Impact of Pesticides on Pollinators and other Non-target Organisms

Keith Tignor
Virginia Department of Agriculture and Consumer Services
What is an Ideal Pollinator?

- Mobile
- Large number of individuals
- Attracted to pollen source
- Apparatus to carry pollen
Presidential Memorandum
June 20, 2014

• Created a Federal Strategy to Promote the Health of Honey Bees and Other Pollinators

• Establish Pollinator Health Task Force

• Mission and Function of the Task Force:
  – Pollinator Research Action Plan
  – Public Education Plan
  – Public-Private Partnerships
U.S. Fish and Wildlife Service Status Review for the Monarch Butterfly

• Migration more perilous for many monarchs because of threats along their migratory pathways and on their breeding and wintering grounds.

• Habitat loss
  – Over wintering site
  – Migratory pathways

• Mortality resulting from pesticide use
  – Adult mortality from insecticides
  – Loss of milkweed from herbicides
What is a Pesticide

• Agent used to kill or control undesired insects, weeds, rodents, fungi, bacteria, or other organisms

• Pesticides are classified according to function:
  – Avicide – birds
  – Herbicides – weeds
  – Fungicides – fungi, mold and mildew
  – Insecticides – insects
  – Rodenticides – rodents

• Herbicides are the most widely used type of pesticide in agriculture
Pesticides Registered for Use in Virginia

*Product count based on number registered on October 1 of each year.
# Categories of Pesticides

<table>
<thead>
<tr>
<th>ALGAECIDE HERBICIDE</th>
<th>FERTILIZER WITH INSECTICIDE</th>
<th>INSECTICIDE &amp; NEMATICIDE</th>
<th>PLANT GROWTH REGULATOR</th>
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<tbody>
<tr>
<td>ALGICIDE</td>
<td>FERTILIZER WITH INSECTICIDE &amp; HERBICIDE</td>
<td>INSECTICIDE &amp; REPELLENT</td>
<td>PLANT GROWTH REGULATOR WITH FERTILIZER</td>
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<td>ANTIFOULENT PAINT</td>
<td>FERTILIZER WITH INSECTICIDE AND FUNGICIDE</td>
<td>INSECTICIDE &amp; TERMITICIDE</td>
<td>PLANT-INCORPORATED PROTECTANT</td>
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<td>AVICIDE</td>
<td>FUMIGANT</td>
<td>INSECTICIDE ACARICIDE</td>
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<td>BIOCIDE (ALGAE, SLIME, BACTERIA, FUNGI)</td>
<td>FUNGICIDE</td>
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<td>BIONEMATICIDE</td>
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<td>INSECTICIDE, FUNGICIDE, MITICIDE</td>
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<td>FUNGICIDE, HERBICIDE, INSECTICIDE &amp; NEMATICIDE</td>
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<td>HERBICIDE</td>
<td>MISCELLANEOUS</td>
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<td>DISINFECTANT, ALGAECIDE</td>
<td>INSECT GROWTH REGULATOR</td>
<td>MITICIDE (ACARICIDE)</td>
<td>SANITIZER, DISINFECTANT, &amp; VIRUCIDE</td>
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<td>MOLLUSCICIDE</td>
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<td>NEMATICIDE</td>
<td>TERMITICIDE</td>
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<tr>
<td>FERTILIZER WITH HERBICIDE</td>
<td>INSECTICIDE &amp; MITICIDE</td>
<td>OTHER</td>
<td>TERMITICIDE, INSECTICIDE, FUNGICIDE</td>
</tr>
</tbody>
</table>
Registered Pesticides in Virginia in 2014

Total number of registered pesticides = 15,211

from Office of Pesticide Services, VDACS

16.7% decline

from EPA website (http://www.epa.gov/opp00001/pestsales)
Estimated Amount of Conventional Pesticides Used in the U.S. in 2007

Total Usage = 857 million lb.

from A. Grube, Donaldson D., Kiely T., and Wu L. (2011)
Estimated Amount of Conventional Pesticides Used in the U.S. in 2007

from A. Grube, Donaldson D., Kiely T., and Wu L. (2011)
One man's beneficial is another man's pest.

Politics

Money

Emotion
Environmental Fate of Pesticides
Ideal Pollinator – Honey Bee

• Year round activity
• Transportable population
• Capable of Flight
• 60,000 to 80,000 individuals in hive
• Hairy
  – Nearly 100% of body covered with hair
  – Plumose hair
  – Pollen basket
• Pollen and nectar are primary food source
Detected Agrochemicals in North American Apiaries

- Sample Source: Bees, Wax, Pollen
- Pesticide contaminants (#):
  - Bees: 40
  - Wax: 90
  - Pollen: 100

Occurrence of Samples with Multiple Agrochemicals in North American Apiaries

Correlation of Fungicide Residues with Pesticide Contents of Pollen Samples

Pesticide Impact on Honey Bee

• R. Fell, Tignor K. (2001)
  – Reduced drone fecundity
  – Reduced queen cell production

• J. Wu, Anelli C., Sheppard S. (2011)
  – Increased larval mortality
  – Delayed adult emergence
  – Reduced adult longevity

• L. Dahlgren (2012)
  – Reduced queen survival

• J. Berry, Hood W., Pietravalle S., Delaplane K. (2013)
  – Decreased brood survival
  – Increase queen supercedure
Winter Hive Losses in Virginia

Overall colony losses of 32.9% during the period 2000-2014.
Status of Bumble Bee Populations in Northern and Coastal Eastern States of the U.S.

![Graph showing the relative abundance of Bombus spp. for different species and time periods.]

from S. Cameron, Lozier J., Strange J., Koch J., Cordes N., Solter L., Griswold T. (2011)
Impact of Pesticides

• Lethal
  – Broad spectrum
  – Toxicity to adult
  – Toxicity to immature
  – Lethal determination
    • Dosage
    • Concentration
    • Time

• Sub-lethal
  – Weight loss
  – Shorter life span
  – Behavior changes
  – Reduced fecundity
  – Reduced immunity
  – Deformity
  – Mutation
  – Loss of habitat/food source
Factors Affecting Pollinator Populations

- **Environment**
  - Temperature extremes
  - Climate change
  - Bloom dates
  - Drought

- **Nutrition**
  - Habitat loss
  - Food resources

- **Genetics**
  - Diversity
  - Isolation
  - Integrity

- **Toxicants/pollutants**
  - Point source
  - Non-point source