

ARE HERBICIDES KILLING OUR BEES?

Erik Johansen, WSDA

Olympic Invasive Working Group Meeting

Jamestown S'Klallam Campus

Sequim, WA

November 16, 2016



Washington
State Department of
Agriculture

Introduction

- **Bee Pollinated Crops.**
- **Species of Bees.**
- **Bee Poisoning / Pesticide Regulation.**
- **Managed Pollinator Protection Plan (MP3).**
- **Examples of MP3 From Other States.**
- **MP3 Development in Washington.**

Bee Pollinated Crops

- **1805:** Journal Entries of Lewis & Clark Expedition Mention use of **Berries** by Tribes Along Columbia River.
- **1820s:** **Apple** Seeds Planted at Fort Vancouver by Hudson's Bay Company.
- **1830s:** Apple Seeds Planted at Whitman Mission. Crops **Irrigated** from Doan Creek.

Bee Pollinated Crops

- **1885:** First **Vegetable Seed** Company was Founded in Washington.
- **1889:** Statehood.
- **1890:** Washington State Agricultural College and School of Science was Founded. (**Go Cougs!**)
- **1919:** Establishment of WSC Experiment Station at **Prosser** for Research on Irrigated Crops.

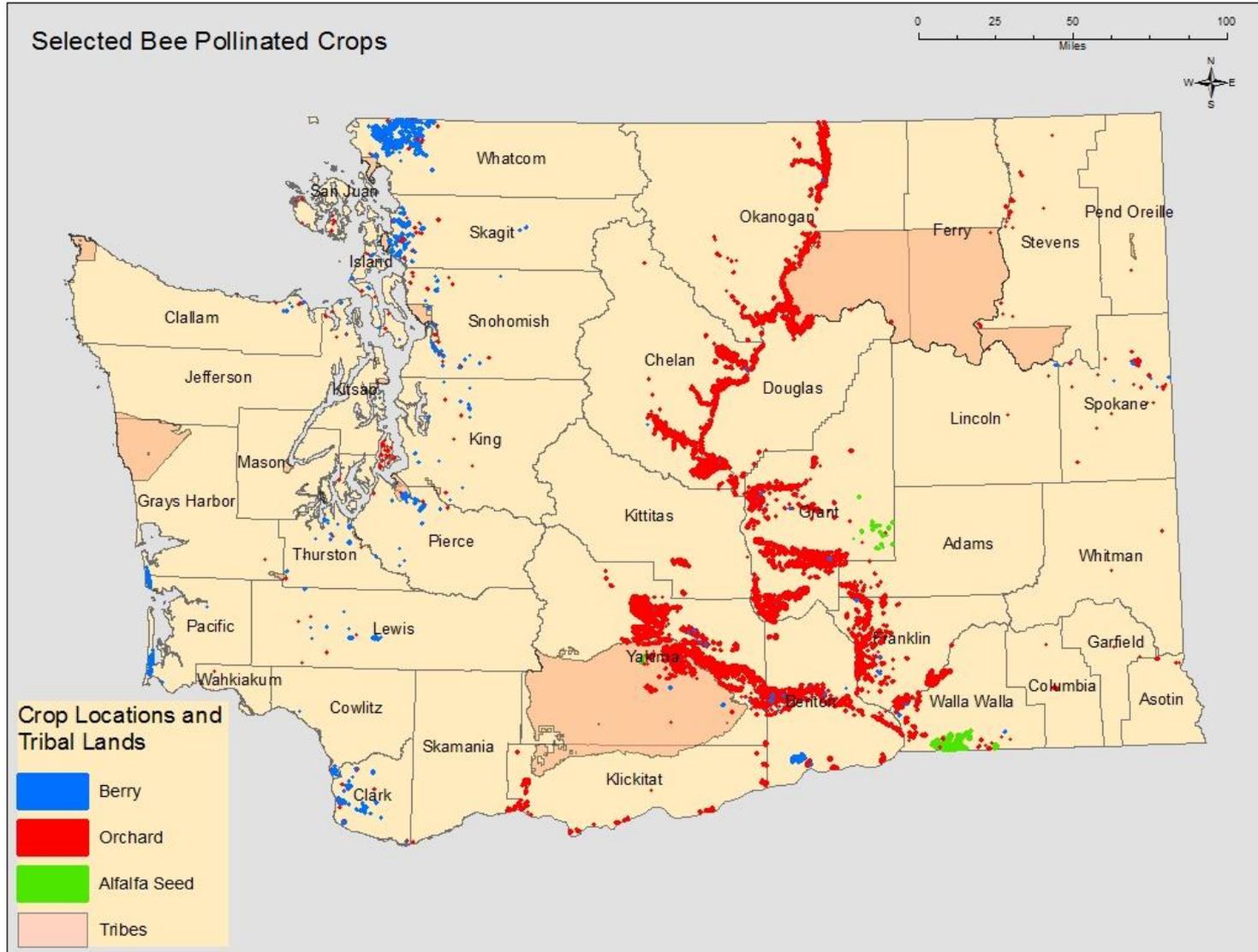
Bee Pollinated Crops

- **1937:** Establishment of WSC Experiment Station at **Wenatchee** for Research on Tree Fruits.
- **1951:** Water from Grand Coulee Dam used to Irrigate the Columbia Basin Project.
- **1952 – 2002:** WSU Research on Pollination (Johansen and Mayer).

