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, butterflies, 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, dinofuran, 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.
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 STATEMENT

The new EPA bee icon and bee advisory box 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.

Nursery and greenhouse growers have alternatives to systemic insecticides. For the last 10 years the EPA has been registering selective, contact insecticides that conserve beneficial insects and pollinators.
- Pymetrozine (Endeavor) stops mouthparts from feeding/working;
- Flonicamid (Aria) stops mouthparts from feeding/working;
- Pyriproxifen (Distance), diflubenzuron (Adept, Dimilin), or novaluron (Pedestal) IGR, insect growth regulator, stops larval growth;
- Beauveria bassiana (Botanigard) microbial;
- S-kinoprene (Enstar II), juvenile hormone mimic;
- Spinosad (Conserve, Entrust) bee friendly when dried;
- New miticides (Akari, Floramite, Hexygon, Judo, Sanmite)

Bee kills should be reported to Minnesota Department of Agriculture (www.mda.state.mn.us, type bee kill into search), National Pesticide Information Center (www.ipm.orst.edu), and the EPA (beekill@epa.gov).
### Insecticide Toxicity to Bees By Active Ingredient in Professional Nursery and Landscape

<table>
<thead>
<tr>
<th>Chemical class</th>
<th>Examples of common names</th>
<th>Examples of trade names</th>
<th>Toxicity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbamates</td>
<td>carbaryl, methomyl</td>
<td>Sevin, Lannate</td>
<td>x</td>
</tr>
<tr>
<td>Neonicotinoids</td>
<td></td>
<td>Nursey/landscape 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)</td>
<td>x</td>
</tr>
<tr>
<td>Organophosphates</td>
<td>acephate, chlorpyrifos, dimethoate, malathion, phosmet</td>
<td>Orthene, Dursban/Lorsban, Dimethoate, Malathion, Imidan</td>
<td>x</td>
</tr>
<tr>
<td>Pyrethroids</td>
<td>bifenthrin, cyfluthrin, fenpropatrin, lambda-cyhalothrin, permethrin</td>
<td>Attain/Talstar, Tempo, Decathalon, Tame, Scimitar, Astro</td>
<td>x</td>
</tr>
<tr>
<td>Botanical</td>
<td>pyrethrum/pyrethrins azadirachtin, neem oil</td>
<td>Pyganic, Azatin, Ornanzin, Triact</td>
<td>x</td>
</tr>
<tr>
<td>Insect growth reg.</td>
<td>diflubenzuron</td>
<td>Adept, Dimilin, Confirm</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>tebufenozide</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>azadirachtin</td>
<td>Aza-Direct, Azatin, Ornanzin, Talus, Distance</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>buprofezin</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>pyriproxyfen</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>novaluron</td>
<td>Pedestal</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>cyromazine</td>
<td>Citation</td>
<td>x</td>
</tr>
<tr>
<td>Juvenile hormone</td>
<td>s-kinoprene</td>
<td>Enstar II</td>
<td>x</td>
</tr>
<tr>
<td>Diamides</td>
<td>chlorantraniliprole</td>
<td>Acelypryn</td>
<td>x</td>
</tr>
<tr>
<td>Macrocyclic lactones</td>
<td>abamectin/avermectin, emamectin benzoate</td>
<td>Avid, Tree-Age</td>
<td>x</td>
</tr>
<tr>
<td>Miticides</td>
<td>acequinocyl, exetoxazole, fenpyroximate, fenbutatin-oxide</td>
<td>Shuttle, TetraSan, Akari, Vendex</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>clofentezine, hexythiazox</td>
<td>Ovation, Hexagon</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>bifenazate</td>
<td>Floramite</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>pyridaben</td>
<td>Sanmite</td>
<td>x</td>
</tr>
<tr>
<td>Spinosyns</td>
<td>spinosad</td>
<td>Conserve/Entrust, less toxic dried</td>
<td>x</td>
</tr>
<tr>
<td>Tetronic acids</td>
<td>spiromesifen</td>
<td>Judo, Kontos</td>
<td></td>
</tr>
<tr>
<td>GABA-gated chloride channel</td>
<td>fipronil</td>
<td>Fipronil, Termidor</td>
<td>x</td>
</tr>
<tr>
<td>Pyridine carboxamide</td>
<td>fonicamid</td>
<td>Aria, sucking mouthparts only</td>
<td>x</td>
</tr>
<tr>
<td>Pyridine azomethines</td>
<td>pymetrozine</td>
<td>Endeavor, sucking mouthparts only</td>
<td>x</td>
</tr>
<tr>
<td>Other insecticides</td>
<td>Bacillus thuringiensis, Cydia pomonella granulosis virus</td>
<td>Bt/Dipel, Carpovirusine/Cyd-X</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>fonicamid, potassium salts of fatty acids</td>
<td>Aria, M-Pede</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>horticultural mineral oils</td>
<td>Monterey</td>
<td>x</td>
</tr>
</tbody>
</table>

## Insecticide Toxicity to Bees in Consumer Products Used in Landscape

This table lists the trade names of insecticides available to homeowners. The common names of the insecticides are followed by the commercial trade names. Not all products are listed in this table. Be sure to read the label.

