  – Risk related to the amount the plant contributes to the overall intake of a specific hive
Top honey bee-visited plants include: most Sedums, most thistles, catmint, *Gaillardia*, most *Agastache*, Blue mist spirea, Russian sage, fruit trees, linden, golden raintree .......
Soil Applied Systemic Insecticides and Honey Bees – Targets for Concern

- Plant is heavily used by honey bees as pollen and/or nectar source
- Plant is treated with persisting systemic insecticides for some pest insect
  - Risk related to time of application
  - Risk related to inherent hazard of the insecticide to pollinators
  - Risk related to rate applied
Not all Neonicotinoids are alike:

- UV stability
- Water solubility
- Rate of uptake by plants
- Mobilization within plants
- Host range of susceptible insects
### Acute Toxicity of Neonicotinoids to Adult Honey Bees

(Dermal LD50 in micrograms/bee)

<table>
<thead>
<tr>
<th>Neonicotinoid</th>
<th>LD50 (μg/bee)</th>
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<tbody>
<tr>
<td>Acetamiprid</td>
<td>8.09</td>
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<tr>
<td>Imidacloprid</td>
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<td>Dinotefuran</td>
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<td>Thiamethoxam</td>
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<tr>
<td>Chlothionidin</td>
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</table>
Soil Applied Systemic Insecticides and Honey Bees – Highest Risk Scenario

• Plant is heavily used by honey bees as pollen and/or nectar source
  – Treated plants constitute important part of food being brought to hive

• Plant is treated with persisting systemic insecticides for some pest insect
  – Treatments are likely to result in hazardous levels of residues in pollen and/or nectar
Most obvious woody plant risk of neonicotinoids and honey bees - Lindens
2013 Oregon Bumble Bee Kills
Some Insecticide Applications with Potential High Risk to Pollinators

• Applications to lindens before or during flowering
  – Linden aphid, Japanese beetle
• Hawthorn mealybug applications to plant before or during flowering
• Japanese beetles on plants that are flowering or will be flowering
  – Rose, linden, several vines,
Linden – A clear place where honey bees and insect management intersect in Colorado
Overwintering forms in bark cracks

Hawthorn Mealybug

Mature females on twigs

Leaf feeding stages in early summer

Overwintering forms in bark cracks
Favored Japanese beetle hosts include:

- Rose
- Virginia creeper
- Linden
Do honey bee-visited plants include: Ash??
Pollen Study
Study in progress

Survey of pollen collected by honey bees

Question to answer:
What are the important pollen sources used by honey bees in Colorado?
Last April, seven beekeepers placed a pollen trap on their hives. Locations were Boulder (2), Longmont (1), Fort Collins (3) and Loveland (1).

A sample of the collected pollen was taken one day a week through the spring and summer.
The pollen trap knocks off the pollen loads of honey bees as they return to the hives.
The samples are now being separated by type, identified, and weighed to determine the percentage of pollen types collected each week.
Primary Early Season Pollen Sources Identified to Date

- Earliest (late March-early April) pollen sources heavily used include:
  - Various Brassicaceae (flixweed, *Brassica* spp., several TBD)
  - *Acer* (Norway maple, boxelder)
  - *Prunus* (*virginiana*, *pumila*, TBD)
  - Redbud
  - Unidentified Rosaceae
  - Dandelion
  - Magnolia
Primary Early Season Pollen Sources Identified to Date

• Later (mid-April – early May) pollen sources heavily used include:
  – *Acer* (*platanoides* primarily)
  – Brassicaceae (TBD)
  – Hawthorn
  – Amelanchier
  – Other Rosacaceae (probably *Prunus*)
  – Dandelion
  – *Caragana*
  – Willow
Among wind pollinated trees, *Acer* (maples, boxelder) are very important early season sources of pollen.
Among wind pollinated trees, so far, no pollen from *Fraxinus* (ash) has been detected in samples.
Pollen Study

• **Overall Goal:** Determine what types of pollen are – and are not – being used by honey bees in urban/residential areas of Colorado.
  