Bee Pollinated Crops

- **2013:** Value of Crops Pollinated by Bees in WA was Approx. **\$3 Billion** (Tree Fruits, Small Fruits, Seed Crops).
 - **Tree Fruits** are Approx. **218,000** acres.
 - **Small Fruits** are Approx. **22,000** acres.
 - **Alfalfa Seed** are Approx. **17,000** acres.
- Bee Pollination of Home Gardens and Native Plants.

Bee Pollinated Crops



Bee Pollinated Crops - Apple



Bee Pollinated Crops - Peach



Bee Pollinated Crops - Blueberry



Bee Pollinated Crops - Cranberry



Bee Pollinated Crops – Alfalfa Seed



Bee Pollinated Crops – Radish Seed



Native Plants - Rhododendron



Species of Bees

- **Honey Bees are the Most Widely Used Pollinators (Many Crops).**
 - **Honey Bees are Social (Colonies). Colonies have Thousands of Foraging Honey Bees.**
- **Alkali Bees and Alfalfa Leafcutting Bees (Alfalfa Seed).**
- **Bumble Bees (Clover Seed, Cranberry).**
- **Orchard Mason Bees (Tree fruits).**

Species of Bees

- **Honey Bee, *Apis mellifera*, Lavender**



Species of Bees

- Honey Bee, *Apis mellifera*



Species of Bees

- Approx. 4,000 Species of Bees in North America (Six Families).
- **Solitary (More Than 90%)** or Social (e.g. *Apis* and *Bombus*).
- **Generalist (Most Species)** or Specialist.
- **Typically 1 Generation per Year.**
 - Some Sweat Bees 2-3 Generations, Honey Bee Colonies are Perennial.

Species of Bees

- **Ground Nesting (Approx. 70%).**
 - Dig Tunnels (Sometimes in Large Aggregations).
 - Reuse Abandoned Rodent Burrows.
- **Tunnel Nesting (Approx. 30%).**
 - Reuse Abandoned Beetle Burrows in Dead Trees or Limbs.
 - Chew Out Nest in Stems or Twigs.

Species of Bees

- **Alkali Bee, *Nomia melanderi*, Alfalfa Seed**



Doug Walsh, WSU

Species of Bees

- **Alkali Bee, *Nomia melanderi***



Species of Bees

- **Alkali Bee, *Nomia melanderi***



Species of Bees

- **Alfalfa Leafcutting Bee, *Megachile rotundata*, Alfalfa Seed**



Natalie Boyle, WSU

Species of Bees

- Alfalfa Leafcutting Bee, *Megachile rotundata*



Natalie Boyle, WSU / Ken Gray Image Courtesy of Oregon State University

Species of Bees

- Alfalfa Leafcutting Bee, *Megachile rotundata*



Species of Bees

- **Bumble Bee, *Bombus vosnesenskii*,
Tomato**



Mace Vaughn, Xerces Society

Species of Bees

- **Bumble Bee, *Bombus* sp.**



Ken Gray Images Courtesy of Oregon State University

Species of Bees

- **Orchard Mason Bee, *Osmia lignaria*,
Almond**



Gordon Wardell, Paramount Farming

Species of Bees

- **Mason Bee**
- ***Osmia* sp.**



USDA Statistics on Honey Bee Colonies

- **1913:** Initial USDA Statistics on Honey Bees in WA, approx. **51,000** Colonies.
- **1959:** Peak - Approx. **100,000** Honey Bee Colonies in WA.
- **2013:** Current - Approx. **69,000** Honey Bee Colonies in WA.
- ***Washington Does Not Have Enough in-state Honey Bee Colonies to Pollinate Crops.***

Bee Poisoning / Pesticide Regulation

Five Classes of Insecticides Have Caused Serious Honey Bee Poisoning Incidents:

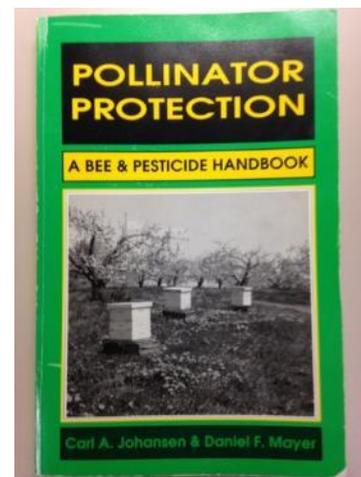
- **1870's:** Copper Acetoarsenite (Arsenical).
- **1940's:** Parathion (Organophosphate).
- **1950's:** Dieldrin (Organochlorine).
- **1960's:** Carbaryl (N-methyl Carbamate).
- **2000's:** Thiamethoxam (Neonicotinoid).

Bee Poisoning / Pesticide Regulation

- **1901:** Initial Regulation of Pesticides in WA.
- **1913:** WSDA was Created.
- **1921:** First Known Bee Poisoning in WA, Copper Acetoarsenite (Paris Green) Use on Apples. **Need to Prohibit Application During Bloom to Protect Bees (Melander, WSC).**
- **1941:** Major Revision of the Law Regulating Pesticides in WA, Including Effects on **Non-target Organisms.**

Bee Poisoning Research

- **1952 – 2002:** Johansen and Mayer, Washington State University, Conducted Research on Bee Poisoning.
- **1950's – 1980's(?):** Atkins, University of California – Riverside, Conducted Similar Research.



