Neonicotinoid Insecticides: What’s all the Buzz

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Total annual loss (%) 2014-2015 by state
Health of native bees also of concern
Neonicotinoid Insecticide

• New Nicotine-Like Insecticide

[Chemical structures of Imidacloprid and Nicotine]
Group 4: Nicotinic acetylcholine receptor agonists

• Example: Neonicotinoids (4A)
Group 4: Nicotinic acetylcholine receptor agonists

• Example: Neonicotinoids (4A)
Neonicotinoid use

- Low mammalian toxicity
  - “Reduced risk”
- High efficacy against diversity of pests
- Systemic within plants
- Seed- or foliar-applied
Insect threats to soybean
Insect threats to soybean

No rescue treatments available
Insect threats to soybean

Seed-applied: limited period of protection

Foliar-applied: follow scouting & threshold recommendations
Insect threats to soybean

Foliar-applied: follow scouting & threshold recommendations
Seed treatments in soybean

• Useful for managing certain pests in targeted, high-risk situations

• Current use exceeds need
Timing is important

Relationship Between Neonicotinoid Seed Treatments and Soybean Aphid Populations

Declining neonicotinoid concentrations

VE VC V2 V4 R2 R5
Vegetative Growth Flowering Pod & Seed Development

TYPICAL SOYBEAN APHID POPULATIONS

Bailey et al. 2015
Foliar insecticides for soybean aphid

- Scouting: Estimate aphid abundance on plants
- Economic threshold (trigger point)
  - 250 aphids/plant, &
  - At least 80% of plants infested, &
  - Aphid populations increasing
- Application of foliar insecticides
<table>
<thead>
<tr>
<th>Group</th>
<th>Common name</th>
<th>Individual A.I.s</th>
<th>Formulated mixtures</th>
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</thead>
<tbody>
<tr>
<td>1A</td>
<td>methomyl</td>
<td>Lannate</td>
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<tr>
<td></td>
<td>acephate</td>
<td>Acephate</td>
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<tr>
<td>1B</td>
<td>chlorpyrifos</td>
<td>Lorsban Advanced, Chlorpyrifos, Govern, Hatchet, Nufos, Vulcan, Warhawk, Whirlwind, Yuma</td>
<td>Tundra Supreme, Cobalt, Cobalt Advanced, Stallion, Match-Up</td>
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<tr>
<td></td>
<td>dimethoate</td>
<td>Dimethoate</td>
<td></td>
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<tr>
<td>2A</td>
<td>alpha-cypermethrin</td>
<td>Fastac</td>
<td>Leverage</td>
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<td></td>
<td>beta-cyfluthrin</td>
<td>Baythroid</td>
<td>Justice, Match-Up, Tundra Supreme, Brigadier, Swagger, Skyraider, Hero, Steed, Triple Crown</td>
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<td>bifenthrin</td>
<td>Tundra, Sniper, Fanfare, Discipline, Brigade, Bifenture</td>
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<td>3A</td>
<td>cyfluthrin</td>
<td>Tombstone</td>
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<td>deltamethrin</td>
<td>Delta Gold, Batallion</td>
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<td>esfenvalerate</td>
<td>Asana XL, Adjourn</td>
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<td>gamma-cyhalothrin</td>
<td>Declare, Proaxis,</td>
<td>Cobalt</td>
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<td>lambda-cyhalothrin</td>
<td>Warrior II, Grizzly Z, LambdaStar, Lambda-Cy, Lamcap, Province, Silencer VC, Taiga Z,</td>
<td>Besiege, Cobalt Advanced, Double Take, Endigo, Seeker</td>
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<td>permethrin</td>
<td>Arctic</td>
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<td>zeta-cypermethrin</td>
<td>Mustang Maxx, Respect</td>
<td>Hero, Steed, Stallion, Triple Crown</td>
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<td>4A</td>
<td>acetamiprid</td>
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<td></td>
<td>chlothianadin</td>
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<td>Belay</td>
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<tr>
<td></td>
<td>imidacloprid</td>
<td>Prey, Admire Pro, ADAMA Alias, Wrangler, Nuprid, Sherpa,</td>
<td>Leverage, Brigadier, Swagger, Skyraider, Triple Crown</td>
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<tr>
<td></td>
<td>thiamethoxam</td>
<td></td>
<td>Endigo</td>
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</table>
Pollinators in soybean fields

- Soybean fields in Iowa
- 32 bee species captured
- Honey bees comprised only 0.52%
- Of the 6 most common bee species, 6% to 15% of individuals had soybean pollen
- Bees occurred in similar numbers from R1 to R6

Gill & O’Neal 2014
Flowers of seed-treated soybean?