  – *Used to identify useful pollen sources to incorporate into landscape plantings*
  
  – *Used to identify plants where use of pesticides may increase hazard to pollinators*

Project Support from CALCP, CDA, NPMA and the Colorado Agricultural Experiment Station
Systemic Neonicotinoids and Pollinators: Bottom Line

Avoid applications to plants *that bees visit* that are in bloom – *or soon will be in bloom*
Latest (September) revision of Bulletin 506A

Cost: $40

Available through the CSU University Resource Center (and at this conference)
Emerald ash borer – A new problem... permanently
2014 distribution of EAB in North America
Colorado EAB
Tree #1

Located near the intersection of 30th and Valmont, Boulder

Positive detection confirmed, September 2013
2014 distribution of EAB in North America
The encircled area includes sites where EAB has been detected within Boulder as of today. However, it is presumed that the insect has likely spread throughout the entire city, but at undetected levels.
Unlike states to the east, Colorado is highly compartmentalized due to its geography.

The current infestation is an infestation of the South Platte River drainage, not the State of Colorado.
Within the next five years, emerald ash borer *will* move out of Boulder into the surrounding counties.
Over time the South Platte River Drainage will be colonized by emerald ash borer
Unlike states to the east, Colorado is highly compartmentalized due to its geography.

The current infestation is an infestation of the South Platte River drainage, not the State of Colorado.
Most of Colorado is no more – nor less – at risk of infestation by Emerald Ash Borer. EAB will be a problem due to Boulder infestation.
How far away is emerald ash borer from your community?
How far away is emerald ash borer from your community?

One truckload
Entertaining visitors from the East this year? – Tell them you will provide all the firewood they need.
Using signs and symptoms to detect EAB infestations
Symptom that will develop as EAB injuries accumulate – Progressive dieback of the crown
ADIOS condition of regional Ash greatly complicates EAB detection
ADIOS - Ash Decline of Idiopathic Origins

- Residual effects of drought
- Residual effects of freezing injuries
- Cumulative effects from secondary insects
- ???????
Detecting Emerald Ash Borer
The presence of the insect is a positive detection.
Local Flatheaded borers of similar appearance to the EAB

- *Cypriacus intricata*
- *Buprestis confluenta*
- *Agrilus cyanescens*
- *Agrilus lacustris*
Emerald Ash Borer in Colorado - Identification of Insects and Damage of Similar Appearance

Whitney Cranshaw and Matt Camper

The emerald ash borer (*Agrilus planipennis*) is a wood boring beetle of Asian origin that has become established in parts of the upper Midwest. It is extremely damaging to all North America species of ash (*Fraxinus*), including green ash and white ash that are very commonly

http://www.ext.colostate.edu/pubs/pubs.html#insects

Also on RamCT homepage ➔ Web Links
Colorado hosts many metallic colored beetles that may be mistaken for emerald ash borer.
Other wood boring insects can be found in ash trees.
Lilac/ash borer
New Fact Sheet Available:

*Lilac/Ash Borer: A Common Wood Borer of Colorado’s Street Trees*
Flatheaded appletree borer

A generalist flatheaded borer/metallic wood borer that is associated with many hardwood that are in decline.
Ash bark beetles

An important contributor to limb dieback in Colorado ash
Ash bark beetles usually are found in limbs – but can occur in the trunk.
Redheaded ash borer

Two roundheaded borers/longhorned beetles occasionally occur in ash trees in advanced decline

Banded ash borer
Meandering tracks under the bark of ash always indicate some flatheaded borer. They will *almost always* indicate emerald ash borer.

Detecting emerald ash borer in Colorado ash
Flatheaded appletree borer

A generalist flatheaded borer/metallic wood borer that is associated with many hardwoods that are in decline.
Flatheaded appletree borer larvae produce dry, powdery sawdust excrement
Look for D-shaped exit holes in ash trees

Detecting Emerald Ash Borer in Colorado
Flatheaded appletree borer also produces a D-shaped exit hole when it emerges from an ash tree.
Easily viewed D-shaped exit holes are not going to be found in the trunk during the first couple of years of infestation!

Early EAB activity will be higher in the crown of the tree and requires inspecting upper branches.
Bark cracking can be a good clue that EAB may be present in a tree.
Peeling the bark away from a cracked area may reveal earlier larval tunneling.
Bark cracking can be a good clue that EAB may be present in a tree.

A good place to look is the underside of limbs, particularly in the area near the trunk.
Possible symptom of EAB injury – irregular yellowing of the foliage
Declining ash trees with dead leaves hanging on the tree – High likelihood of EAB