Bee Poisoning / Pesticide Regulation

- **1960s:** Bee Poisoning in WA, Carbaryl Use on Corn (Pollen). **WSDA Adopted Rules to Protect Bees.**
- **1970:** EPA was Created.
- **1970s:** Bee Poisoning in WA, Microencapsulated Methyl Parathion (PennCap M) Use on Various Crops, Including Apples. **WSDA Adopted Rules to Protect Bees.**

Bee Poisoning / Pesticide Regulation

- **1990s:** Bee Poisoning in WA; Acephate Use on Mint, Carbaryl Use on Apples, Chlorpyrifos Use on Carrot Seed, Methyl Parathion EC Use on Canola, Microencapsulated Methyl Parathion Use on Apples. **WSDA Revised Rules, and Section 24c SLN Labels, to Protect Bees.**
- **2000:** EPA Developed a Draft PR Notice on Pollinator Protection (Not Finalized).
- **2002:** Bee Poisoning in WA, Thiamethoxam Use on Pears. **WSDA Adopted Rules to Protect Bees.**

Bee Poisoning / Pesticide Regulation

- **2007 & 2008:** Bumble Bee Poisoning in Delaware from **Imidacloprid** Use on Linden (Ornamental - Systemic).
- **2008:** Honey Bee Poisoning in Germany from **Clothianidin** in Fugitive Dust (Corn Seed Treatment).
- **2012-2014:** Honey Bee Poisoning in Canada from **Clothianidin** and **Thiamethoxam** in Fugitive Dust (Corn Seed Treatment).

Bee Poisoning / Pesticide Regulation

- **2010:** High Levels of Miticides and other Pesticides in Honey Bee Colonies (Mullin et al). (***11 Herbicides Detected.***)
- **2011:** Sublethal Effects of Pesticide Residues in Brood Comb (Wu et al, WSU). (***2 Herbicides Detected.***)
- **2013:** Exposure to Multiple Cholinergic Pesticides Impairs Learning (Williamson and Wright).
- **2013:** Multiple, Interrelated Causes of Colony Mortality (vanEngelsdorp et al).
- **2013:** Comparative Toxicities and Synergism of Insecticides and Fungicides to Honey Bees & Mason Bees (Biddinger et al).

Acute Toxicity of Five Pesticides

Practically Non-Toxic to Bees

- **Clopyralid, Imazapyr, Triclopyr**
 - Honey Bee Contact LD₅₀: >100 ug/bee.
- **Glyphosate**
 - Honey Bee Oral and Contact LD₅₀: >100 ug/bee.

Highly Toxic to Bees

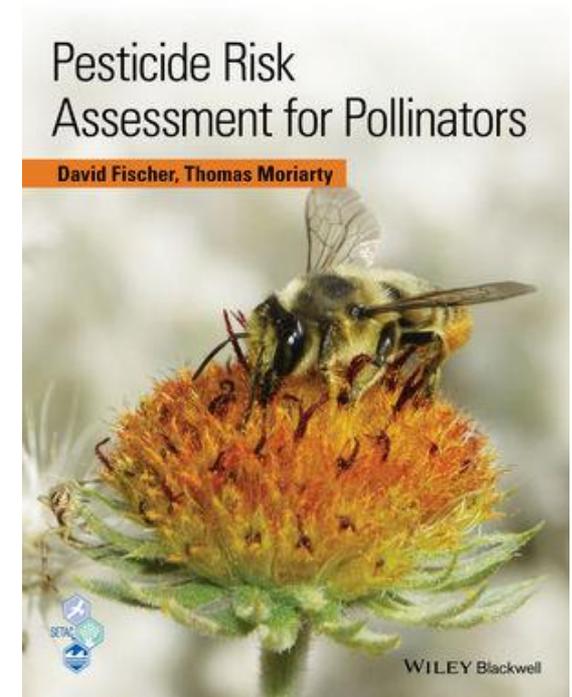
- **Imidacloprid**
 - Honey Bee Oral LD₅₀: 3.7 to 40.9 ng/bee,
 - Honey Bee Contact LD₅₀: 59.7 to 242.6 ng/bee.

Bee Poisoning / Pesticide Regulation

- **Growing Awareness: Risk Management to Protect Bees from Pesticides Needs Improvement.**
 - Acute and Chronic Effects, **Adult and Larval Effects**, Multiple Species of Bees, **Multiple Routes of Exposure**, Agricultural and Ornamental Use.
- **Synergism (Insecticides, Fungicides, Miticides)?**
- **Interactions with Pathogens?**
- **Concerns with Nitroguanidine Neonicotinoids?**
 - **Foliar and Systemic** (Agricultural and Ornamental Use), **Dust** (Seed Treatment Use).

