Pesticides and Pollinators

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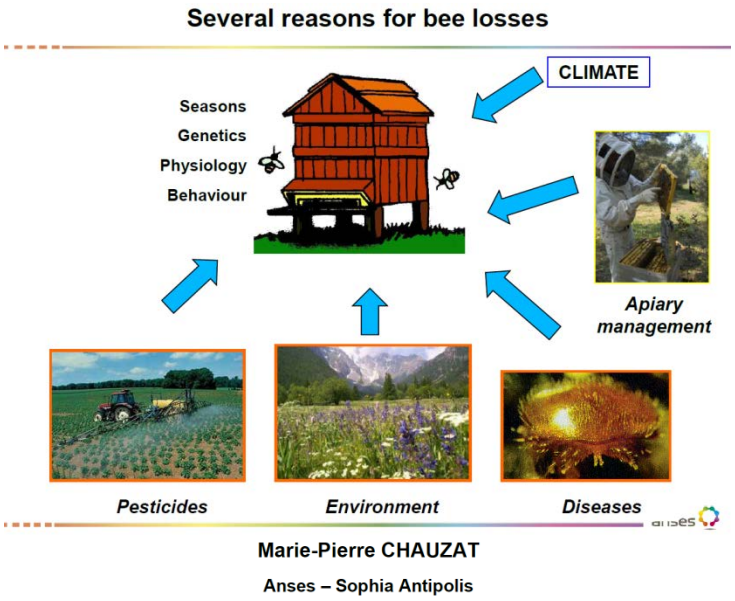
My premise

* I am not here to defend or indict pesticides
* I will try to outline the latest research findings
* I am not a bee or CCD expert by any means
* My head continues to spin from all the reading I have done over the past 5 years



Agricultural Pesticide Sales in Maine

* Historically fungicides have dominated agricultural sales
* Herbicides are next
* Insecticides:
  * In 1984 it was all organophosphates and carbamates
  * Synthetic pyrethroids began showing soon after
  * Imidacloprid arrived in 1994

Major Conventional Pesticide Use Sectors in Maine

* Agriculture
  * Blueberries 45,000 acres
  * Potatoes 54,000 acres
  * Small Grains 45,000 acres
  * Field Corn 25,000 acres
  * Broccoli 6,000 acres ?
  * Apples 3,000 acres
  * Mixed Vegetables 6,000?
  * Horticulture
  * Certified Organic Production
    * 41,000 acres✸
    * 459 farms ✸
* Other Use Sectors
  * Commercial
    * Structural
    * Lawn & Ornamental
    * Mosquito & Tick
  * Forestry
  * Homeowner
  * Rights-Of-Way
  * Industrial

✸ Includes dairy and maple operations

Pesticide Use in Maine Agriculture

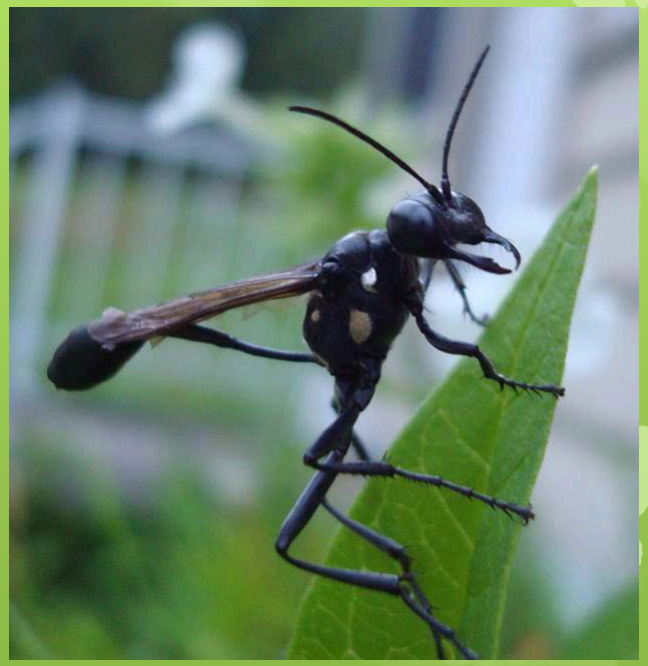
* Blueberries – fungicides before and at bloom, insecticides when berries are ripe, some neonics very late in the year if at all
* Potatoes – neonics at planting, insecticides starting in mid-July, fungicides multiple times
* Small Grains – no insecticides used, but fungicides may be on the rise
* Field Corn – most seed is treated but at rates that protect the roots and seedlings
* Broccoli – insecticides before harvest, no neonics – no flowers either
* Apples – multiple insecticide and fungicide applications, some neonic use before bloom
* Mixed vegetables/berries – neonics on some cucurbits at planting, berries often require some pesticides, sweet corn at tassel

Greenhouse & Nursery

* These businesses involve – among other things – flowering plants, shrubs and trees
* Consumers don't want infested plants
* We know neonics are used some in this industry
* Some growers are focusing on the use of beneficial insects
* The BPC doesn't have very good data on this industry

Systemics can be harmful to beneficial predators and parasites

- Spider mite outbreaks have been observed after imidacloprid applications
  - May be the result of secondary poisoning of predators
  - May act as a fertility drug to the mites
  - Improves the health of the plant which feeds the mites
- Hemipteran predators like pirate bugs or big-eyed bugs may be eliminated
  - This may cause outbreaks of chinch bugs in turf
  - These “true bugs” may also feed on plant sap directly



Impacts of neonics used on trees and woody ornamentals

- Imidacloprid and dinotefuran are both highly toxic to bees.
- Low doses of these neonics can cause bees to behave in ways that lead to death or colony weakening
- Imidacloprid changes to its olefin stage in trees and the olefin stage is 10 – 16 times more toxic to insects
- Peak concentrations may occur 18 months after a soil treatment

Impacts of neonics used on trees and woody ornamentals

- Use in woody plants tends to concentrate neonics
  - 32-inch tree treatment is equivalent to treating one acre of agricultural crops
  - Higher rates can be more risky to pollinators
  - Must not treat trees or shrubs that produce flowers that are highly attractive to pollinators unless they have finished flowering for that season
  - Best to use dinotefuran over imidacloprid on trees that provide bee attractive blooms
    - Imidacloprid can persist for as long as 8 years
    - Dinotefuran usually breaks down over one growing season

Organic Agriculture

* Presumably involves more row covers and fewer pesticide applications
* *Bt* shouldn't be an issue for bees
* Neem is very toxic to larval bees
* *Pay attention to:*
  * Pyrethrin is highly toxic but very short lived
  * Spinosad is highly/moderately toxic to bees
  * Copper Sulfate is highly toxic to bees

Even pesticides approved for organic grower use can be highly toxic to pollinators

