2017 *updated* Toxicity to Pollinators of Insecticides Used in Greenhouse, Landscapes

Vera Krischik, Department of Entomology, University of Minnesota

The conservation of beneficial insects, that includes bees, insect predators, parasitic wasps, and butterflies, is an essential part of Integrated Pest management (IPM) programs. IPM promotes multiple tactics to manage pests and to suppress the population size below levels that will damage the plant. IPM tactics include cultural control, sanitation, biological control, using insecticides friendly to beneficial insects, and finally the use of conventional insecticides. IPM recognizes that the few remaining pest insects will support beneficial predators and parasitic wasps.

When scouting plants for pest insects, check for populations of both pest and beneficial insects, such as lady beetles and bees. If beneficial insects are present, wait to spray insecticides to see if the beneficial insects control the pest insects or use specific insecticides that only target the pest insect. Do not apply insecticides while plants are in full bloom. If possible avoid beneficial insects by spraying leaves in the evening when bees and lady beetles are not foraging. Neonicotinoid systemic insecticides have been implicated in the decline of bees and other beneficial insects. The European Union banned the use of neonicotinoid insecticides from 2014-2016 on crops and plants that bee's visit. The concern was the residue in pollen and nectar and their negative effects on survival and foraging behavior of bees.

There are few systemic insecticides, while there are many systemic herbicides and fungicides. Systemic, neonicotinoid insecticides are the most widely used insecticides in the world, due to their low mammalian toxicity and the ability of the insecticide to move systemically from soil into the entire plant, including pollen and nectar. Application methods include seed treatments, foliar sprays, soil and trunk drenches, and trunk-injections. Flowers that open after being sprayed with contact insecticides do not contain insecticide residue, while toxicity to pests lasts for 1-3 weeks. However, flowers that open after systemic insecticides are sprayed can contain the insecticide residue for many months in both the leaves and pollen and nectar.

There are six neonicotinoid active ingredients, imidacloprid, dinotefuran, thiamethoxam, and clothianidin, of which acetamiprid and thiacloprid are the least toxic to bees. There is another systemic insecticide, fipronil that is used around structures that is also toxic to bees. You will find these active ingredients listed on the insecticide label in small print. The neonicotinyl class of insecticides is highly toxic to bees and kills bees at around 180 ppb in flower nectar or pollen. However, sublethal doses of neonicotinyl insecticide starting around 10 ppb, causes bees to lose navigation and foraging skills. The longevity and amount of the neonicotinoid in the pollen and nectar will depend on application method, concentration applied, and binding capacity of the soil.

The use of neonicotinyl insecticides as trunk injections and soil drenches for ash trees is important to slow the spread of the exotic, invasive Emerald Ash Borer and other invasive pests.

As bees do not collect ash pollen in quantities, the risk to bee pollinators is low. In contrast, the use of neonicotinyl insecticides on flowering garden plants, shrubs and trees, including linden and basswood trees can kill bees and beneficial insects that utilize the flowers for pollen and nectar. It is wise to avoid using systemic neonicotinyl insecticides on flowering plants that bees visit regularly. Instead use spot treatments of contact insecticides.

New EPA labeling for neonicotinoid as of March 2014

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.

The new EPA bee hazard icon in the directions for use on insecticide labels EPA has added new language to neonicotinyl insecticide products (imidacloprid, dinotefuran, thiamethoxam, and clothianidin) to protect bees and other insect pollinators. The bee icon above signals that the pesticide has potential to harm bees. The language in the new bee advisory box explains application restrictions to protect bees.

Bee and other insect pollinators can be exposed to the product from:

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

When using this product take steps to:

1. Minimize exposure when bees are foraging on pollinator attractive plants around the application site.
2. Minimize drift of this product onto beehives or to off-site pollinator attractive habitat. Drift of this product onto beehives can result in bee kills. Bee kills should be reported to Minnesota Department of Agriculture (type bee kill into search), National Pesticide Information Center, and the EPA.

Nursery and greenhouse growers have alternatives to systemic insecticides

The EPA has been registering selective, insecticides that conserve beneficial insects and pollinators:

- S-kinoprene (Enstar II), juvenile hormone mimic
- Miticides (Akari, Hexygon)
- Chlorantraniliprole (Acelepryn), grubs in soil or most landscape pests

New Minnesota bee labeling laws July 1, 2014

The following list of potential systemic insecticides affected by the law, the use of which (depending on their product labels) may render the labelling of plants as non-compliant with the law if residues are detected in the plant material, include:

On the list, but not registered for use on nursery, greenhouse, and landscape by the EPA (24 insecticides) are: aldicarb, bendiocarb, demeton-S-methyl, ethoprop, dichlorvos, dicrotophos (cotton only), fensulfothion (field crops), fenthion (mosquitoes in Florida), fipronil, methamidophos, methomyl, methyl bromide, mevinphos, oxydemeton-methyl, phosphamidon, sulfoxaflor, terbufos, tralomethrin (roach), carbofuran (U.S. cancelled), dimethoate (U.S.

cancelled), disulfoton (U.S. cancelled), mexacarbate (U.S. cancelled), phorate (U.S. cancelled), ronnel (U.S. cancelled). Here is the list of systemic insecticides identified by the law as not approved on bee-friendly-labeled plants. These insecticides are registered for use on nursery, greenhouse, and landscape by the EPA (18 insecticides): abamectin, acephate, acetamiprid, avermectin, bifenazate, carbaryl, chlorfenapyr, clothianidin, cyantraniliprole, dinotefuran, emamectin benzoate, imidacloprid, milbemectin, oxamyl, pymetrozine, spinosad, thiacloprid, thiamethoxam.