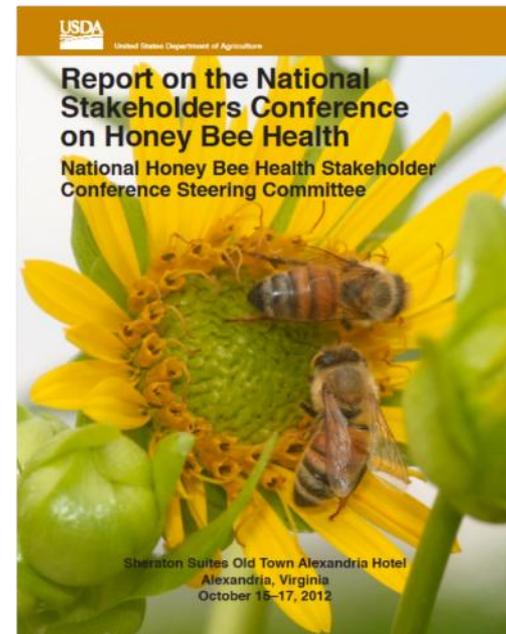
Society of Environmental Toxicology and Chemistry (SETAC)

- **2011:** SETAC Pellston Workshop on Pesticide Risk Assessment for Pollinators.
 - 48 Participants (Africa, Australia, Europe, North and South America).
 - 5 Workgroups.
 - **Best Available Science.**
 - Book was Published in 2014.



USDA / USEPA

- **2012:** National Stakeholders Conference on Honey Bee Health.
 - **Multiple Factors (Including Pesticides)**
Contributing to Decline in Honey Bee Health.
 - Approx. 175 Participants.
 - U.S., Canada, and Europe.
 - Report was Published in 2013.



USEPA / Health Canada / California Dept of Pesticide Regulation

- **2012:** White Paper in Support of the Proposed Risk Assessment Process for Bees.
 - Protection Goals.
 - **Exposure: Foliar and Systemic.**
 - **Effects: Adult and Larval.**
 - Tiered Approach.
 - Risk Characterization.
 - Guidance was Finalized in 2014.

Guidance for Assessing Pesticide Risks to Bees

Office of Pesticide Programs
United States Environmental Protection Agency
Washington, D.C. 20460

Health Canada Pest Management Regulatory Agency
Ottawa, ON, Canada

California Department of Pesticide Regulation*
Sacramento, CA

*Currently, due to resource limitations, the California Department of Pesticide Regulation does not conduct full ecological risk assessments, but reserves the right to do so in the future.

June 19, 2014

USEPA

- **2013:** Label Requirements for Nitroguanidine Neonicotinoids.
 - Different Requirements for Different Crops / Sites.
 - **Reference to Pesticide Environmental Stewardship Website.**



Pesticide Environmental Stewardship

- Coordinated by North Carolina State University.
- Contributors from Several Universities, Many Supporting Organizations.
- **Pollinator Protection Information for Different Regions, Including BMPs.**



Pollinator Partnership / North American Pollinator Protection Campaign

- **2013-2014: Corn Dust Research Consortium.**
 - Administered by Pollinator Partnership.
 - **Multi-stakeholder Coalition** that Issued 37 Recommendations.
 - Research by University of Guelph, Iowa State University, Ohio State University.



Protect their lives. Preserve ours.

Corn Dust Research Consortium (CDRC)

Preliminary Report

- Initial Findings for 2013
- Provisional Recommendations
- Timetable

January 30, 2014
FINAL

Reviewed and approved by the CDRC
Contact: Laurie Davies Adams
Executive Director
Pollinator Partnership
423 Washington Street, 5th Floor
San Francisco, CA 94010
USA
415.362.1137
LDA@pollinator.org

Washington State Department of Agriculture

- **2013: 10 Ways to Protect Bees from Pesticides.**
 - Beekeepers Concerned with Neonicotinoid Use by Homeowners in **Thurston County.**
 - Brochure for **Homeowners**, Pesticide Use on Ornamental Plants (**Foliar and Systemic**).



Oregon Department of Agriculture

- **2013-2014: Serious Bee Kills Incidents in Oregon Involving Bumble Bees.**
 - Prohibited Use of **Dinotefuran** or **Imidacloprid** on Linden Trees (*Tilia* species), Developed Brochures.



Subject: Oregon, 2014 Pesticide Product Registration, Pollinator Protection Labeling for Nitroimidazole Neurotoxic Products Containing Dinotefuran or Imidacloprid, Use Restrictions on Linden or Rosewood Trees (Tilia species)

Dear Registrant:

You are receiving this letter because your company currently has one or more registrations in Oregon for pesticide products containing dinotefuran or imidacloprid that have directions for use with certain linden applications to linden or rosewood trees (Tilia species). The conditions of registration on this letter apply for 2014 and apply to you, to any agent, and to any parent registrant for a company holding such a registration. This is not a renewal notice or final action on a renewal application. Final notices for Oregon 2014 pesticide product registration will be mailed to registrants by November 22, 2013.

I. Oregon Incidents

In June and July of 2013, the Oregon Department of Agriculture (Department) discovered four separate bumble bee kill incidents related to applications of dinotefuran or imidacloprid on linden trees (Tilia spp.). The flowers of Tilia species are highly attractive to bees and other pollinators. The pesticide applications were made using a variety of application methods. The common factors among the four Oregon bumblebee incidents were the interaction of the natural occurring toxins of the Tilia species, in combination with known toxicity of bumble bees and the application of products containing the active ingredients dinotefuran or imidacloprid.