Toxicity of Common Organic-Approved Pesticides to Pollinators

PESTICIDE	NON-TOXIC	LOW TOXICITY	HIGHLY TOXIC
Insecticides/Repellants/Pest Barriers			
Bacillus thuringiensis (Bt)			
Beauveria bassiana			
Cydia pomonella granulosis			
Diatomaceous Earth			
Garlic			
Insecticidal Soap			
Kaolin Clay			
Neem			
Horticultural Oil			
Pyrethrins			
Rotenone			
Sabadilla			
Spinosad			
Herbicides/Plant Growth Regulators/Adjuvants			
Adjuvants			
Corn Gluten			
Gibberellic Acid			
Horticultural Vinegar			
Fungicides			
Copper			
Copper Sulfate			
Lime Sulfur			
Sulfur			

Soaps and Oils, only when directly sprayed upon the pollinator

Eric Mader – The Xerces Society for Invertebrate Conservation

Recent research on botanical pesticides

* Acute Toxicity and Sublethal Effects to Honey Bees
  * Andiroba oil, Garlic extract, Eucalyptus oil, Rotenone, Neem oil and Citronella oil applied to adults and fed to larvae
    * All but Andiroba oil caused significant mortality to adult bees
    * Andiroba, Garlic and Neem caused significant larval mortality
      * These may work like insect growth regulators preventing moulting

J. Insect Sci. (2015) 15(1): 137; DOI: 10.1093/jisesa/iev110

Commercial Application

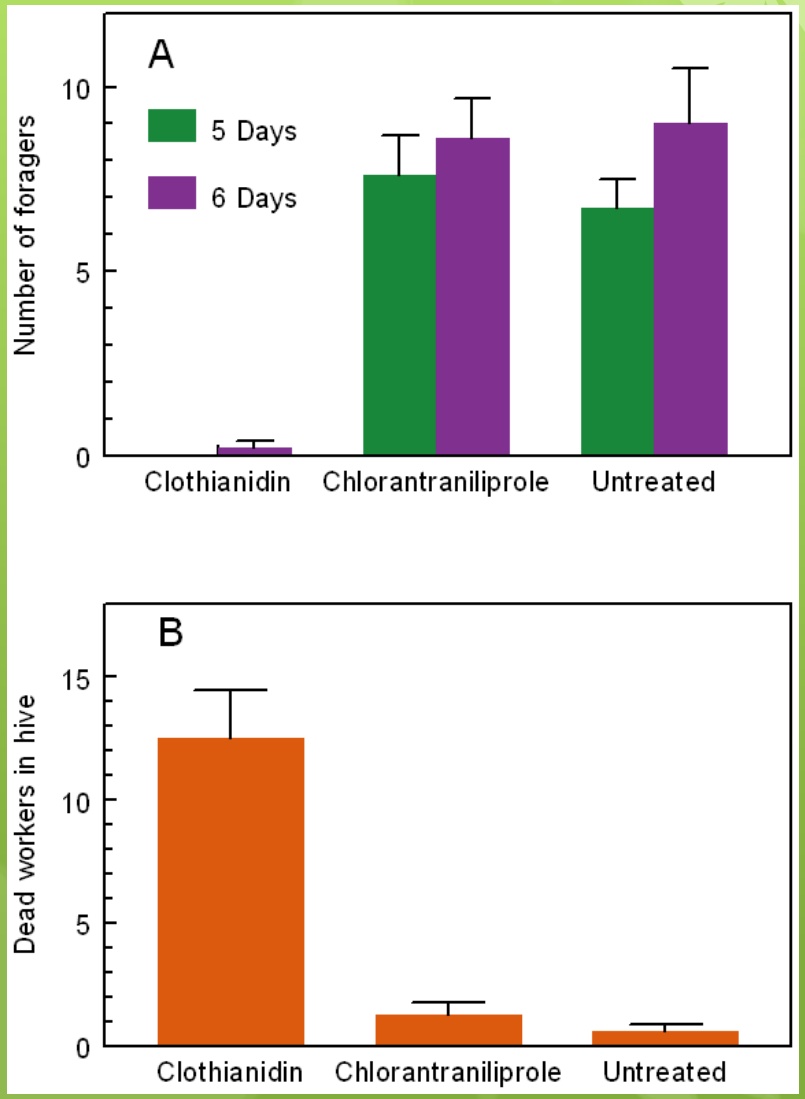
* Insecticide Use
  * Structural
    * Single & Multi-family Residences, Food Processing, Restaurants, Commercial & Institutional Buildings
  * Turf
  * Golf Courses
  * Tick & Mosquito
  * Ornamentals
* Other Pesticide Use Sectors
  * ROW
  * Industrial
  * General Vegetation Management
  * Forestry

Commercial Application

* Structural Insecticide Use – dominated by pyrethroids and pretty much irrelevant to pollinators
* Turf Insecticide Use – a fair amount of neonic use for grub control – but risks to pollinators can be mitigated
* Golf Courses – similar to turf with the addition of fungicides on greens and tees – risks should be low
* Ticks and mosquitoes – dominated by bifenthrin and some cypermethrin – low, dense vegetation at lawn perimeter is the most commonly targeted area
* Ornamentals – there isn't a large volume of insecticide used in this sector, but imidacloprid is common

Risk of systemic insecticide application to turf with flowering weeds

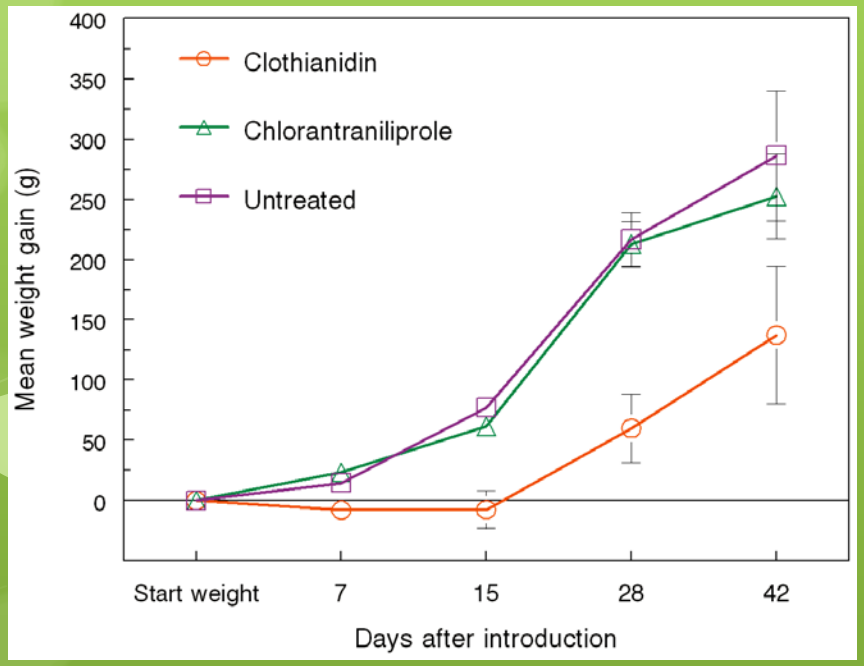
- Clothianidin & chlorantraniliprole were applied to turf with white clover flowers and bumble bees were confined to the treatment plots for 6 days
- Clothianidin caused
  - reduce weight gain
  - stopped queen production in bumble bees, and
  - also resulted in over a 10-fold increase in worker deaths
- Chlorantraniliprole had no statistically significant effects compared to the untreated check

