Minimizing the Impact of Pesticides on Pollinators

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Horticulture Agent
NC Cooperative Extension, Chatham County Center
Minimizing Pesticide Impact

• Understanding pesticide exposure and toxicity
• Pesticide labeling
• Minimizing impact:
  – Minimizing need for pesticides
  – Best management practices
Why We Need Bees

- **Human Health** - Most fruits and vegetables require insect pollination
Why We Need Bees

• **Economic Impact** – Pollinators are essential to the production of more than 90 crops in the U.S.

• **Value of crops in US that depend on pollination:** >$18.9 billion

• $217 billion worldwide
Why We Need Bees

Ecosystems rely on pollinators

- 80% of plants on earth rely on animal mediated pollination
- Native plants sustain wildlife and provide ecosystem services
Bees in Decline

• The number of managed honey bee colonies in the US has **declined by 50% in the past 60 years.**
• **Xerces Society** lists 57 species of native bees as vulnerable or imperiled

Native to the eastern US, the rusty patch bumble bee is at high risk of extinction.
*Image by: Johanna James-Heinz*
Causes of Bee Decline: Complex and Interacting

Parasites and Diseases

Pesticides and Environmental Stress

Poor Nutrition: Lack of flowers

Habitat Loss (native bees)
Pesticides and Pollinators

• **Chronic Exposure**
  “sublethal effects” = exposure to sublethal levels over extended period can impair foraging ability, reduce fertility, increase disease susceptibility

• **Acute Toxicity**
  “lethal effects” = immediate death or death within a few hours of exposure

Mass bee death due to improper insecticide application
Acute Toxicity

Pesticides include:

- **Insecticides** – kill insects
- **Miticides** – kill mites
- **Herbicides** – kill plants
- **Fungicides** – control pathogens

Majority of *pesticides* are “relatively nontoxic” to bees
Insecticides

• Most are toxic to bees
• For most insecticides, bees are more sensitive than pest insects
• Honeybee genome has less genes for pesticide detoxification compared to other insects
Herbicides & Fungicides

• Most are “relatively nontoxic” to bees, including:
  – Glyphosate (Roundup and generics)
  – Triclopyr (Garlon, “Brushkiller”)

• Herbicide impact on pollinators is from loss of forage
  – “Weeds” provide important forage throughout the year
EPA Pesticide Toxicity Groups: Acute Toxicity to Honeybees

- **Category 1: “Highly Toxic to Bees”**
  - The Acute Contact $LD_{50}$ is less than or equal to 2 micrograms per bee

- **Category 2: “Toxic to Bees”**
  - $LD_{50}$ is less than 11 but greater than 2 micrograms per bee

- **Category 3: “Relatively Nontoxic”**
  - $LD_{50}$ of the pesticide is greater than 11 micrograms per bee; no bee caution statement is required on the label

Category 1 & 2 known as “Pollinator Toxic Pesticides”, PTP’s
Bee Toxicity Ratings

<table>
<thead>
<tr>
<th>Highly Toxic</th>
<th>Moderately Toxic</th>
<th>Relatively Nontoxic</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Severe bee losses</td>
<td>• Can be used in vicinity of bees if:</td>
<td>• Can be used around bees with a minimum of injury if:</td>
</tr>
<tr>
<td>losses expected if used:</td>
<td>- Dosage, timing, and method of application are correct</td>
<td>• Dosage, timing, and method of application are correct</td>
</tr>
<tr>
<td></td>
<td>• Should never be applied directly to bees in field or hive</td>
<td>• Never apply directly to beehive</td>
</tr>
<tr>
<td></td>
<td>- when bees present</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Bees forage in treated area within a day after application</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- applied near hives</td>
<td></td>
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</tbody>
</table>
Highly & Moderately Toxic - Acute toxicity can occur from:

- **Direct exposure** during application
- **Residues** picked up through foraging (pollen and nectar) and taken back to the hive
- **Residues** from non-target plants (ground cover, weeds, etc.)
Residual Toxicity

Some pesticides remain toxic to bees for some time after the application is made via contact with residues on the treated plant, including blooms. This is residual toxicity.
Extended Residual Toxicity (ERT)

Compounds that remain toxic to bees for an extended period of time (8 hrs +) following foliar applications are referred to as Extended Residual Toxicity or ERT.