**Toxicity to bees: 1= highly toxic; 2= moderately toxic; 3= nontoxic to bees**

<table>
<thead>
<tr>
<th>Common name</th>
<th>Trade names</th>
</tr>
</thead>
<tbody>
<tr>
<td>acephate</td>
<td>Acephate Bonide Systemic Insect Control Orthene</td>
</tr>
<tr>
<td>acetamiprid</td>
<td>Ortho Flower, Fruit &amp; Vegetable Insect Killer Ortho Rose &amp; Flower Insect Killer</td>
</tr>
<tr>
<td>Bacillus thuringiensis var. kurstaki (bacterial toxin)</td>
<td>Bayer Advanced Dual Action Rose &amp; Flower Insect Killer (+imidacloprid) Bayer Advanced Home Pest Control Indoor/Outdoor</td>
</tr>
<tr>
<td>beta-cyfluthrin</td>
<td>Bayer Advanced Complete Insect Killer for Gardens Bonide Dragon Dust (+copper) Bonide Fruit Spray (+malathion, captan)</td>
</tr>
<tr>
<td>bifenthrin</td>
<td>Bonide Eight Insect Control Flower &amp; Vegetable Green Thumb Premium Insect Control Hi-Yield Bug Blaster II Ortho Bug-B-Gon MAX Insect Killer for Lawns Ortho Bug-B-Gon MAX Lawn &amp; Garden Insect Killer Scott’s Super Turf Builder with Summerguard</td>
</tr>
<tr>
<td>canola oil</td>
<td>Bayer Advanced Natria Multi-Insect Control Earth-tone Horticultural Oil Earth-tone Insect Control (+pyrethrins) Gardens Alive House Guardian Insect Spray (+pyrethrins) Ortho Elementals Garden Insect Killer (+pyrethrins) Gardens Alive Pyola (+pyrethrins)</td>
</tr>
<tr>
<td>carbaryl</td>
<td>Bayer Advanced Complete Insect Killer for Gardens Bonide Dragon Dust (+copper) Bonide Fruit Spray (+malathion, captan) Bonide Rose Rx Rose &amp; Flower Dust (+malathion, captan) Ortho® Bug-Geta Plus Snail, Slug &amp; Insect (+metaldehyde) Sevin</td>
</tr>
<tr>
<td>chlorantraniliprole</td>
<td>Acelpryn Grub-ex</td>
</tr>
<tr>
<td>clove oil</td>
<td>Bonide Mite-X (+cottonseed oil, garlic extract) EcoSmart Home Pest Control (+rosemary oil, peppermint oil, thyme oil)</td>
</tr>
<tr>
<td>cottonseed oil</td>
<td>Bonide Mite-X (+clove oil, garlic extract) Gardens Alive Oil-Away Supreme Insecticidal Spray</td>
</tr>
<tr>
<td>cyfluthrin</td>
<td>Bayer Advanced Vegetable &amp; Garden Insect Spray Bayer Advanced PowerForce Multi-Insect Killer Liquid</td>
</tr>
<tr>
<td>deltamethrin</td>
<td>Hi-Yield Kill-A-Bug II Dust Hi-Yield Kill-A-Bug II Indoor/Outdoor Spray Hi-Yield Turf Ranger Insect Control Granules Hi-Yield Veg. &amp; Ornamental Insect Control Granules</td>
</tr>
<tr>
<td>diatomaceous earth</td>
<td>Garden Safe Crawling Insect Killer Natural Guard Crawling Insect Control</td>
</tr>
<tr>
<td>gamma-cyhalothrin</td>
<td>Spectracide Triazicide Once &amp; Done Insect Killer</td>
</tr>
<tr>
<td>garlic</td>
<td>Bonide Mite-X (+clove oil, cottonseed oil)</td>
</tr>
<tr>
<td>halofenozide</td>
<td>Dow Mach II</td>
</tr>
<tr>
<td>Heterorhabditis bacteriophora (insect-attacking nematode)</td>
<td>Gardens Alive Grub-Away Beneficial Nematodes</td>
</tr>
<tr>
<td>imidacloprid Systemic</td>
<td>Bayer Advanced All-in-One Rose &amp; Flwr (+tebuconazole) Bonite Annual Tree &amp; Shrub Insect Control Bonite Borer-Miner Killer with Systemaxx Bonite Guard-N-Grow Bonite Rose Rx Systemic Drench (+tebuconazole) Bonite Systemic Insect Control with Systemaxx Ferti-lome Rose &amp; Flower Food w/Systemic Insecticide Ferti-lome Tree &amp; Shrub Systemic Hi-Yield Systemic Insect Granules Merit Ortho Max Tree &amp; Shrub Insect Control Ortho Tree &amp; Shrub Insect Control</td>