II. Authority

Every pesticide, including such formulae or formulations, manufactured, compounded, delivered, distributed, sold, offered for sale or for use in Oregon or required to be registered each year with the State Department of Agriculture (ODA 634-016 [1]). The departments, at the time of application for registration of any pesticide, shall review or limit the manufacturer, delivery, distribution, sale, or use of any pesticide in the state in monitoring the progress for which pesticide may be manufactured, delivered, distributed, sold or used, or refusing to register any pesticide. The department shall give consideration to the damage to health or life, of humans or animals, or otherwise to the environment, which might result from the distribution and use of such pesticide (ODA 634-016 [1][A]).

The Department has determined that the use of dinotefuran or imidacloprid on Tilia species, regardless of method or application, represents an unacceptable risk, and is detrimental to the environment and may cause wildlife (bumble bees). Therefore, the Department will also determine that dinotefuran and imidacloprid products will not be used in Tilia species in Oregon. To implement that determination, the Department will register certain products containing dinotefuran and imidacloprid only if the label clearly prohibits use on Tilia species.



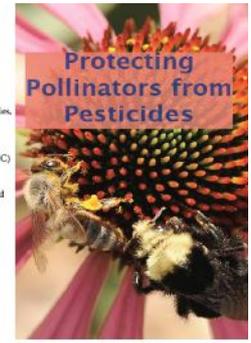
Consult us
Oregon Department of Agriculture, Pesticide Program
633 Capitol St. NE, Salem, OR 97331-2572
http://oregon.gov/ODA
Phone number of the State / Oregon State University, Oregon Department of Agriculture, Thomas Hobbs / Oregon Department of Agriculture



The Importance of Pollinators
It is estimated that bumble bees, honey bees, mason bees, and other insects are responsible for pollinating 80% of the world's food supply. These bees and other pollinators play a role in the production of more than 150 food crops in the United States.

Pollinator Health
Bees and other pollinators are under attack from many sources including diseases, poor nutrition, and loss of habitat. Pollinators can also be at risk by the use of pesticides.

Neonicotinoid Pesticides
Neonicotinoids are a class of synthetic insecticides that affect an insect's nicotinic receptors in the central nervous system. They are widely used to control aphids, weevils, fleas, and many other insects. Neonicotinoids are of concern because they are systemic pesticides, and can move into a plant's pollen and nectar.



Oregon Department of Agriculture Pesticides Program
635 Capitol St. NE
Salem, OR 97302
(503) 986-4635
pests@oda.state.or.us



#12014

International Commission on Plant Pollinator Relationships (ICP-PR)

- **2014: ICP-PR 12th International Symposium of the Bee Protection Group**
 - Ghent University, Belgium.
 - 170 Participants from 20 Countries.
 - 43 Presentations and 24 Posters.
 - **Risk Assessment, Testing Methods, Exposure Assessment, Risk Management.**
 - Proceedings were Published in 2015.

USEPA

- **2014: Letter to AAPCO and SFIREG.**
 - Federal-State Partnerships are a Key Component of EPA Activities Under the Pollinator Health Task Force.
 - **Request Input on Necessary Elements** and Approaches to Establish State Pollinator Protection Plans.
 - Work with States in Their Efforts to Develop Pollinator Protection Plans.

Managed Pollinator Protection Plan

- **2014-2015: SFIREG Developed Guidance for State Lead Agencies.**
 - Resource to Develop and Implement State Managed Pollinator Protection Plans (MP3).
 - **Encouraged to Communicate with Tribes.**
 - Define Scope of MP3.
 - **Need for State Flexibility.**
 - Critical Elements (7).
 - Optional/Recommended Elements (3).

Elements of a Managed Pollinator Protection Plan

- **Critical Elements:**
 - Stakeholder Participation Process.
 - Method for Growers/Applicators to Know if Managed Pollinators are Near Treatment Sites.
 - Method for Growers/Applicators to Identify and Contact Beekeepers Prior to Application.
 - **Best Management Practices (BMPs) to Minimize Risk of Pesticides to Bees.**

BMPs - Oregon State University

- **2013:** How to Reduce Bee Poisoning from Pesticides.
 - Developed by WSU in 1960.
 - **Focus on Agriculture.**
 - Causes of Bee Poisoning.
 - Communication, BMPs.
 - Toxicity Information.
 - Sources / References.
 - **Pdf and Smartphone App.**



Elements of a Managed Pollinator Protection Plan

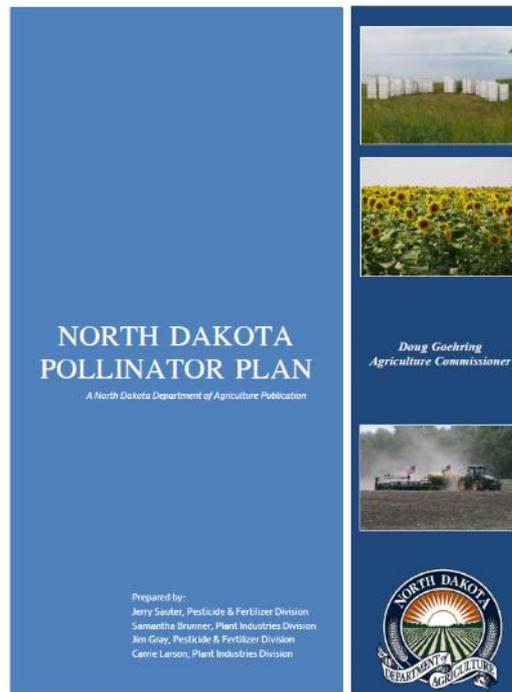
- **Critical Elements (cont.):**
 - **Plan for Public Outreach.**
 - Process to Periodically Review and Modify MP3.
 - Mechanism to Measure Effectiveness of MP3.