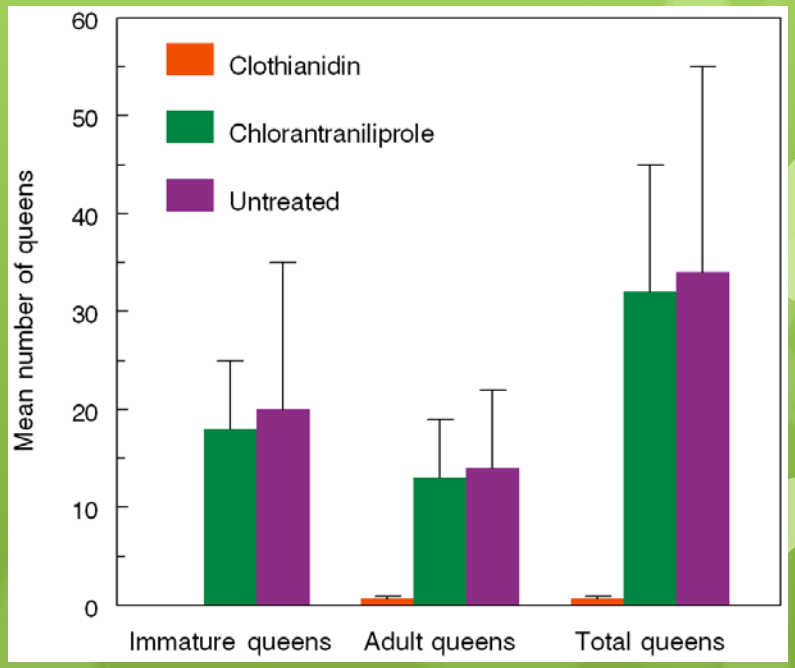


Potter , Redmond & Larson, PLOS ONE June 2013

Risk of systemic insecticide application to turf with flowering weeds

Impacts of clothianidin on bumble bee weight and queen production





Risk of systemic insecticide application to turf with flowering weeds

- Unfortunately bumble bees are not repelled by application of either insecticide
- Mowing treatment plots and removing the clover blossoms just before treatment prevented the impact on bumble bees

Table 3. Absence of acute adverse effects on *Bombus impatiens* colonies after 2 weeks' exposure to turf with flowering white clover that had bloomed after the sward was mown to remove flowers present at the time of treatment.

	Adult workers per hive[a]		Immature bees per hive[b]				
Treatment	Live	Dead	Live	Dead	Honey pots	Total weight (g) of live adults[c]	Hive weight (g)
Clothianidin	93±9	11±4	12±8	6±1	52±6	13.0±1.3	585±11
Chlorantraniliprole	130±12*	7±2	8±4	6±2	69±6	16.7±1.6	621±16
Untreated	81±8	7±2	0	3±1	56±3	11.3±0.9	588±8

Commercial Application

* ROW – all herbicides
* Industrial (non-structural) – almost all herbicides
* General Vegetation Management – all herbicides
* Forestry – currently all herbicides, spruce budworm is on the way

Home & Garden (Homeowner) Use of Pesticides

8% of Conventional Pesticide Use, but 15% of the Insecticide Use

National Data

* 67% herbicides
* 22% insecticides
* 11% fungicides

Qualitative Estimate of Insecticides Sold ✸

Active Ingredient	Number of Units Sold
Bifenthrin	18,000
Cypermethrin	12,000
Carbaryl	10,000
Chlorantraniliprole	7,500
Imidacloprid	2,500
Pyrethrins	2,100

✸ **2013 Maine Sales Reports**

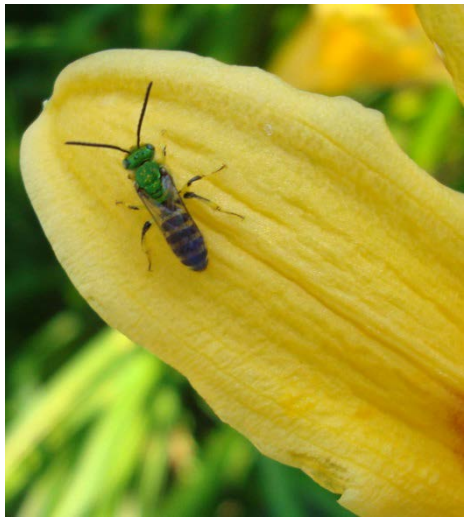
So Where Do We Focus Our Efforts?

* 70 % of insecticides are used in agriculture
  * Focus on applications that could result in residues in/on the flowers
    * Persistent and systemic insecticides
    * Fungicides and insecticides together
  * Reduce drift to adjacent flowering plants
  * Spraying when bees aren't foraging in the area helps
  * Improve communication between growers and beekeepers

So Where Do We Focus Our Efforts?

Insecticide Use by Professional Applicators

* 15% of insecticide use is by professional applicators
  * A significant percentage is applied in, on, and around structures
  * A significant percentage is used on turf – should be low risk as long as clovers are mowed off
  * Part is used for mosquito and tick control – watch out for flowering plants
  * A relatively small part is used on trees and shrubs – but it's worth giving some additional thought