ERT pesticides may not be applied to blooming crops or weeds.
Insecticides With Extended Residual Toxicity

Families of insecticides most commonly associated with ERT include:

- **Organophosphates** (e.g. malathion, chlorpyrifos, acephate, “Orthene”)
- **Carbamates** (e.g., carbaryl, “Sevin”)

**Newer Chemistries:**

- **Neonicotinoids, Pyrethroids**
Insecticides with ERT: Pyrethroids

• Active ingredients end in “thrin”
  – Bifenthrin, Permethrin, Cyfluthrin

• **Brands:** Astro, Talstar, Onyx, Ambush, Pounce, Asana . . .

• **Broad spectrum contact insecticides,** harsh on beneficial insects, highly toxic to bees

Pyrethroids are synthetic versions of natural pyrethrins, derived from a species of Chrysanthemum
Insecticides with ERT: Neonicotinoids

• **Imidacloprid** – Merit, Admire, Gaucho, generics, many homeowner products
  – Most widely used insecticide in the world
• **Dinotefuran** – Safari, Venom
• **Acetamiprid** – TriStar, Assail
• **Thiamethoxam** – Flagship, Cruiser, Platinum and more
• **Clothianidin** – Arena, Clutch

Control most sap feeding insects (scale, aphids, whitefly) and leaf feeding beetles
DO NOT control caterpillars or ambrosia beetle borers
Neonicotinoids

Bee deaths a result of pesticide Safari; count upped to 50,000 dead insects

WILSONVILLE, OREGON – June 18, 2013 – A dead bumblebee clings to a linden tree. The Oregon Department of Agriculture suspects they were killed by improper pesticide. Motoya Nakamura/The Oregonian
Neonicotinoids

- All except acetamiprid are “highly toxic” — acute toxicity
- Systemic: Transported to all parts of plant, including pollen and nectar — chronic exposure

Xerces Society report — available online
With so many brand names, how do you know what you are using?

Check the label for the active ingredients:

Active Ingredients:
Imidacloprid ............... 2.94%
Other Ingredients ...... 97.06%
Total ......................... 100.00%

- Prevents new infestations
What else can the label tell you?

• **Acute toxicity:**
  - “Highly toxic to bees”
  - “Toxic to bees”
  - If no bee caution, “relatively nontoxic”

• **Found in:**
  - Environmental Hazard Statement
  - Directions for Use
**Sevin® 80 WSP**

**CARBARYL INSECTICIDE**

**ENVIRONMENTAL HAZARDS**

**BEE CAUTION:** MAY KILL HONEYBEES IN SUBSTANTIAL NUMBERS.

This product is highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees are visiting the treatment area. Contact your Cooperative Agricultural Extension Service or your local Bayer Environmental Science representative for further information.
Is There Residual Toxicity?

- **If NO:** “Actively visiting the treatment area”
  - Refers to bees you see on plants
- **If YES:** “Visiting the treatment area”
  - Refers to bees that may visit the plants after treatment
- “Visiting” replaced with “FORAGING” on newer labels
Sevin® 80 WSP
CARBARYL INSECTICIDE

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Actively Foraging/Visiting

- Honey bees forage 2-4 miles from hive, temps over 55°F
- Native bees typically forage less than 1 mile from nest; capable of foraging at lower temperatures
- From sun-up to sun-down

If flowers are present, assume pollinators are foraging!
Pesticide Labeling

- As long as you know what words to look for, you can determine how “safe” or “harmful” a pesticide is to bees
- READ THE LABELS
- Compare products
  - Choose least toxic option
<table>
<thead>
<tr>
<th>Toxicity Group</th>
<th>If Extended Residual Toxicity</th>
<th>If NO Extended Residual Toxicity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>I = Highly Toxic</strong></td>
<td>This product is <strong>highly toxic</strong> to bees exposed to <strong>direct treatment or residues</strong> on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees are <strong>visiting</strong> the treatment area.</td>
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</tr>
<tr>
<td><strong>II = Toxic</strong></td>
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</tr>
<tr>
<td><strong>III = Relatively Nontoxic</strong></td>
<td>No bee caution required</td>
<td></td>
</tr>
</tbody>
</table>
New Labeling: Neonicotinoids

