Protecting Pollinator Habitat from Pesticides

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How to
Reduce Bee Poisoning
from pesticides
L. Hooven
R. Sagili
E. Johansen
Photo: Ramesh Sagili
A PACIFIC NORTHWEST EXTENSION PUBLICATION • PNW 591
Oregon State University ■ University of Idaho ■ Washington State University

Most bee poisoning incidents occur when:

- Insecticides are applied
  - when bees are foraging
  - **to bee-pollinated crops when in bloom**
  - **to blooming weeds in orchards or field margins**
  - **drifting onto blooming plants adjacent to the target crop**
- Bees collect insecticide-contaminated pollen or nectar from treated crops that do not require bee pollination
- Bees collect insecticide-contaminated nectar or pollen from plants treated with systemic insecticides
- Insecticides contaminate nesting materials (soil for ground-nesting bees, leaves collected by leaf-cutting bees)
- Bees collect insecticide-contaminated water (drip tape, chemigation, drift into water sources)
- Beekeepers and growers do not adequately communicate

- List adapted from “How to Reduce Bee Poisoning from Pesticides”

Pollinator Habitat Too Close to the Crop (if you are using pesticides) !

Photo by Ramesh Sagili – from How to Reduce Bee Poisoning from Pesticides

Squash Bees Nesting in the Crop

Photos from Kristen Brochu – Cornell University

Acute Toxicity of Pesticides to Worker Bees – from Wild Pollinators of Eastern Apple Orchards and How to Conserve Them – Cornell University

TOXICITY OF PESTICIDES TO BEES

(NOTE: TOXICITY RATINGS BASED ON HONEY BEE TESTS)

Disclaimer: These data mostly incorporate studies looking at acute, short-term adult toxicity. The effects on other life stages from feeding on contaminated pollen might be different in chronic exposure. For example, larvae exposed to some IGRs could have developmental and reproductive effects including reductions in fecundity and fertility. Also, effects on non-honey bee, pollinating insects are not well known.

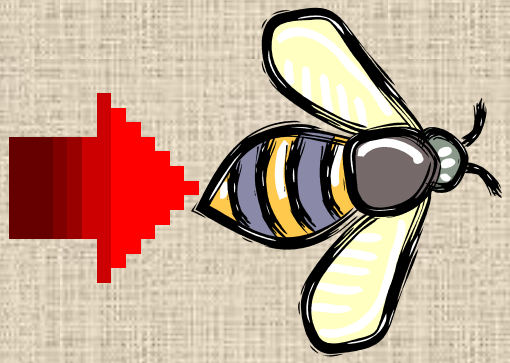
CHEMICAL CLASS/GROUP	EXAMPLES OF COMMON NAMES	EXAMPLES OF TRADE NAMES	TOXICITY LEVEL: NON	LOW	MODERATE	HIGH
CARBAMATES	oxamyl	Vydate				
	carbaryl, methomyl	Sevin, Lannate				
Neonicotinoids	clothianidin, imidacloprid, thiamethoxam	Clutch, Provado, Actara				
	acetamiprid, thiacloprid	Assail, Calypso				
ORGANOPHOSPHATES	azinphos-methyl, chlorpyrifos, diazinon,	Guthion, Lorsban, Diazinon, Dimethoate				
	dimethoate, malathion, methidathion, phosmet	/Dimate, Malathion, Supracide, Imidan				
CHLORINATED HYDROCARBON	endosulfan	Thiodan/Thionex				
PYRETHROIDS	bifenthrin, cyfluthrin, deltamethrin, esfenvalerate,	Brigade, Baythroid, Decis, Asana,				
	fenpropathrin, lambda-cyhalothrin, permethrin	Danitol, Warrior, Ambush/Pounce				
	pyrethrum/pyrethrin	PyGanic				
INSECT GROWTH REGULATORS (IGRS)	methoxyfenozide, tebufenozide	Intrepid, Confirm				
	buprofezin, pyriproxyfen	Applaud/Centaur, Esteem				
	novaluron	Rimon				
DIAMIDES	chlorantraniliprole, flubendiamide	Altacor, Belt				
MACROCYCLIC LACTONES	abamectin/avermectin, emamectin benzoate,	Agri-Mek, Proclaim, Delegate,				
	spinetoram, spinosad	Entrust/Success				
MITICIDES	acequinocyl, clofentezine, extoxazole, fenpyroximate,	Kanemite, Apollo, Zeal/Secure,				
	fenbutatin-oxide, hexythiazox	Fujimite/Portal, Vendex, Onager/Savey				
	spirodiclofen	Envidor				
	bifenazate	Acramite				
	pyridaben	Nexter/Pyramite				
OTHER INSECTICIDES	formetanateHCl	Carzol				
	azadirachtin, horticultural mineral oils,	Aza-Direct/Neemix, Stylet Oil,				
	indoxacarb, spirotetramat	Avaunt, Movento				
	flonicamid, kaolin clay, potassium salts of fatty acids/soap	Beleaf, Surround, M-Pede				
	Bacillus thuringiensis, Cydia pomonella granulosis virus	Bt/Dipel, Carpovirusine/Cyd-X				
FUNGICIDES	captan, mancozeb	Captan, Dithane/Manzate/Penncozeb				
	sterol inhibitors, strobilurins	Indar/Nova/Rally/Rubigan, Flint/Sovran				
	lime sulfur, sulfur					
PLANT GROWTH REGULATORS	ethephon, NAA/1-Naphthaleneacetic acid	Ethrel				