</tr>
<tr>
<td>Related neonicotinyls: thiamethoxam (Flagship, Meridian) clothianidin (Arena, Aloft) dinotefuran (Safari) imid+bifenthrin (Allectus)</td>
<td>Bayer Advanced Dual Action Rose &amp; Flwr (+beta-cyfluthrin) Bayer Advanced Dual Action Rose &amp; Flwr (+imidacloprid) Bayer Advanced Fruit, Citrus, &amp; Veg. Insect Control Bayer Advanced Season-Long Grub Control Bayer Advanced 3-in-1 Insect, Disease, &amp; Mite Control (+tau-fluvalinate, tebuconazole) Bayer Advanced 2-in-1 Systemic Rose &amp; Flower Care Bayer Advanced 12 Mo. Tree &amp; Shrub Insect Control Bayer Advanced 12 Mo. Tree &amp; Shrub Protect &amp; Feed Bayer Advanced 2-in-1 Insect Control +Fertilizer Spikes Bayer Annual Grub Beater Bayer Annual Tree &amp; Shrub Insect Control Bonite Borer-Miner Killer with Systemaxx Bonite Guard-N-Grow Bonite Rose Rx Systemic Drench (+tebuconazole) Bonite Systemic Insect Control with Systemaxx Ferti-lome Rose &amp; Flower Food w/Systemic Insecticide Ferti-lome Tree &amp; Shrub Systemic Hi-Yield Systemic Insect Granules Merit Ortho Max Tree &amp; Shrub Insect Control Ortho Tree &amp; Shrub Insect Control</td>
</tr>
<tr>
<td>Common name</td>
<td>Trade names</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Insecticides</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Used in Greenhouse and Landscapes and Toxicity to Pollinators</strong></td>
<td></td>
</tr>
</tbody>
</table>
| insecticidal soap (potassium salts of fatty acids) | Bayer Advanced Natria Insecticidal Soap  
Bonide Insecticidal Soap  
Concern Insect Killing Soap  
Concern Tomato & Vegetable Insect Killer (+pyrethrins)  
Earth Options by Raid Insecticidal Soap  
Earth-tone Insecticidal Soap  
Garden Safe Insecticidal Soap  
Ortho Elementals Insecticidal Soap |
| 1 contact, 3 residual            | Safer End-ALL Insect Killer (+neem, pyrethrins)  
Safer Fruit & Vegetable Insect Killer  
Safer Insecticidal Soap  
Safer Rose & Flower Insect Killer  
Safer 3-in-1 Garden Spray (+sulfur)  
Safer Tomato & Vegetable Insect Killer (+pyrethrins)  
Safer Yard & Garden Insect Killer (+pyrethrins) |
| **3 iron phosphate**             | Bayer Advanced Dual Action Snail & Slug Killer Bait  
Bayer Advanced Snail & Slug Killer Bait  
Bonide Bug & Slug Killer (+spinosad)  
Bonide Slug Magic  
Ferramol Slug & Snail Bait  
Ortho Elementals Slug & Snail Killer  
Sluggo  
Gardens Alive Escar-Go |
| **3 kaolin**                     | Surround at Home Crop Protectant                                             |
| **1 lambda-cyhalothrin**         | Bonide Beetle Killer  
Bonide Caterpillar Killer  
Bonide Colorado Potato Beetle Beater  
Spectracide Triazicide Once & Done Insect Killer |
| **2 malathion**                  | Malathion  
Malathion  
Malathion  
Bonide Fruit Spray (+carbaryl, captan)  
Bonide Rose Rx Rose & Flower Dust (+carbaryl, captan)  
Ortho Max Malathion Insect Spray  
Ortho Bug-Geta Plus Snail, Slug & Insect Killer (+carbaryl)  
Ortho Bug-Geta Snail & Slug Killer |
| **3 metaldehyde**                | Deadline  
Enforcer Everlast Snail & Slug Bait  
Hi-Yield Improved Slug & Snail Bait  
Ortho Bug-Geta Snail & Slug Bait  
Ortho Max Malathion Insect Spray  
Ortho Bug-Geta Plus Snail, Slug & Insect Killer (+carbaryl)  