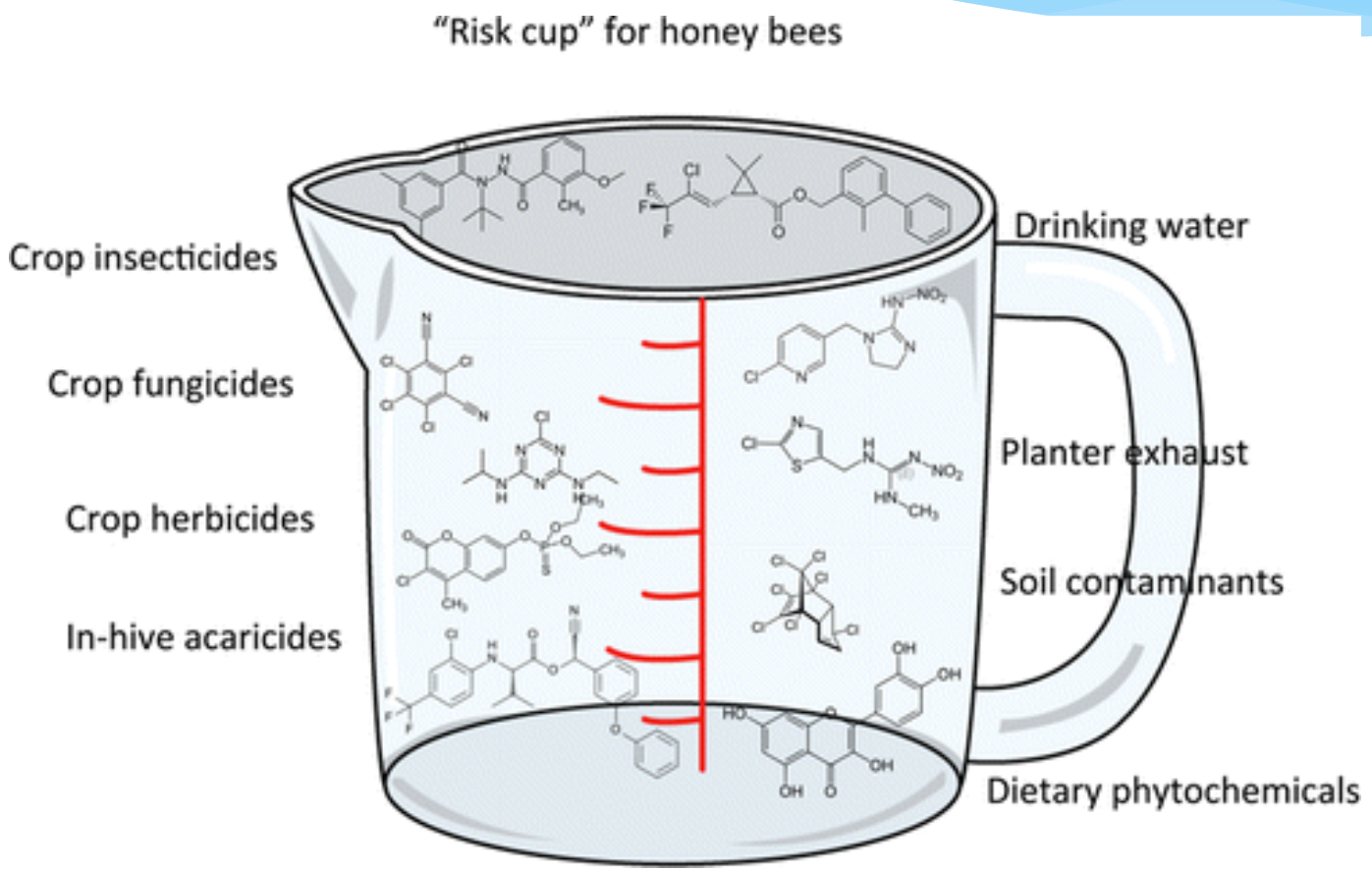


Home & Garden Insecticide Use

15% of the insecticide use

* Based on the products purchased in Maine, we think:
  * The bifenthrin is primarily ant control around structures
  * The imidacloprid is probably turf related
  * Carbaryl would be used on gardens
  * This is a good sector to do some work on

Many potential "pesticide" hazards exist



Formulation Toxicity

- Top 27 most toxic insecticide formulations to honey bee adults
- Tested at row crop application rates with a tower sprayer

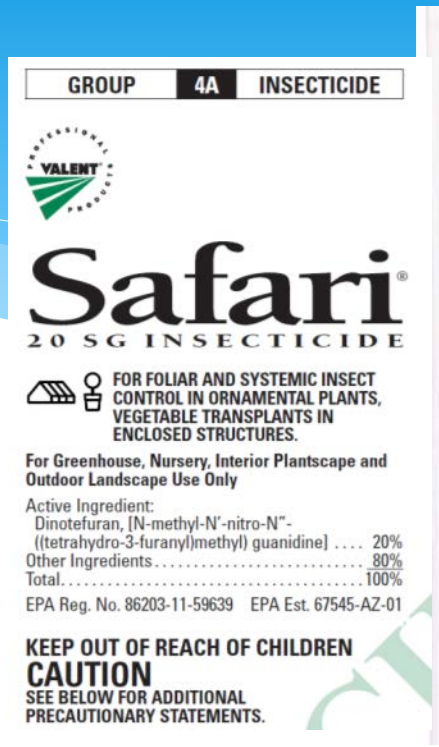
* **Commonly used by Maine growers or homeowners.**

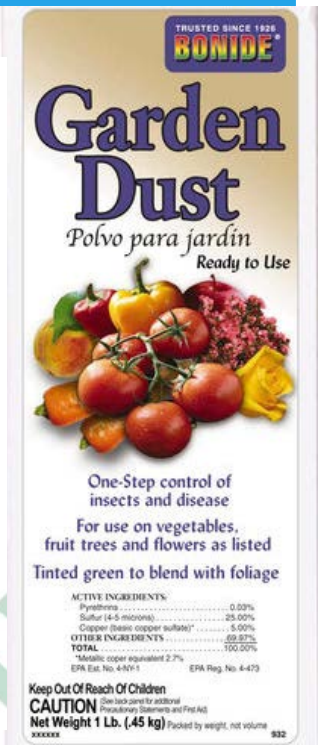
J. Econ. Entomol. 1–8 (2015); DOI: 10.1093/jee/tov269

Chemical name	LC_{50} mg/liter (F)	LC_{50} mg/liter[a,b] (AI)	Toxicity rank by LC_{50} (F)
Dicrotophos	24.92	20.43	1
Thiamethoxam	62.56	25.02	2
Emamectin Benzoate	65.51	1.41	3
* Clothianidin	67.27	15.88	4
Abamectin	68.32	1.37	5
Thiamethoxam + l-cyhalothrin	107.32	13.52	6
Acephate	126.43	122.64	7
* Zeta-cypermethrin	138.31	13.28	8
Chlorpyrifos	141.10	67.73	9
Dimethoate	142.78	62.11	10
* Methomyl	179.38	52.02	11
Cyfluthrin	182.54	45.16	12
Bifenthrin + avermectin	197.21	17.43	13
Permethrin	198.25	72.96	14
Imidacloprid + b-cyfluthrin	213.12	44.76	15
Oxamyl	214.03	89.89	16
Sulfoxaflor	229.50	114.75	17
* Bifenthrin	258.30	64.83	18
* Spinosad	302.26	133.60	19
Beta-cyfluthrin	312.15	39.64	20
Cypermethrin	332.55	101.76	21
Bifenthrin + Zeta-cypermethrin	498.31	56.06	22
* Imidacloprid	552.20	118.17	23
Gamma-Cyhalothrin	575.31	82.84	24
Lambda-Cyhalothrin	575.41	131.19	25
Methoxyfenozide + spinetoram	712.21	201.56	26
* Carbaryl	895.21	394.79	27