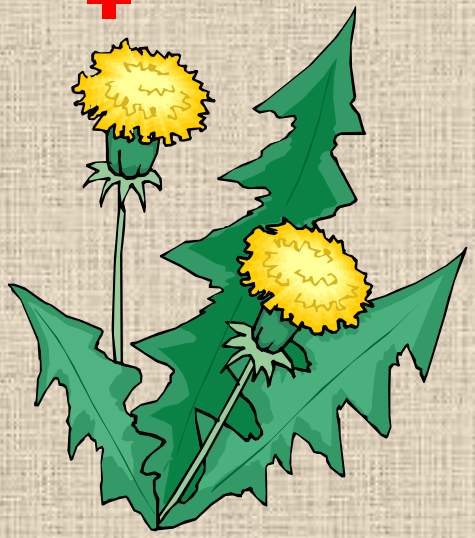
Note: On-going research has recently shown that even the inert ingredients that are part of the pesticide formulation can be toxic to honey bees by impairing their ability to learn. Of the inert ingredients tested, organosilicone surfactants/adjuvants were most toxic. Other non-ionic surfactants showed some toxicity and crop oils were least toxic.

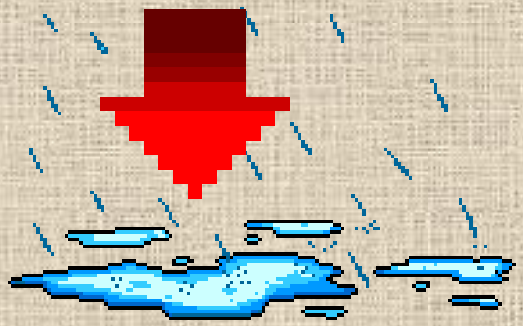
Limitations of our knowledge of pesticide effects on bees

- Most pesticides have only been tested in the lab for acute contact toxicity on individual honey bee worker adults
- Only recently started testing for acute and chronic oral toxicity to honey bees
- Most insecticides are neurotoxins – effects on behavior still being established
- Effects on larvae, reproduction, whole colonies – very few recent studies
- Interactions among pesticides and with pathogens, parasites, and beneficial organisms (including fungi) – very few recent studies
- Effects of adjuvants – some have recently been shown to affect bee learning and behavior
- Effects on others besides honey bees. Honey bee colonies relatively insulated from pesticides by large numbers. More effects at lower concentrations on bumble bees and solitary bees in recent studies.