- If contain:
  - Clothianidin,
  - dinotefuran,
  - imidacloprid
  - thiamethoxam

- And labeled for outdoor foliar application
Insecticide Labels

- Safari
- Talstar
- Azatin
- Conserve

- Which is a neonic?
- Which is relatively nontoxic to bees?
- Which has ERT?
- Which is toxic to bees but does not have residual toxicity?
Insecticide Labels

• Which is a neonic?
  – Safari

• Which is relatively nontoxic to bees?
  – Azatin

• Which has ERT?
  – Talstar

• Which is toxic to bees but does not have residual toxicity?
  – Conserve

• Which would you apply to flowering plants?
Using Pesticides: Best Management Practices

To minimize impact on pollinators:

- Minimize the need for pesticides
- Select least toxic products
- Manage drift
- Time application to avoid bee activity
- Avoid treating plants in bloom
Minimize Need for Pesticides: Integrated Pest Management

- An **integrated** approach
- **Seeks balance**, not eradication
- **ID pests** before deciding on control strategy
- Pesticides used if other strategies do not provide sufficient control
Plant Selection

• Know the plants you care for
  – Bloom time, common pests
• Avoid and replace pest prone species!
• Plant a diversity of species
• Allowing plants to die is an option!

Scale infested Euonymus
Reduce Stress

- Right plant for the site
- Amend soils, alleviate compaction
- Nutrient management
- Water management

Like many pests, lecanium scale reproduce faster on stressed plants.
Beneficial Insects

• Learn to recognize all **life stages** of beneficials

• **Diverse landscapes** encourage beneficials – plant many different types of plants, including flowers

• Strive for a **balance** of good and bad insects

• **Insecticides with ERT** are especially harsh on beneficials
Scout Regularly

- Catch pests before they become severe
- Remove small infestations
  - Prune out
  - Crush insects or eggs
- **Spot treat**
- NO calendar sprays

Fall Webworm
Only treat when necessary - Before you spray, ask:

- Is the problem correctly identified?
- Does problem threaten plant health?
  - Many pests cosmetic, eg. Azalea lace bug
  - Many pests short-term, eg. Japanese beetles
Before You Spray, Ask:

• Is the plant worth treating?
• Is it the right time to treat?
• Are 1-2 applications likely to cure the problem?
• What products are effective? Which are least toxic to non target species?
• Is replacing the plant with a less pest prone species a better option?
Most bee poisoning incidents occur when insecticides that are highly toxic to bees and that have a residual hazard longer than 8 hours are applied to bee-pollinated plants during the bloom period.
Minimize Impact

• Never spray plants in bloom with highly or moderately toxic pesticides!

• Check adjacent plants and weeds
  – Mow weeds
  – Prune off flowers if necessary

Holly blossoms
Minimizing Impact: Neonicotinoids

• Never apply to plants in bud or bloom
• If necessary, apply only after flowering complete – petals have shed
• Beware of soil residual build up
Minimize Impact

Minimize Drift

– Coarse droplet size, lower pressure
– Hold nozzle close to target
– Check forecast
– Don’t spray if winds over 5 mph; temps over 85 F
Minimize Impact: Application Timing

Honey bees forage sun up to sun down unless it’s raining

Source: Marla Spivak, UMinn
Best time for pesticide application: Just after sun down

<table>
<thead>
<tr>
<th>OK if no residue</th>
<th>Kills Bees</th>
<th>Best</th>
<th>OK if little residue</th>
</tr>
</thead>
<tbody>
<tr>
<td># of foragers</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Never spray ERT pesticides on blooming plants

