**2015 Toxicity to Pollinators of Insecticides Used in Greenhouse, Nursery, Landscapes**

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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 insecticides 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](http://www.mda.state.mn.us/) (type bee kill into search), [National Pesticide Information Center](http://npic.orst.edu/), and the [EPA](http://www2.epa.gov/pollinator-protection/report-bee-kills).

**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** | | | | | | |
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| 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** | **Common name** | **Examples of trade names** | **LD 50\*** | **Toxicity to honeybees\*\*** | | |
|  |  |  | **ug/bee** | **Non** | **Mod Toxic** | **Highly** |
| Carbamates | **carbaryl** methomyl | Sevin, Lannate | 0.014 0.816 |  |  | x x |
| Neonicotinoids | **imidacloprid (I)  thiamethoxam (T) clothianidin (C)  dinotefuran (D)** imid+bifenthrin (I,B) | Merit, Marathon Flagship, Meridian Arena, Aloft Safari Allectus Field crops Gaucho (I), Poncho (C), Cruiser(T) (seed treatments), Admire/Provado (I), Venom (C), Platinum (T) | 0.004 0.004 0.005 0.023 |  |  | x x x x |
| less toxic: **acetamiprid  thiacloprid** | Tristar (A), Assail (A) Calypso (T) | 14.5 27.8 | x x |  |  |
| Organophosphates | **acephate** chlorpyrifos dimethoate malathion phosmet | Orthene Dursban/Lorsban Dimethoate Malathion Imidan | 0.1082 0.06 0.038 0.16 0.1 |  |  | x x x x x |
| Pyrethroids | bifenthrin  cyfluthrin, fenpropathrin  lambda-cyhalothrin permethrin resmethrin | Attain/Talstar Tempo, Decathalon Tame, Scimitar Astro, Pounce foggers | 0.1 0.001  0.05 0.038 0.029 0.065 |  |  | x x x x x |
| Botanical | pyrethrin | Pyganic | 0.15 |  |  | x |
| Insect growth regulators | diflubenzuron tebufenozide | Adept, Dimilin Confirm | 25 234 | x x |  |  |
| azadirachtin buprofezin pyriproxyfen | Aza-Direct, Azatin Talus, Distance | 2.5 163 100 | x x | x |  |
| novaluron | Pedestal | 150 | x |  |  |
| cyromazine | Citation | 25 | x |  |  |
| Juvenile hormone | s-kinoprene | Enstar II | 35 | x |  |  |
| Anthranilic Diamides | chlorantraniliprole **cyantraniliprole** | Acelepryn Mainspring | >104 0.116 | x |  | x |
| Macrocyclic lactones | **abamectin  emamectin-benzoate** | Avid, Sirocco  Tree-age, Enfold | 0.009 0.41 0.285 |  |  | x x x |
| Miticides | acequinocyl etoxazole fenpyroximate fenbutatin-oxide halofenozide | Shuttle TetraSan, Beethoven Akari, Vendex Mach II | >100 200 162 3982 100 | x x x x x |  |  |
| clofentezine, hexythiazox | Ovation Hexygon | 111 200 | x x |  |  |
| **bifenazate** | Floramite, Sirocco | 7.8 |  | x |  |
| pyridaben | Sanmite | 0.024 |  |  | x |
| **chlorfenapyr** | Pylon | 0.12 |  |  | x |
| Spinosyns | **spinosad, less toxic when dry** | Conserve/Entrust less toxic dried | 0.05 |  |  | x |
| Tetronic acids | spirotetramat spiromesifen | Kontos Judo, Forbid | 107 200 | x x |  |  |
| GABA-channel | fipronil | Fipronil, Termidor | 0.004 |  |  | x |
| Pyridine carboxamide | flonicamid | Aria | 60.5 | x |  |  |
| Pyridine azomethines | **pymetrozine** | Endeavor | 158.5 | x |  |  |
| Other insecticides | *Bacillus thuringiensis* | Bt/Dipel | N/A | x |  |  |
| potassium salts fatty acids soaps | Surround, M-Pede |  | x |  |  |
| horticultural mineral oils | Monterey Oil |  |  | x |  |
| *The information given herein is supplied with the understanding that no discrimination is intended and no endorsement by the University of Minnesota Extension. Remember, the label is law.* | | | | | | |
| \*\*Toxicity Category I, highly toxic to bees, Acute Contact LD50 is < 2 µg/bee Toxicity Category II, moderately toxic to bees, the LD50 is 2-10.99 µg/bee Toxicity Category III, Relatively nontoxic, NT, to bees, the LD50 is 11-100 µg/bee \*1. [Protecting honeybees from pesticides, Purdue Extension](http://extension.entm.purdue.edu/publications/E-53.pdf), E-53W, Krupke, C., G. Hunt, and R. Foster, June 2014 2. [How to reduce bee poisoning from pesticides](http://pesticidestewardship.org/PollinatorProtection/Documents/How%20to%20Reduce%20Bee%20Poisoning%20from%20Pesticides_PNW.pdf), A Pacific Northwest Extension Publication, OSU, UI, WSU, PNW 591, Hooven, L., Sagili, and E. Johansen; Pesticide toxicity to bees 3. [Pesticide stewardship](http://pesticidestewardship.org/PollinatorProtection/Pages/Pesticide-Toxicity-to-Bees.aspx) 4. [Farmland birds, list of EPA 2011 pesticides and LD50](http://www.farmlandbirds.net/content/acute-toxicity-ld50-values-honey-bees-all-pesticides-fungicides-herbicides-insecticides-etc-) 5. [University of Hertfordshire PPDB, pesticide properties database](http://sitem.herts.ac.uk/aeru/ppdb/en/index.htm) 6. [Pesticide Target Interaction Base](http://lilab.ecust.edu.cn/ptid/) 7. [Safety and use of neonicotinoids insecticides in turfgrass](http://extension.entm.purdue.edu/neonicotinoids/PDF/Safetyanduseofneonicotinoidsinturfgrass.pdf), Doug Richmond, Purdue University | | | | | | |

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