Formulation types differ in risk to pollinators

- More risky
  - Dusts
  - Microencapsulated
  - Wettable powders
  - Flowables
  - Emulsifiable concentrates
  - Systemic products
  - Some adjuvants
    - Super-Organosilicone surfactants





No endorsement intended or implied

OPEN ACCESS Freely available online PLoS one

Learning Impairment in Honey Bees Caused by Agricultural Spray Adjuvants

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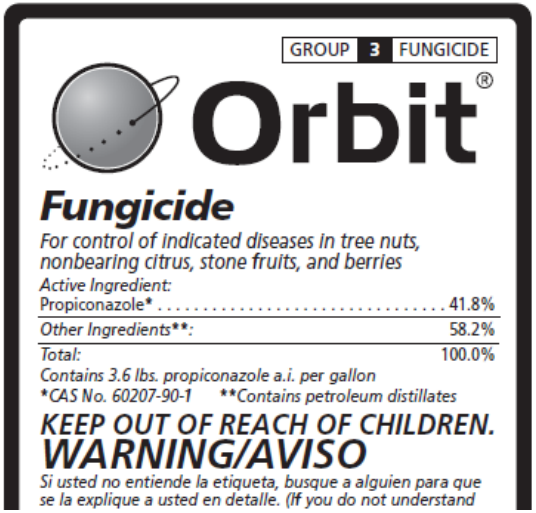
Abstract

Background: Spray adjuvants are often applied to crops in conjunction with agricultural pesticides in order to boost the efficacy of the active ingredient(s). The adjuvants themselves are largely assumed to be biologically inert and are therefore subject to minimal scrutiny and toxicological testing by regulatory agencies. Honey bees are exposed to a wide array of pesticides as they conduct normal foraging operations, meaning that they are likely exposed to spray adjuvants as well. It was previously unknown whether these agrochemicals have any deleterious effects on honey bee behavior.

Methodology/Principal Findings: An improved, automated version of the proboscis extension reflex (PER) assay with a high degree of trial-to-trial reproducibility was used to measure the olfactory learning ability of honey bees treated orally with sublethal doses of the most widely used spray adjuvants on almonds in the Central Valley of California. Three different adjuvant classes (nonionic surfactants, crop oil concentrates, and organosilicone surfactants) were investigated in this study. Learning was impaired after ingestion of 20 µg organosilicone surfactant, indicating harmful effects on honey bees caused by agrochemicals previously believed to be innocuous. Organosilicones were more active than the nonionic adjuvants, while the crop oil concentrates were inactive. Ingestion was required for the tested adjuvant to have an effect on learning, as exposure via antennal contact only induced no level of impairment.

Different tank mixes may also increase risk to pollinators

* Some combinations can be very risky…
  * Insecticides mixed with miticides
  * Insecticides mixed with fungicides or piperonyl butoxide (a synergist)
    * Acetamiprid (Assail) and propiconazole (Orbit)
    * Pyrethroids and propiconazole
    * Piperonyl butoxide and some neonicotinoids
* Avoid tank mixes entirely



No endorsement intended or implied

Neonicotinoids - History

* Neonicotinoids are “systemic insecticides” and of course they can and will kill bees, other pollinators, beneficials and aquatic invertebrates
* Came onto the market when EPA began to encourage registration of alternatives to organophosphates and carbamates
* Imidacloprid came first in 1994 and was originally conditionally registered for ornamental & turf uses
* The rest soon followed after EPA instituted a Reduced Risk (RR) and OP Alternative (OPA) accelerated registration process
  * Thiamethoxam – 2000
  * Acetamiprid – 2002
  * Clothianidin – 2003
  * Dinotefuran – 2004
* Thiacloprid was conditionally registered in 2003 outside of the RR/OPA program

More history

* Neonicotinoids were favored for their
  * low mammalian toxicity
  * lack of mammalian CNS effects, and
  * lack of carcinogenic (cancer) effects
* Use rates are very low (ml vs pts/Ac)
* EPA knew all along that they had some negatives:
  * very water soluble (good & bad)
  * very leachable (groundwater concerns)
  * fairly persistent in woody plants and soils

Neonic history

* EPA decided right from the beginning to manage the negatives with very specific label language
  * Ground water warnings, reduced rates, pollinator warnings, etc.
* EPA scientists agreed that using neonics as labeled would be a better alternative to the continued use of OPs and carbamates because:
  * OPs and carbamates are much higher in mammalian toxicity, data on carcinogenicity is equivocal and nervous system effects are definite

Recent neonic studies

* Assessment of Chronic Sublethal Effects of Imidacloprid on Honey Bee Colony Health
  * Sub-lethal effects of imidacloprid
    * No significant effects on foraging up to 100 ug/kg
    * Varroa mites significantly higher in exposed colonies
    * High doses in pollen **"could"** reduce colony health and reduce overwintering success
    * Relevant field dose from seed treated crops had negligible effects

March 18, 2015 DOI: 10.1371/journal.pone.0118748

Recent neonic studies

* Neonicotinoid pesticides severely affected honey bee queens
  * Thiamethoxam and clothianidin fed in pollen supplements at "environmentally relevant" concentrations
  * Queens's ovaries and stored sperm affected
  * Flight behavior was not affected

Scientific Reports **5,** Article number: 14621 (2015) doi:10.1038/srep14621

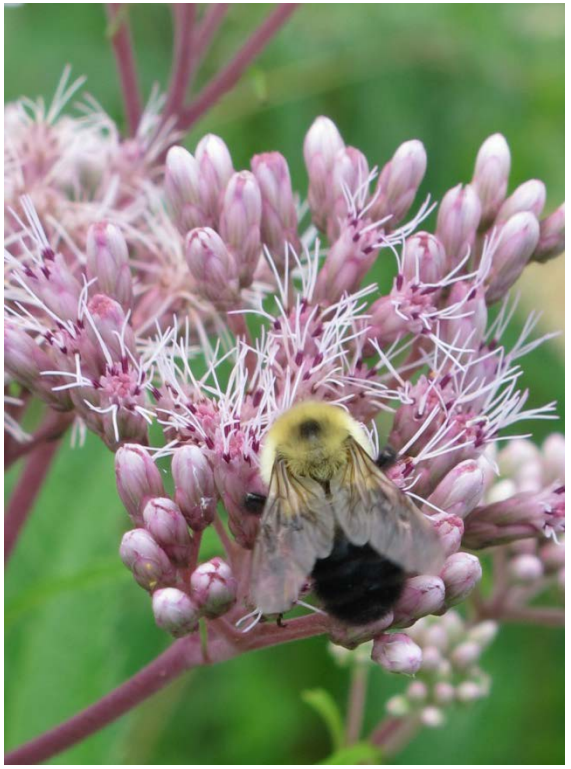
Recent neonic studies

* Neonic seed treatments negatively affected wild bees
  * Clothianidin and beta-cyfluthrin treated canola seed in Swedish fields caused:
    * Reduced density of wild (bumble and solitary bees)
    * Reduced nesting in Osmia (solitary bee)
    * Reduced colony growth and reproduction in bumblebee
    * No significant effects on honey bee colony strength

Nature 521, 77–80 (07 May 2015) doi:10.1038/nature14420

Recent neonic studies

* Bees prefer sucrose solutions with neonicotinoids
  * No feeding avoidance in honey bees and bumblebees
  * Both preferred solutions with imidacloprid and thiamethoxam
  * Those two neonics and clothianidin reduced feeding for both species
  * Why are they attracted to something that reduces their overall feeding?