Source: Marla Spivak, UMinn
Minimize Impact

- **READ AND FOLLOW ALL LABEL DIRECTIONS**
- **Identify pest** – if treatment necessary:
  - Identify all control options
    - Cultural, mechanical, biological, chemical
    - Identify all products labeled for use
- Choose products that are **relatively nontoxic** if available
  - Check environmental hazard statement and **directions for use**
- **Time applications to avoid bee activity and minimize drift**
Identify All Products

2015 North Carolina Agricultural Chemicals Manual Introduction

Recommendations

These recommendations apply only to North Carolina. They may not be appropriate for conditions in other states and may not comply with laws and regulations outside of North Carolina. Unless otherwise noted, these recommendations were current as of November 2014. Individuals who use agricultural chemicals are responsible for ensuring that the intended use complies with current regulations and conforms to the product label. Be sure to obtain current information about usage regulations and examine a current product label before applying any chemical. For assistance, contact your county Cooperative Extension Service agent. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by the North Carolina Cooperative Extension Service nor discrimination against similar products or services not mentioned.

Printed Manual

Click here to order copies of the printed version of this manual.

Table of Contents

ABBREVIATIONS
I. PESTICIDE USE AND SAFETY INFORMATION

http://content.ces.ncsu.edu/north-carolina-agricultural-chemicals-manual/
Caterpillars (such as armyworm, budworm, eastern tent caterpillar, fall webworm, orangestriped oakworm, leafrollers)  

<table>
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<th>Insecticide Product(s)</th>
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<tbody>
<tr>
<td>acephate (Orthene)</td>
</tr>
<tr>
<td>acetamiprid (Tri-Star)</td>
</tr>
<tr>
<td>azadirachtin (Azatin)</td>
</tr>
<tr>
<td><em>Bacillus thuringiensis kurstaki</em> (DiPel)</td>
</tr>
<tr>
<td>bifenthrin (Onyx, Talstar)</td>
</tr>
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<td>bifenthrin + imidacloprid (Allectus)</td>
</tr>
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</tr>
<tr>
<td>carbaryl (Sevin)</td>
</tr>
<tr>
<td>chlorantraniliprole (Acelepryn)</td>
</tr>
<tr>
<td>indoxacarb (Provaunt)</td>
</tr>
<tr>
<td>insecticidal soap (various)</td>
</tr>
<tr>
<td>novaluron (Pedestal)</td>
</tr>
<tr>
<td>permethrin (Astro, Perm-up, Permethrin Pro)</td>
</tr>
<tr>
<td>spinetoram + sulfoxaflor (XXpire)</td>
</tr>
<tr>
<td>spinosad (Conserve SC)</td>
</tr>
<tr>
<td>tebufenozide (Confirm)</td>
</tr>
</tbody>
</table>
Relatively Nontoxic

• **Organic/natural insecticides** do not have ERT; some are relatively non-toxic:
  – Soaps, Oils, Neem/Azadirachtin, B.t.

• Some newer synthetic products
**Xxpire**

spinetoram + sulfoxaflor

- Whiteflies, Aphids, Mealybugs, Lepidopterans (caterpillars), Lacebugs, Certain Scales, Thrips, others
- Controls chewing and sap-feeding insects
- Can be used in nurseries, greenhouses and commercial landscapes
• Active ingredient: Chlorantraniliprole
• Landscapes and turf (professional applicators)
• Systemic activity
• Caterpillars, Beetles, Leafminers, some Borers
• Sucking pests: lacebugs, aphids
• Granular formulation – white grubs in turf
**Active Ingredient:**
Indoxacarb

**Controls:**
Caterpillars on landscape ornamentals and turf
<table>
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Relatively Nontoxic Options?

Chapter V: Insect Control
Table 5-15: Arthropod Management for Ornamental Plants Grown in Nurseries and Landscapes, Page 154
Minimizing Impact

Use Integrated Pest Management to reduce the need to spray and consider:

• **What you spray**
  – Consider acute and residual toxicity
  – Choose relatively nontoxic options when available

• **When you spray**
  – Time of day; Bloom cycle
  – Only when necessary – no calendar sprays

• **Where you spray**
  – Never open blossoms
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http://ces.ncsu.edu
to submit questions to our ‘Ask an Expert’ widget and to find your local Extension center

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