Elements of a Managed Pollinator Protection Plan

- **Optional/Recommended Elements.**
 - **Communication with Crop Advisors and Extension Service.**
 - **Crop-specific or Site-specific Plans.**
 - Recommendations for Formalized Agreements Between Beekeepers, Crop Producers, and Property Owners.

Examples From Other States

- **2014: North Dakota Pollinator Plan.**
 - Developed by Stakeholders.
 - **BMPs for Beekeepers, Growers, and Applicators.**



Examples From Other States

- **2014:** Mississippi Honey Bee Stewardship Program.
 - Developed by Stakeholders.
 - **Emphasis on Improving Communication.**



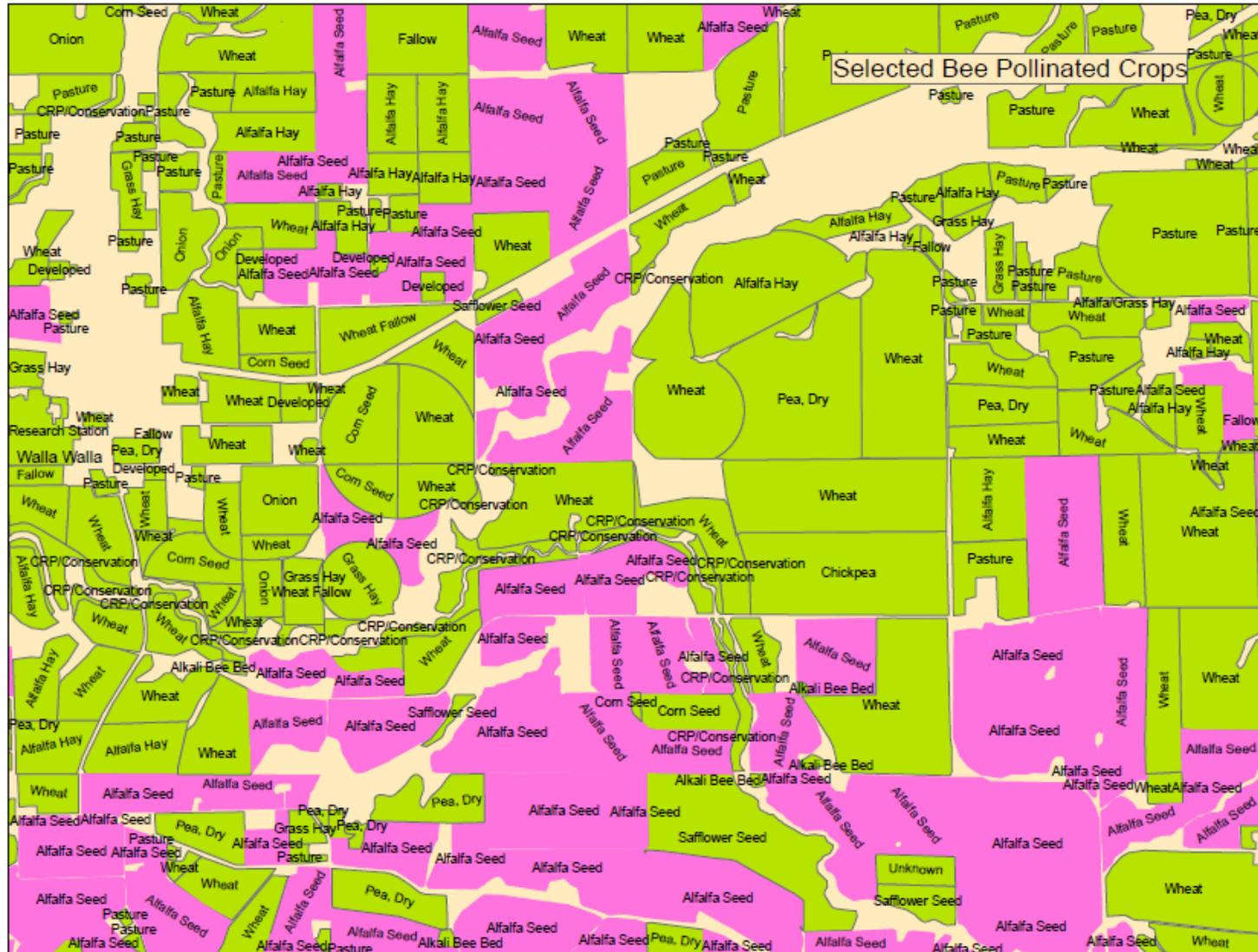
MP3 Development in Washington

- **2014-2016: WSDA Believes a Broad Group of Stakeholders Should Develop a MP3 for WA.**
 - **Working With Approx. 76 Stakeholders** (e.g. Beekeepers, Commodity Organizations, Government Agencies, Non-Governmental Organizations, Tribes, University Researchers).
 - Several Meetings with Stakeholders in Eastern and Western WA.