Future of neonicitinoids

* EPA is opening the re-registration docket on all the neonicotinoids
* EPA - "some uncertainties have been identified since their initial registration"
  * Environmental fate and
  * Effects on pollinators
* Concerns about persistence and bioaccumulation
  * Higher levels in guttation water
  * Higher levels expressed in soil injected woody plants
  * Higher levels expressed in ornamental plants

Schedule for Review of Neonicotinoid Pesticides

The dockets for all the neonicotinoid pesticides have been opened. Our goal is to review the pesticides in this class in the same timeframe so we can ensure consistency across the class. As EPA completes risk assessments for the neonicotinoids, the Agency will pursue risk mitigation, as appropriate.

Chemical Name and Docket Number	Planned Completion	Milestones
Imidacloprid EPA-HQ-OPP-2008-0844	2016-2017	• initial set of risk assessments issued for public comment in 2015 • potential early pollinator mitigation in 2015 • remainder of risk assessments issued for public comment in 2016
Clothianidin EPA-HQ-OPP-2100-0865	2016-2017	• initial set of risk assessments issued for public comment in 2016 • potential early pollinator mitigation in 2016 • remainder of risk assessments issued for public comment in 2017
Thiamethoxam EPA-HQ-OPP-2011-0581	2016-2017	• initial set of risk assessments issued for public comment in 2016 • potential early pollinator mitigation in 2016 • remainder of risk assessments issued for public comment in 2017
Dinotefuran EPA-HQ-OPP-2011-0920	2016-2017	• initial set of risk assessments issued for public comment in 2016 • potential early pollinator mitigation in 2016 • remainder of risk assessments issued for public comment in 2017
Acetamiprid EPA-HQ-OPP-2012-0329	2018-2019	Data Generation 2014-2017
Thiacloprid EPA-HQ-OPP-2012-0218	Voluntarily cancelled by registrant Registration review case closure issued in November 2014	

EPA publishes Preliminary Pollinator Risk Assessment for imidacloprid on January 6, 2016

* EPA published the Preliminary Pollinator Risk Assessment on January 6 and is taking comments for 60 days
* Assessed risk to honey bees and to some wild bees where data was available
* The preliminary risk assessment identified a residue level for imidacloprid of 25 ppb, which sets a threshold above which effects on pollinator hives are likely to be seen, and at that level and below which effects are unlikely. These effects include decreases in pollinators as well as less honey produced

EPA publishes Preliminary Pollinator Risk Assessment for imidacloprid on January 6, 2016

* EPA risk findings for honey bees only
  * Highest potential risks in citrus and cotton
  * Low risk potential for potatoes, broccoli, corn, blueberries, leafy greens, onions, tomatoes-(not for Bumblebees however)
  * Crop field risk potential a concern for:
    * Legumes, cucurbits, pome fruits, stone fruits, small fruits, tree nuts, cereal grains, herbs and spices and oilseed

What if…

* Neonicotinoids are banned…
* Other pesticides will fill the vacuum
* Pyrethroids, OPs, carbamates, spinosad, phorate, chlorantraniliprole, indoxacarb, spinetoram, etc.
  * Most of these are as toxic or more toxic to bees than neonics
  * Some of these are also systemics
* What if bee declines continue?
* We need to look at the whole universe of exposures
  * Insecticides, fungicides, herbicides
  * Surfactants and other adjuvants
  * Tank mixes and synergistic effects

The facts about systemic insecticides – Richard Cowles - CAES

* CCD has not diminished in countries where neonicotinoid insecticide use was curtailed[6]
* CCD is not found in Australia, where neonicotinoid insecticides are used, but where Varroa mite (a parasite and vector of bee viruses) is also not found[6]
* 96% of colonies with CCD have been found to harbor a complex of viruses, for which Israeli Acute Paralysis Virus is most strongly implicated[7]

6 Ratnieks, FLW and N. L. Carreck. 2010. Science 327: 152 - 153.
7 Cox-Foster, D. L., et al. 2007. Science 318: 283 - 287.

Do some pesticides make bees more susceptible to disease?

- One study shows an association between the miticides* beekeepers use and the relative risk of bees being impacted by *Nosema ceranae* *(an intestinal parasite)*
- Relative risk of nosema was significantly worse for:
  - Chlorothalonil (2.31)
  - Pyraclostrobin (2.85)
  - ▶DMPF (Amitraz) (2.13)
  - Bifenthrin (2.08)
  - Endosulfan (1.60)
  - ▶Fluvalinate (2.43)

PLoS ONE 8(7): e70182. doi: 10.1371/journal.pone.0070182

* Used as an in-hive treatment for Varroa mites

Do some pesticides make bees less susceptible to disease?

* In the same study some pesticides were associated with a reduced incidence of nosema compared to the control, including all the neonics that were found
* Relative risk of nosema was significantly less for:

- Captan (0.59)
- Cyprodinil (0.31)
- Difenoconazole (0.31)
- Acetamiprid (0.31)
- Carbaryl (0.42)
- ▶Coumaphos (0.62)
- Diazinon (0.56)
- Esfenvalerate (0.51)
- Imidicloprid (0.31)
- Indoxacarb (0.28)
- Phosmet (0.36)
- Thiacloprid (0.35)

PLoS ONE 8(7): e70182. doi: 10.1371/journal.pone.0070182

▶ Used as an in-hive treatment for Varroa mites

What about herbicides

* Much more research needed to access the impacts that herbicides have on pollinator floral resources
* Much more research needed on the synergistic effects of fungicides as well as their effects on brood development
* Herbicides have been used for years
* Growers have always strived for clean fields and headlands
* Are the impacts related to the way herbicides are used or are impacts more related to the intensity of the agriculture?
* These questions need to be answered

What has EPA done?

* EPA and the State FIFRA Issues Research and Evaluation Group (SFIREG) have been discussing better ways to label pesticides for pollinator protection since I started as a regulator in 1988
* Pesticide labels have always had warnings and restrictions
* Neonics and new systemic insecticides have new labeling to help protect pollinators

PROTECTION OF POLLINATORS

APPLICATION RESTRICTIONS

EXIST FOR THIS PRODUCT BECAUSE OF RISK TO BEES AND OTHER INSECT POLLINATORS. FOLLOW APPLICATION RESTRICTIONS FOUND IN THE DIRECTIONS FOR USE TO PROTECT POLLINATORS.