Routes of Bee Exposure to Pesticides



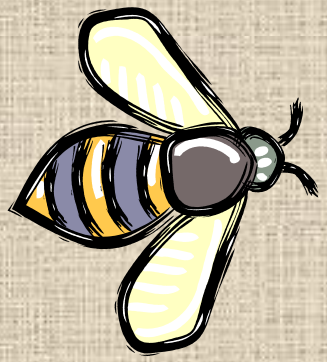


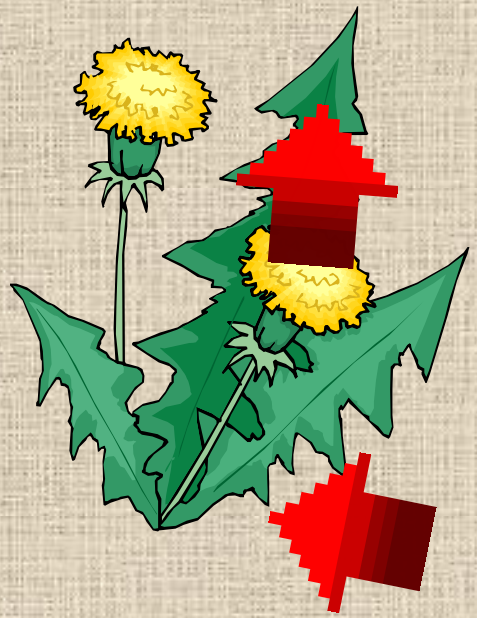


Routes of Exposure for Non-Systemic Pesticides

- Direct application to flowers of crop plants visited by bees (especially fungicides)
- Drift onto non-target plants visited by bees
- In air where bees travel
- In water collected by bees
- In or around nesting site (e.g. ground-nesting bees)
- For honey bees: applied by beekeeper to manage mites

Systemic Pesticides





Additional Routes of Exposure for Systemic Pesticides

- In nectar and/or pollen of target plant
- In nectar and/or pollen of non-target plant
- In guttation water (xylem sap exuded overnight) of target or non-target plants
- Increased movement into water because systemic pesticides are typically highly water-soluble
- Biggest demonstrated problem – drift of dust from seed treatments

How Neonicotinoids Can Kill Bees
Xerces Report

http://www.xerces.org/neonic-report-exec-summary/

Summarizes current knowledge, identifies data gaps

What Are Neonicotinoids?