MP3 Development in Washington

- **2014-2016: Initial Focus was Pesticide Use on Bee Pollinated Crops.**
 - Started With **Alfalfa Grown for Seed** (Alkali Bee, Alfalfa Leafcutting Bee).
 - **Ultimate Goal is a Comprehensive MP3.**
 - Several Stakeholders (Including WSDOT and Xerces Society) Have Expressed Interest in **Pollinator Habitat.**

Alfalfa Seed in Walla Walla County



Discussions with Alfalfa Seed Growers



Discussions with Alfalfa Seed Growers

- **Alfalfa Seed Growers Agree to Work with WSDA and WSU on MP3 Development.**
- **Alfalfa Seed Growers Believe Specific Section of MP3 Should be Focused on Alfalfa Seed.**
- **WSU Offered to Develop a Draft MP3 Section on Alfalfa Seed, for Review by Alfalfa Seed Growers and WSDA.**
- **Alfalfa Seed Growers Provided Comments to WSU Regarding Methods Used to Protect Pollinators, and Areas Where Additional Research is Needed.**
- ***Alfalfa Seed Growers Would Like WSDA to Update Alfalfa, Clover and Mint Rule. (Rulemaking Process Not Part of MP3.)***

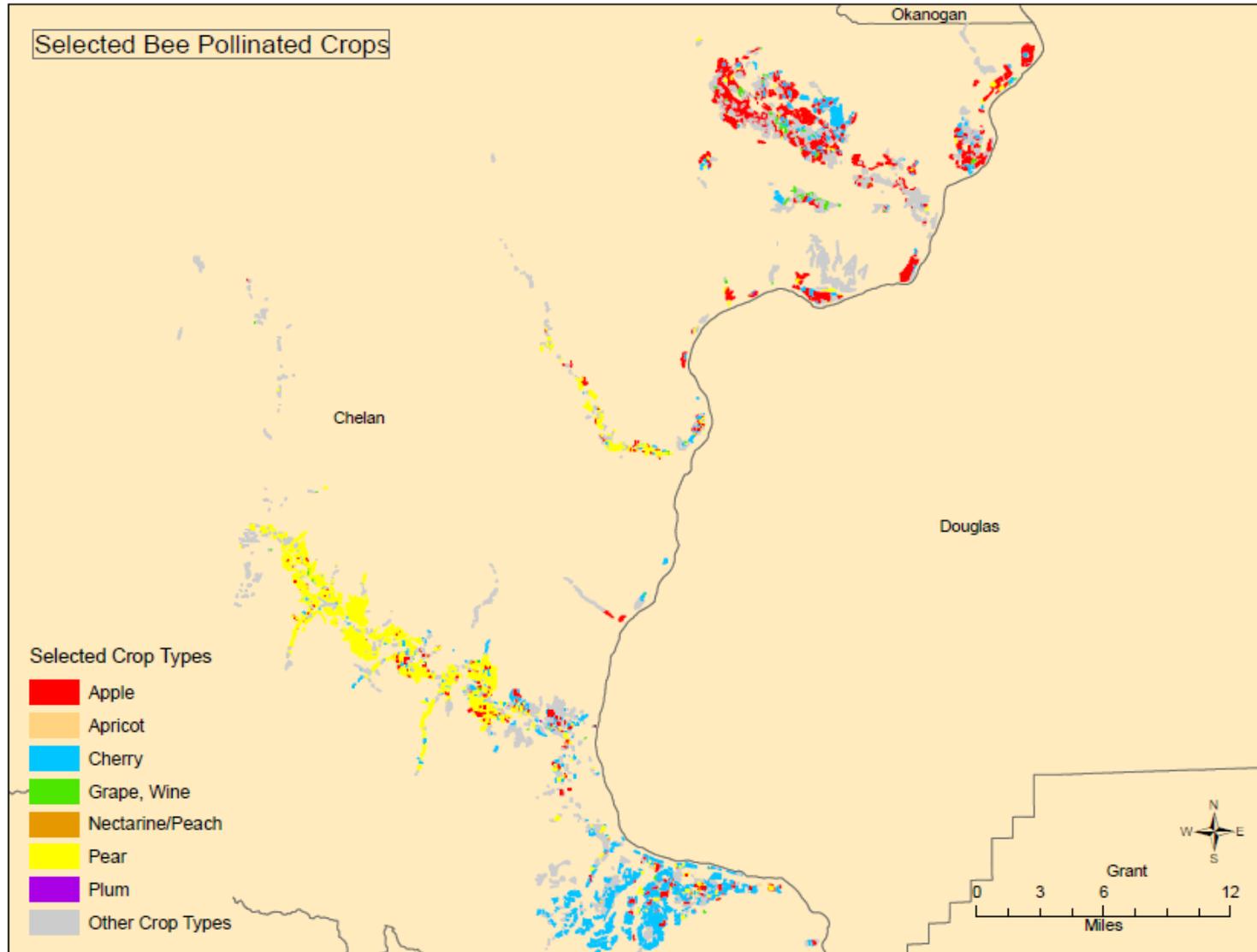
Discussions with Other Stakeholders

- **Most Stakeholders Agree on Using North Dakota MP3 as a Model**
 - *Key Differences: Apiary Programs, Honey Production vs. Pollination.*
- **Are Pesticides the Primary Issue?**
 - Importance of Habitat for Pollinators.
 - Pollinator Health Issues (e.g. Varroa Mites, Viruses).
- **Should MP3 be Generic?**
- **Should MP3 Have Specific Information for Tree Fruits? Berries? Other Crops?**