Look for the bee hazard icon in the Directions for Use for each application site for specific use restrictions and instructions to protect bees and other insect pollinators.

This product can kill bees and other insect pollinators.

Bees and other insect pollinators will forage on plants when they flower, shed pollen, or produce nectar.
Bees and other insect pollinators can be exposed to this pesticide from:

- Direct contact during foliar applications, or contact with residues on plant surfaces after foliar applications
- Ingestion of residues in nectar and pollen when the pesticide is applied as a seed treatment, soil, tree injection, as well as foliar applications.

When Using This Product Take Steps To:

- Minimize exposure of this product to bees and other insect pollinators when they are foraging on pollinator attractive plants around the application site.
- Minimize drift of this product on to beehives or to off-site pollinator attractive habitat. Drift of this product onto beehives or off-site to pollinator attractive habitat can result in bee kills.

Information on protecting bees and other insect pollinators may be found at the Pesticide Environmental Stewardship website at: http://pesticidestewardship.org/PollinatorProtection/Pages/default.aspx.
Pesticide incidents (for example, bee kills) should immediately be reported to the state/tribal lead agency. For contact information for your state, go to: www.aapco.org/officials.html. Pesticide incidents should also be reported to the National Pesticide Information Center at: www.npic.orst.edu or directly to EPA at: beekill@epa.gov

Many insecticides have specific label warnings

Drexel

Carbaryl 4L

Insecticide

BEE CAUTION: May kill honeybees and other bees in substantial numbers. This product is highly toxic to bees exposed to direct treatment or residues on crops or weeds in bloom.

Notifying beekeepers within 1 mile of treatment area at least 48 hours before product is applied will allow them to take additional steps to protect their bees.

Limiting applications to times when bees are least active, e.g., within 2 hours of sunrise or sunset, will minimize risk to bees.

***For crops in bloom (except corn and soybeans)*:**

Do not apply this product to target crops or weeds in bloom.

***For corn and soybeans*:**

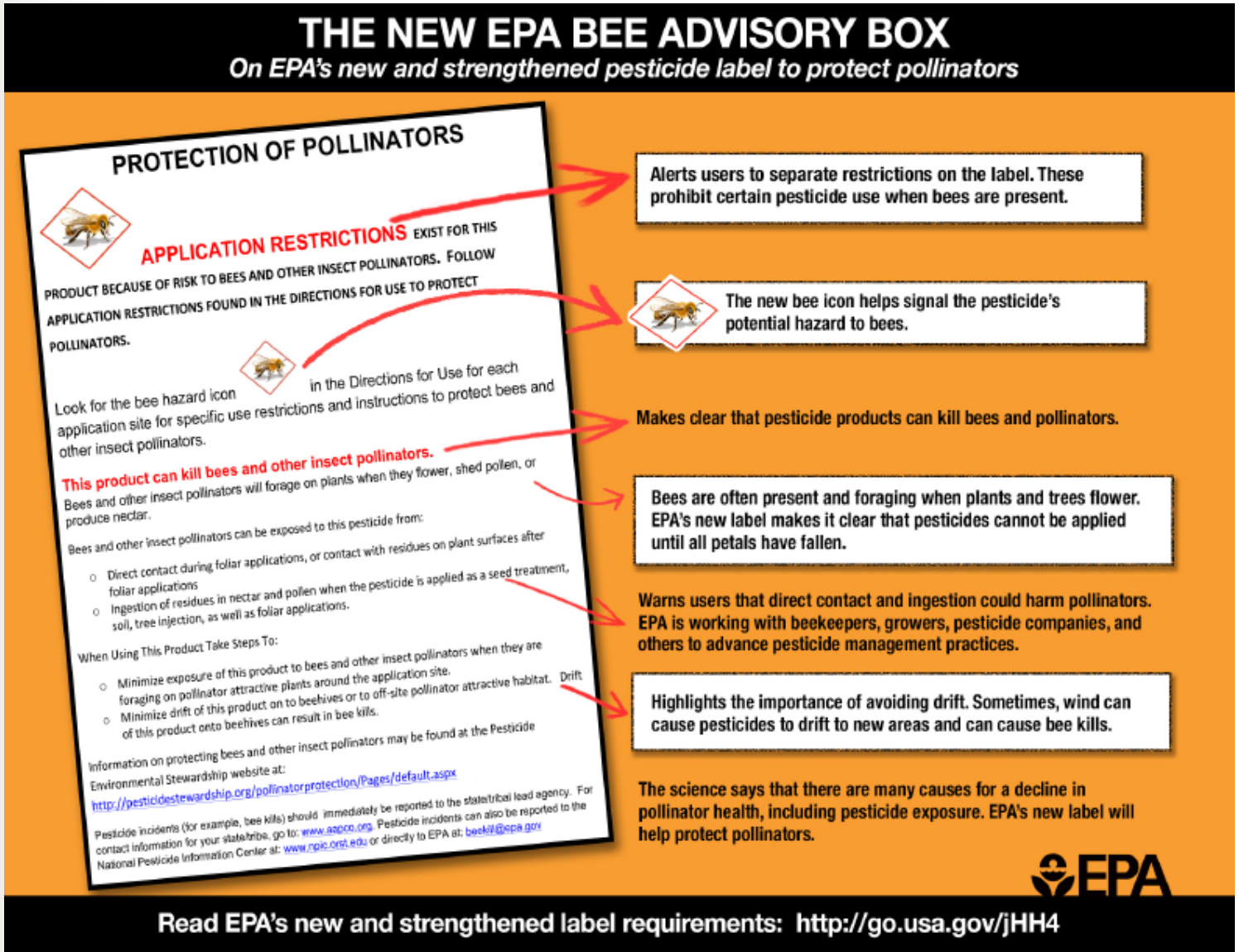
If application cannot be avoided when target crop or weeds are in bloom, limiting applications to times when bees are least active, e.g., within 2 hours of sunrise or sunset, will minimize risk to bees.

Look for the bee icon on new labels

* Products with acute or residual toxicity to pollinators will have the bee icon on their labels

* The new warnings will be next to that icon

Pollinator Protection



PROTECTION OF POLLINATORS

APPLICATION RESTRICTIONS EXIST FOR THIS PRODUCT BECAUSE OF RISK TO BEES AND OTHER INSECT POLLINATORS. FOLLOW APPLICATION RESTRICTIONS FOUND IN THE DIRECTIONS FOR USE TO PROTECT POLLINATORS.

Look for the bee hazard icon  in the Directions for Use for each application site for specific use restrictions and instructions to protect bees and other insect pollinators.

This product can kill bees and other insect pollinators.