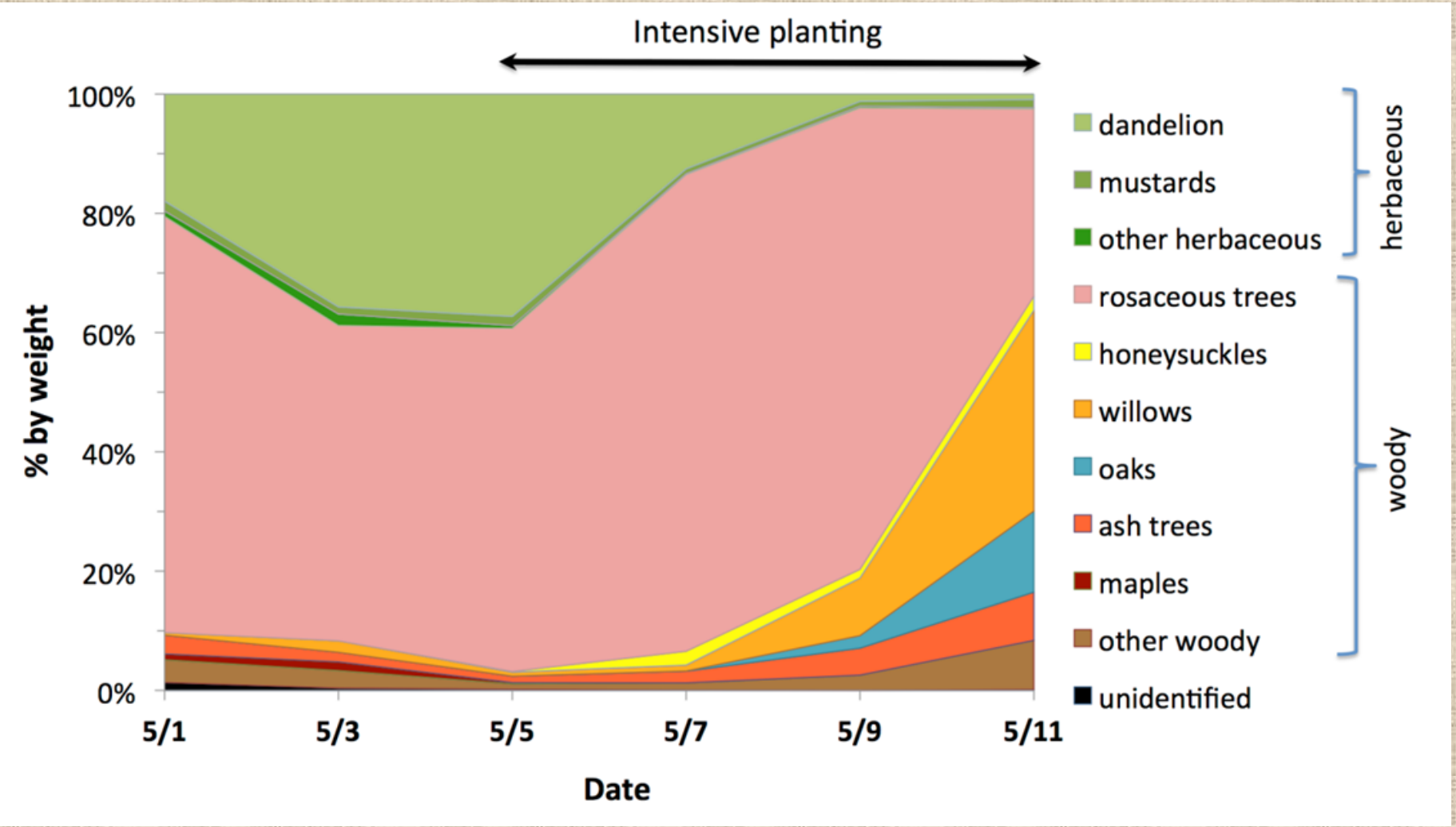
- Systemic insecticides – travel upwards through the plant – in pollen and nectar
- Target the same site in the insect nervous system as nicotine
- Two groups by bee toxicity:
  - Highly toxic to bees: imidacloprid, thiamethoxam, clothianidin, dinotefuran, nitenpyram
  - Less toxic to bees: acetamiprid, thiacloprid
- Some are highly mobile in water and thus may contaminate surface or ground water
- Some are very slow to break down and thus may build up in soil and/or plants with repeated use, even over a period of years

Over 95% of the 97 million acres of corn in the US are planted with seed treated with clothianidin or thiamethoxam

Corn planting – Note dust

Source: http://www.producer.com/2013/05/no-yield-benefit-from-neonicotinoids-scientist/

Honey bee pollen collected from hives near corn fields at the time of planting



From the report of the Corn Dust Research Cooperative – OSU – July 2015

Canada – proposed ban on imidacloprid – based on movement into water and effects on aquatic insects

News Release

Health Canada Santé Canada

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Health Canada to consult on plan to manage agricultural uses of the neonicotinoid imidacloprid to protect aquatic insects

Special reviews for two other neonicotinoids launched based on similar concerns

November 23, 2016 - Ottawa - Health Canada

When it comes to regulating pest control products, protecting the health and safety of Canadians and their environment is a priority for the Government of Canada.

Health Canada regularly reviews all pesticides to make sure they continue to meet modern health and safety standards. Neonicotinoid pesticides have been approved in Canada for many years and replaced older pesticides that had much greater risks to health and the environment.

As part of the regular review process, Health Canada has now completed its re-evaluation of the neonicotinoid imidacloprid, and has published its draft risk assessment for public comment. The assessment proposes that current use of imidacloprid is not sustainable, and the levels of this pesticide that are being found in waterways and aquatic environments are harmful to aquatic insects, such as mayflies and midges, which are important food sources for fish, birds and other animals.