• Neonicotinoids not detected in soybean pollen in north central region (Krupke, unpublished)

• Neonicotinoids not detected in soybean flowers in mid-south region (Stewart et al. 2014)

• Neonicotinoids found in corn pollen (Krupke et al. 2012, Stewart et al. 2014)
Other routes of pollinator exposure to neonicotinoids

- Contamination of soil & flowers in/near fields (Krupke et al. 2012, Stewart et al. 2014)
- Increasing availability of foliar insecticides as formulated mixtures with neonicotinoids
Toxicity of neonicotinoids to bees

“Highly toxic”

(LD$_{50}$ oral: 13 ng / bee)

(Sánchez-Bayo et al. 2016)

1 ng = one billionth of a gram

Known sublethal effects at lower concentrations
What is the impact of neonicotinoids on bees?

Risk = Effect x Exposure

Risk = “highly toxic x ???"
I, Mark Dayton, Governor of the State of Minnesota, by virtue of the authority vested in me by the Constitution and applicable statutes, do hereby issue this Executive Order:

Whereas, Minnesota farmers provide food, feed, fuel, and fiber for the nation and the world, and agriculture is a cornerstone of Minnesota’s economy;

Whereas, Minnesota’s agricultural economy provides over 340,000 jobs and $90 billion in economic activity;

Whereas, pollinators are essential to the reproduction of many native plants and cultivated food crops;

Whereas, pollinators sustain habitat that support wildlife and provide aesthetic and ecological benefits such as carbon storage and improved water quality;

Whereas, more than 200,000 pollinator species including insects, birds, bats, and other animals exist worldwide; including insect pollinators such as bees, wasps, flies, butterflies, moths, and beetles that are critical to our food production system;

Whereas, bees are considered to be the most efficient and important pollinators for our food crops; the estimated annual value of honey bee pollination alone for food production is $17 billion dollars while that of native pollinators is estimated at $6 billion;

Whereas, over the past decade there has been a significant loss of pollinators including honey bees, native bees, butterflies, moths, birds and bats;
Executive Order 16-07

1. **MDA** shall take immediate action to implement the special registration review of neonics...

• Require “verification of need” prior to use of neonics, where appropriate;

• Review pesticide labels & implement restrictions, as appropriate…;

• Increase inspections & enforcement of label requirements for pesticides acutely toxic to pollinators;

• Develop pollinator stewardship materials…

• Continue to develop & promote BMPs…
Executive Order 16-07

2. **Environmental Quality Board** shall convene agency leadership & Minnesotans to implement this order...

3. **Governor’s Committee on Pollinator Protection** created to advise Governor and others...

4. **DNR** will develop an IPM strategy for public lands administered by DNR...

5. **BWSR** shall direct work to restore/improve pollinator habitat...

6. **MnDOT** shall manage transportation properties, etc. for pollinator habitat.

7. **MPCA** shall manage landfills for pollinator habitat.

8. **Administration** shall take measures to support pollinator health on Capitol Complex, etc.
MDA’s 8 Action Steps

1. Create a treated seed program
2. Create a dedicated “Pollinator Protection Account”
3. Require formal verification of need prior to use of neonicotinoid pesticides
4. Develop educational campaign for homeowners & residential users of insecticides
5. Review product labels for appropriate use of neonicotinoids for homeowners & residential users
6. Develop Minnesota-specific pollinator stewardship materials
7. Increase use inspections for insecticides highly toxic to pollinators
8. Review label requirements for individual neonicotinoid products
1. Create a treated seed program

- “Treated articles” meet US EPA’s exemption & are not subject to US EPA or MDA pesticide regulation
- Requires legislative action
- New program would:
  - Provide authority to regulate seeds treated with pesticides
  - Fund research to develop recommendations for use
  - (May) require that seed with no or lower rates of pesticide be available
3. Require formal verification of need prior to use of neonicotinoids

- Focused on foliar applications
- Products could be applied when:
  - Imminent threat of significant crop loss
  - Consistent with IPM plan or economic threshold
- Application requirements already exist on product labels
- What qualifies as an imminent threat or an adequate IPM plan requires further definition
3. Require formal verification of need prior to use of neonicotinoids

- MDA will ensure applications are made only when need verified by a qualified individual
- MDA will develop:
  - Process for verification of need
  - Process for training “qualified individuals”
- Requirements will be phased in over time
  - Emphasis on education
Thank you

- Questions???
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