Bees and other insect pollinators will **forage on plants** when they flower, shed pollen, or produce nectar.

Bees and other insect pollinators can be exposed to this pesticide from:

- Direct contact during foliar applications, or contact with residues on plant surfaces after foliar applications
- Ingestion of residues in nectar and pollen when the pesticide is applied as a seed treatment, soil, tree injection, as well as foliar applications.

When Using This Product Take Steps To:

- Minimize exposure of this product to bees and other insect pollinators when they are foraging on pollinator attractive plants around the application site.
- Minimize drift of this product on to beehives or to off-site pollinator attractive habitat. Drift of this product onto beehives or off-site to pollinator attractive habitat can result in bee kills.

Information on protecting bees and other insect pollinators may be found at the Pesticide Environmental Stewardship website at:
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New use directions – Non-Ag products

3. **Non-Agricultural Products:**

Do not apply [insert name of product] while bees are foraging. Do not apply [insert name of product] to plants that are flowering. Only apply after all flower petals have fallen off.

New use directions – Ag products

2. FOR FOOD CROPS AND COMMERCIALLY GROWN ORNAMENTALS NOT UNDER CONTRACT FOR POLLINATION SERVICES BUT ARE ATTRACTIVE TO POLLINATORS

Do not apply this product while bees are foraging. Do not apply this product until flowering is complete and all petals have fallen unless one of the following conditions is met:

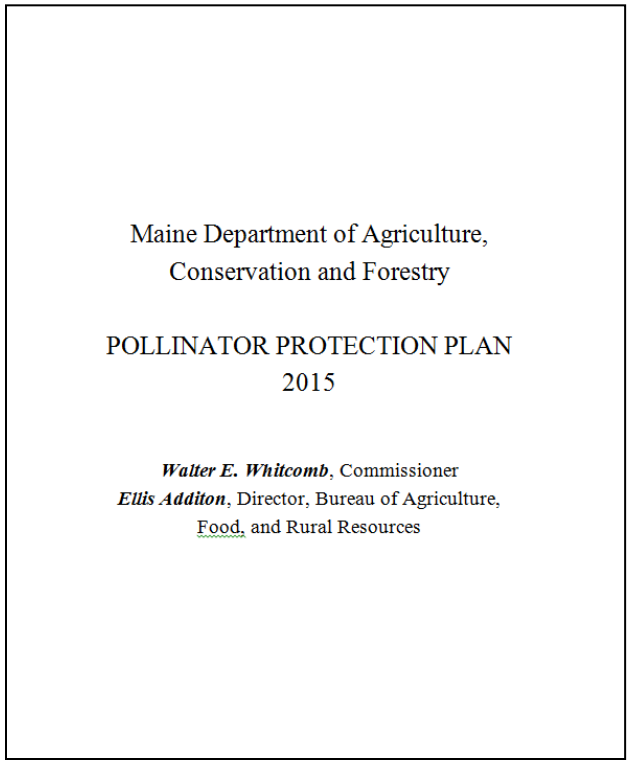
- **The application is made to the target site after sunset**
- **The application is made to the target site when temperatures are below 55˚F**
- **The application is made in accordance with a government-initiated public health response**
- **The application is made in accordance with an active state-administered apiary registry program where beekeepers are notified no less than 48-hours prior to the time of the planned application so that the bees can be removed, covered or otherwise protected prior to spraying**

New use directions – Ag products

- **The application is made due to an imminent threat of significant crop loss, and a documented determination consistent with an IPM plan or predetermined economic threshold is met. Every effort should be made to notify beekeepers no less than 48-hours prior to the time of the planned application so that the bees can be removed, covered or otherwise protected prior to spraying.**

Maine DACF Pollinator protection plan

* The Maine DACF developed a pollinator plan
* It is based on the North Dakota plan
* It stresses voluntary measures such as education, BMPs and communication
* It does not contain any new regulatory requirements



Maine Department of Agriculture,
Conservation and Forestry

POLLINATOR PROTECTION PLAN
2015

Walter E. Whitcomb, Commissioner
Ellis Additon, Director, Bureau of Agriculture,
Food, and Rural Resources

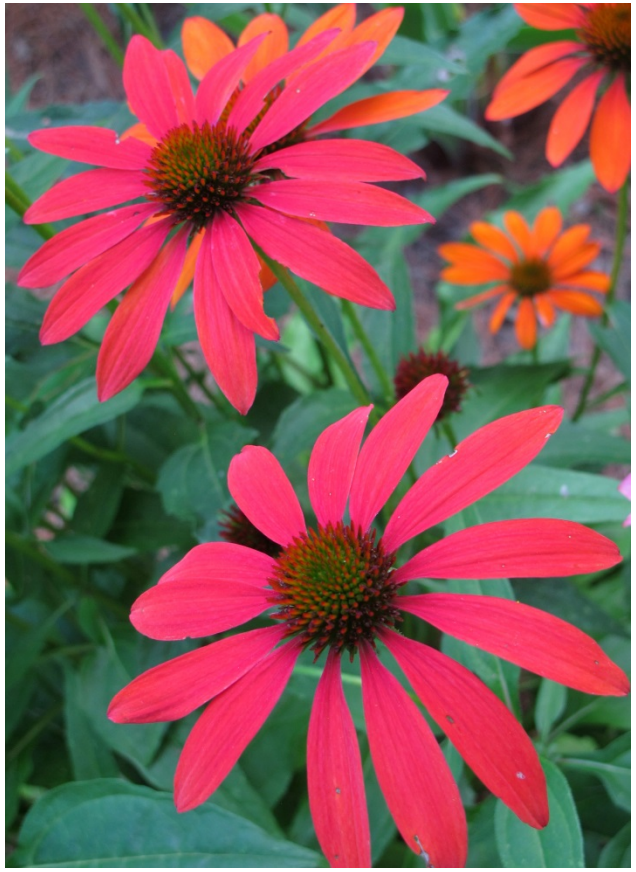
http://www.maine.gov/dacf/php/pesticides/documents2/pollinators/Maine%20DACF%20Pollinator%20Protection%20Plan%206-2015.pdf

Plan contents

- Challenges Faced by Beekeepers
- Challenges Faced by Growers and Pesticide Users
- DACF Activities Committed to Pollinator Health
- Best Management Practices
  - Beekeeper Best Management Practices
  - Landowner/Grower/Agency Best Management Practices
  - Pesticide User Best Management Practices
- Supporting Pollinator Forage and Habitat

Summary

* Bees are insects and insecticides do kill bees
* Both growers and bee keepers need to follow BMPs and practice IPM to reduce the overall impacts of pesticides on bees
* Fungicides need to be carefully evaluated for effects on immature bees
* Overall grower practices (including herbicide use) need to be evaluated for reductions in floral resources
* Scientists, growers and bee keepers need to work together to help figure out the risks and benefits of pesticide use



Questions?

* That's all folks!