To address the risks identified, Health Canada has also published a proposed risk management plan for public comment, which includes a proposed three-year phase-out of agricultural uses of imidacloprid in order to address risks to aquatic insects. In some cases, where there are no alternative pest control products available, a longer phase-out transition period of five years is being proposed.

We are consulting on these proposed mitigation measures, and the final re-evaluation decision and risk management plan will take into consideration any comments received during the consultations. The consultation phase includes a 90-day commentary period in addition to a multi-stakeholder forum that would discuss any proposals for potential alternative mitigation strategies that would achieve the same outcomes in a similar timeframe. However, any proposals for continued registration would need to clearly demonstrate concrete actions that would ensure that levels of imidacloprid in water would be reduced below the level of concern.

Based on the findings of the re-evaluation assessment on imidacloprid, the Department is also launching special reviews for two other widely used neonicotinoids, clothianidin and thiamethoxam. These special reviews will examine any potential risks these pesticides may pose to aquatic invertebrates, including insects, as they are also being detected frequently in aquatic environments.

Health Canada will continue to follow the evidence on neonicotinoid use and will act when necessary to protect the health and safety of Canadians and the environment. The Department is committed to keeping Canadians informed about this issue and will provide updates as new information becomes available.

Quick Facts

- In recent years, Health Canada identified and worked to address risks to bees and other pollinators from this class of pesticides. The Department's neonicotinoid re-evaluation efforts on potential risks to pollinators have reduced the environmental risks of neonicotinoids. Since Health Canada introduced mandatory mitigation measures on treated corn and soybean seed in 2014, the number of incidents reported at the time of planting has decreased by up to 80%.

Sublethal effects of neonics on bees

- Delay in larval development
- Changes in behavior
- Reduction in learning
- Decreased foraging activity, feeding activity
- Decreased reproduction of bumble bee colonies
- Reduction in wax comb production
- Reduction in survival of winter bees
- Increased susceptibility to *Nosema ceranae*
- Reduction in activity of genes for defense against *N. ceranae* and viruses, and increased replication of deformed wing virus in treated bees as dose increases

    - Blacquiere et al. 2012, Pettis et al. 2012, DiPrisco et al. 2013

New CT State Law

- Restricts the neonicotinoids most highly toxic to bees to licensed applicators
- Prohibits application to linden trees
- Prohibits application to blooming plants during the bloom period (with some exceptions)
- Identifies best management practices to reduce dust from seed treatments

Recommendations to protect pollinator habitat
1. Pesticide practices

- Do not apply pesticides highly toxic to bees during bloom.
- Use Integrated Pest Management (IPM) to limit pesticide use to where it is most needed and most effective. Consider alternatives to pesticides.
- Don’t use pesticides where they are not needed or not effective against the target pest.
- Minimize drift and turn off application equipment near water sources.
- Evaluate the bee toxicity of pesticides and choose less toxic options.
- Consider less hazardous pesticide formulations and length of residual toxicity to reduce bee exposure.
- Remove blooming plants in or near the application area before spraying.
- Identify pollinator nesting as well as foraging habitats and protect them from pesticides.

Recommendations to protect pollinator habitat
2. Habitat considerations

- Identify fields, orchards, or landscapes where pesticides are likely to be used near any proposed pollinator habitat
- Identify potential patterns of drift and water drainage.
- Know the field history of your site and if there are potentially long-lived pesticide residues in the soil.
- Create buffer zones between pollinator habitat and treated areas – using plants not attractive to pollinators – windbreaks of conifers and grass filter strips.
- How much buffer is enough? Xerces says 40 ft. from ground-based pesticide applications, 60 ft. from air-blast sprayers, 125 ft. from crops treated with the most toxic neonicotinoids.
- Work with growers to avoid pest problems – don't plant alternate hosts for crop pests or diseases or aggressive crop weeds.


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Look for “Pollinator Information” in left column