Toxicity to Pollinators of Insecticides Used in Greenhouse, Nursery, and Landscapes

Bolded are insecticides not permitted by the MDA on bee-friendly-labeled plants. Systemic neonicotinoid insecticides (imidacloprid, clothianidin, dinotefuran, and thiamethoxam) and fipronil are translocated to pollen and nectar for some time after application. Contact insecticides should not be translocated to pollen and nectar and should not be present in new flowers. Many contact insecticides are toxic to bees and should not be sprayed directly on foraging bees or flowers. In greenhouse structures if you use contact insecticides during cultivation; the residue should be minimal after 5 weeks.

Chemical class/MOA	**Common name/MOA**	**Examples of trade names**	**LD 50***	**Toxicity to honeybees****		
			ug/bee	**Non**	**Mod Toxic**	**Highly**
Carbamates/1A	carbaryl	Sevin,	0.014			x
	methomyl	Lannate	0.816			x
Neonicotinoids/4	**imidacloprid**	Merit, Marathon	0.004			x
	thiamethoxam	Flagship, Meridian	0.004			x
	clothianidin	Arena, Aloft	0.005			x
	dinotefuran	Safari	0.023			x
	imid+bifenthrin	Allectus	0.004			x
	imid+cyfluthrin	Discus	0.004			x
	ag: imidacloprid	Gaucho, Admire				
	ag: clothianidin	Poncho, Venom,				
	ag: thiamethoxam	Cruiser, Platinum				
	flypyradifurone	Altus	1.2			x
	sulfloxaflor	XXpire cancelled	0.0208			x
	+spinetoram		0.14			x
	less toxic:					
	acetamiprid	Tristar, Assail	14.5	x		
	thiacloprid	Calypso	27.8	x		
Organophosphates/1B	**acephate**	Orthene	0.1082			x
	chlorpyrifos	Dursban/Lorsban	0.06			x
	dimethoate	Dimethoate	0.038			x
	malathion	Malathion	0.16			x
	phosmet	Imidan	0.1			x
Pyrethroids/3A	bifenthrin	Attain/Talstar	0.1			x
	cyfluthrin	Tempo, Decathalon	0.001			x
	fenpropathrin	Tame	0.05			x

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Chemical class/MOA	Common name/MOA	Examples of trade names	LD 50*	Toxicity to honeybees**		
			ug/bee	Non	Mod Toxic	Highly
	lambda-cyhalothrin	Scimitar	0.038			x
	permethrin	Astro, Pounce	0.029			x
	resmethrin	foggers	0.065			x
Botanical/3	pyrethrin	Pyganic	0.15			x
Insect growth regulators	diflubenzuron/15	Adept, Dimilin	25	x		
	tebufenozide/18	Confirm	234	x		
	azadirachtin/UN	Aza-Direct, Azatin	2.5		x	
	buprofezin/16	Talus	163	x		
	pyriproxyfen/7C	Distance, *Fulcrom*	100	x		
	novaluron/15	Pedestal	150	x		
	cyromazine/17	Citation	25	x		
Juvenile hormone /7A	s-kinoprene	Enstar II	35	x		
Anthranilic Diamides/28	chlorantraniliprole	Acelepryn	>104	x		
	cyantraniliprole	*Mainspring*	0.116			x
Macrocyclic lactones/6	**abamectin**	Avid, Sirocco	0.009			x
	emamectin-benzoate	Tree-age, Enfold	0.41			x
Miticides	acequinocyl/20B	Shuttle	>100	x		
	etoxazole/10B	TetraSan, Beethoven	200	x		
	fenpyroximate/21A	Akari,	162	x		
	fenbutatin-oxide/12B	Vendex	3982	x		
	halofenozide/18	Mach II	100	x		
	clofentezine/10A	Ovation	111	x		
	hexythiazox /10A	Hexygon	200	x		
	bifenazate/20D	Floramite, Sirocco	7.8		x	
	pyridaben/21A	Sanmite	0.024			x
	chlorfenapyr/13	Pylon	0.12			x
	cyflumetofen/25A	*Sultan*	102	x		
Spinosyns/5	**spinosad**	Conserve/Entrust less toxic dried	0.05			x

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	spinetoram	*Radiant*	0.14			x
Tetronic acids/23	spirotetramat	Kontos	107	x		
	spiromesifen	Judo, Forbid	200	x		
GABA-channel	fipronil/2B	Fipronil, Termidor	0.004			x
Pyridine carboxamide	flonicamid/29	Aria	60.5	x		
Pyridine azomethines	**pymetrozine/9B**	Endeavor	158.5	x		
Other insecticides	pyridalyl/UN	*Overture*	6.16		x	
	Bacillus thuringiensis/11A	Bt/Dipel	N/A	x		
	potassium salts fatty acids soaps	Surround, M-Pede		x		
	horticultural mineral oils	Monterey Oil			x	

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