Ortho Bug-Geta Snail & Slug Killer |
| **2 neem oil**                   | Bonide Bon-Neem II (+pyrethrins)  
Bonide Neem Oil  
Bonide Rose Rx 3-in-1  
Concern Garden Defense Multi-purpose Spray  
Ferti-lome Fruit Tree Spray (+pyrethrins)  
Ferti-lome Triple Action Plus  
Green Light Fruit Tree Spray (+pyrethrins)  
Safer BioNEEM Insecticide & Repellent  
Safer End-ALL Insect Killer (+insect. soap, pyrethrins) |
| **3 parasitic nematodes**        | Many trade names  
(Milky spore disease)  
Many trade names  
Product is not very effective |
| **3 Paenibacillus popilliae**    | Many trade names  
(Milky spore disease)  
Many trade names  
Product is not very effective |
| **1 permethrin**                 | Bayer Advanced Complete Insect Dust for Gardens  
Borer-Miner Killer  
Bonide Eight Garden & Home Insect Control  
Bonide Eight Insect Control Garden Dust  
Bonide Eight Insect Control Vegetable, Fruit, & Flower  
Bonide Eight Insect Control Yard & Garden  
Bonide Total Pest Control Outdoor  
Enforcer Outdoor Insect Killer  
Ferti-lome Indoor – Outdoor Multipurpose Insect Spray  
Green Thumb Flying Insect Killer (+d-trans allethrin)  
Hi-Yield Indoor Outdoor Broad Use Insecticide  
Hi-Yield Lawn, Garden, Pet, and Livestock Insect Control  
Ortho Bug-B-Gon MAX Garden Insect Killer Dust |
| **petroleum oil**                | Bonide All Seasons Horticultural Spray Oil  
Bonide All Seasons Spray Oil  
Horticultural Spray Oil  
Ortho Volck Oil Spray |
| **1-3 pyrethrins principally from plant species Chrysanthemum cineriaefolium** | Bayer Advanced Natria Insect, Disease, & Mite Control (+sulfur)  
Bonide Bug Beater Yard & Garden  
Bonide Citrus, Fruit, & Nut Orchard Spray (+sulfur)  
Bonide Japanese Beetle Killer  
Bonide Pyrethrins Garden Insect Spray  
Bonide Tomato & Vegetable 3-in-1 (+sulfur)  
Concern Tomato & Veg. Insect Killer (+insecticidal soap)  
Earth-tone Insect Control (+canola oil)  
Ferti-lome Quick Kill Home, Garden, and Pet Spray  
Ferti-lome Triple Action Plus II  
Safer End-ALL Insect Killer (+neem, insecticidal soap)  
Safer Tomato & Vegetable Insect Killer (+insecticidal soap)  
Garden Safe Fruit & Vegetable Insect Killer  
Garden Safe Houseplant & Garden Insect Killer  
Garden Safe Multi-Purpose Garden Insect Killer  
Garden Safe Rose & Flower Insect Killer  
Gardens Alive Rose & Ornamental Plant Spray (+sulfur)  
Ortho Elementals 3-in-1 Rose & Flower Care (+sulfur)  
Gardens Alive Pyola (+canola oil)  
Safer Yard & Garden Insect Killer (+insecticidal soap)  
Conserve  
Ferti-lome Borer, Bagworm, Leafminer & Tent Caterpillar Spray |
| **3 sodium ferric EDTA**          | Safer Dr. T Slug & Snail Killer  
Ortho Volck Oil Spray  
Ortho Elementals 3-in-1 Rose & Flower Care (+sulfur)  
Gardens Alive Pyola (+canola oil)  
Safer Yard & Garden Insect Killer (+insecticidal soap) |
| **3 spinosad, when residue is dry** | Bonide Bug & Slug Killer (+iron phosphate)  
Bonide Captain Jack’s Deadbug Brew  
Gardens Alive Bulls-Eye Bioinsecticide  
Conserv  
Ferti-lome Borer, Bagworm, Leafminer & Tent Caterpillar Spray  
Gardens Alive Pyola (+canola oil)  
Safer Yard & Garden Insect Killer (+insecticidal soap) |
| **3 trichlorfon**                | Dylox  
Bayer Advanced 24-Hour Grub Killer Plus |