Tree Fruit Industry



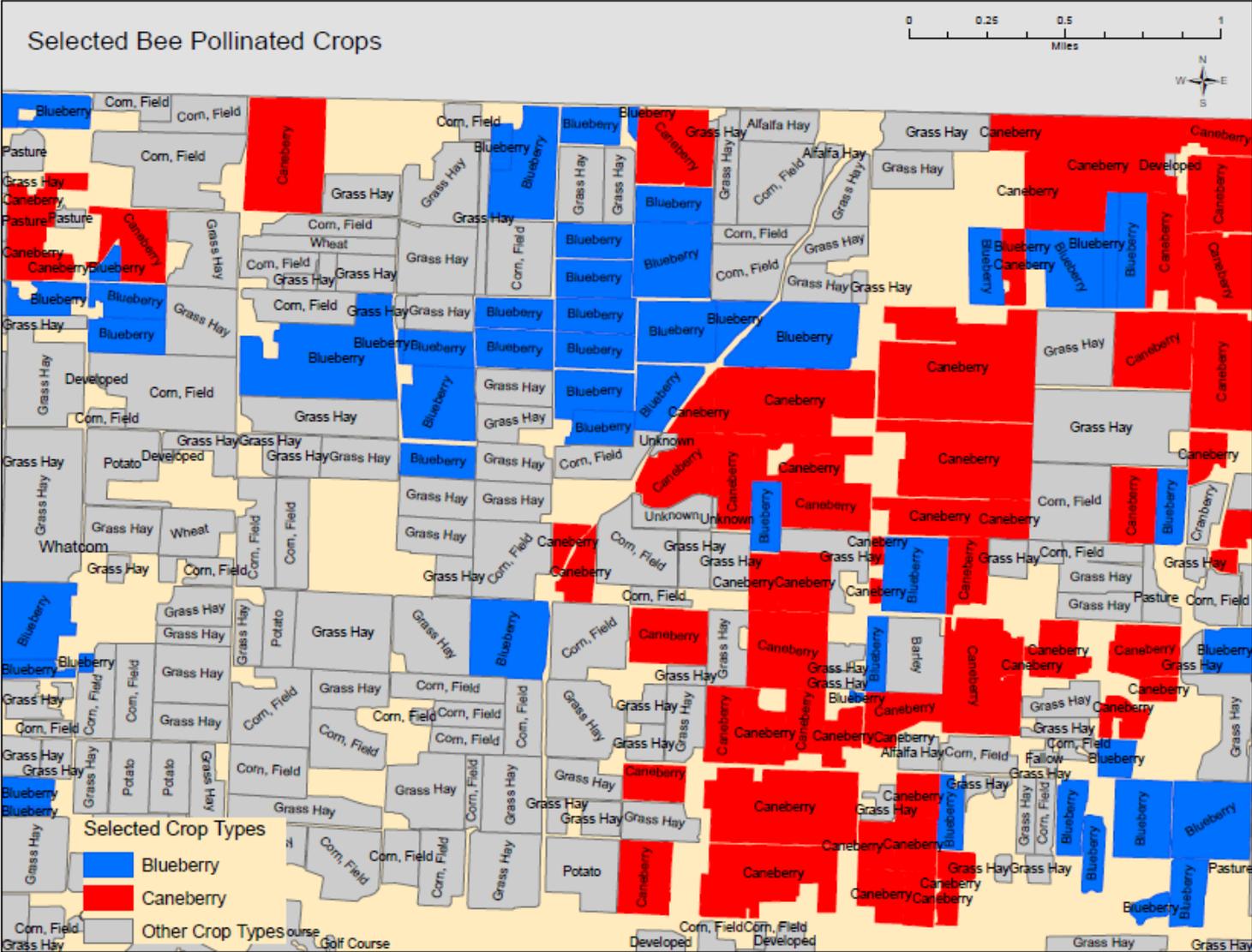
Tree Fruits in Chelan County



Berry Industry



Berries in Whatcom County



Beekeepers



Washington State University



Other Agencies



Acknowledgements

- **Agencies - EPA, USDA, WSCPR, WSNWCB.**
- **Organizations - ICPPR, SETAC, Xerces Society.**
- **Universities - Cornell University, North Carolina State University, Oregon State University, Penn State, and Washington State University (Go Cougs!).**
- **Paramount Farming.**
- **Numerous Beekeepers, Growers, Applicators, Consultants, Registrants, Agencies, and NGOs.**

Questions?



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Washington
State Department of
Agriculture