**INSECT CONTROL**

# Relative Toxicity of Pesticides to Honey Bees

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Most pesticides are at least somewhat toxic to honey bees and other pollinators; however, the degree of toxicity varies considerably from product to product. Insecticides are generally the most likely to cause a bee kill; herbicides, fungicides, and defoliants present relatively minor danger to bees if used according to label directions. Pesticides are listed by active ingredients (AI) and common and/or brand name(s) where appropriate.

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| **Table 5-1A. Relative Toxicity of Pesticides to Honey Bees** |
| **Group 1 — Highly Toxic.** Severe bee losses may be expected **IF** the following pesticides are used when bees are present, or the product is applied near beehives, or within a day after application to foraging bees in the pesticide application area. |
| abemectin (Zephyr) acephate (Orthene) aldicarb (Temik) alpha-cypermethrin arsenicals avermectin azadirachtinazinphos-methyl (Guthion) bensulidebeta-cyfluthrinbifenthrin (Brigade, Discipline) carbaryl (Sevin 80 S) carbofuranchlorethoxyfos chlorfenapyrchlorpyrifos (Dursban, Lorsban) clothianidin (Poncho 600) cyantraniliprolecyfluthrin (Baythroid) cypermethrin (Ammo) cyphenothrindeltamethrin (Decis)*d*-phenothrin (Sumithrin) diazinon (Spectracide) dichlorvos (DDVP, Vapona) dicrotophos (Bidrin)dimethoate (Cygon, DE-FEND) dinotefurandiuronD-trans-allethrin emamectin benzoate esfenvalerate (Asona) | ethion etofenproxfamoxadone (Famoxate) famphur (Famophos) fenamiphosfenazaquinfenitrothion (Sumithion) fenoxaprop-ethylfenpropathrin (Danitol, Dasanit) fenthion (Baytex)fenvalerate fipronil fluvalinate foramsulfuron fosthiazategamma-cyhalothrin (Prolex) imidaclopridimiprothrinindoxacarb (Steward, Avaunt) isofenphoslambda-cyhalothrin (Karate) lindaneLPOS (Sulfotine, RAID TVK) malathion (Cythion) methamidophos (Monitor, Tamaron) methidathion (Supracide) methiocarb (Mesurol)methomyl (Lannate, Nudrin) methoprenemethyl parathion mexacarbate (Zectran) | milbemectin (Milbemycin A4 + Milbemycin A3) momfluorothrinmonocrotophos (Azodrin) naled (Dibrom)oxamyl parathionpentachloronitrobenzene (PCNB) permethrin (Ambush, Pounce) phenothrinphoratephosmet (Imidan) phosphamidon pirimiphos-methyl prallethrin (ETOC) profenofos propoxur (Baygon)pyrazophos (Afugan) pyrethrinspyridaben resmethrin (Synthrin) rotenonespinetoramspinosad (XDE-105, Tracer) sulfoxaflortefluthrin tetrachlorvinphos tetramethrin thiamethoxam tralomethrin tolfenpyradzetamethrin (Mustang max) zineb |
| **Group 2 — Moderately Toxic.** These pesticides can be used in the vicinity of bees if dosage, timing, and method of application are correct; but these products should never be applied directly on bees in the field or at the colony location (apiaries). |
| acetamipridallethrin, D-trans arsenic acid azadirachtin benomylbifenazate (Floramite) bromoxynil octanoatealuminum phosphide (Phostoxin)*Bacillius thuringiensis* (Di-Beta)Biothion carbophenothioncoumaphos (Co-Ral) crotoxyphos crotoxyphos (Ciodrin) demeton | disulfoton demeton disulfotonendosulfan (Thiodan)endothion ethoprop (Mocap)fenarimol fluazinamfonofos (Dyfonate) formetanate (Carzol) mesosulfuron methyl oxamyl (Vydate)oxydemeton-methyl (Metasystox-R) paraquat dichloridephorate (Thimet) phosalone (Zolone) | pirimicarb (Pirimor) profenofox (Curacron)propamocarb (Carbamult)propamocarb hydrochloride (Banol)pyrethrum ronnel sethoxydim ppiroxaminesumithrin (Anvillollo) tartar emetic temephos (Abate) terbufos (Counter)thiacloprid (Calypso, YRC-2894) thiazopyr (MANDATE, VISOR) thiodicarb (Larvin) |

#### Table 5-1A. Relative Toxicity of Pesticides to Honey Bees

**Group 3 — Relatively Non-Toxic.** These pesticides can be used around bees with a minimum risk of injury.

#### Acaricides, Diseases, IGRs, and Insecticides

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| aldoxycarb (Standak) allethrinamitrazazadirachtin (Margosan-O) Bacillus thuringiensis (Biotrol) Bacillus thuringiensis (Dipel) Bacillus thuringiensis (Thuricide)B.t. kurstaki (Dipel 4L)B.t. kurstaki (Javelin)B.t. tenebrionis chlorobenzilate (Acaraben) chlorobenzilate (Folbex) clofentizine (Apollo) | cryolite (Kyocide) cymiazole (Apitol) cyromazine (Trigard)dibromochloropropane (Nemagon) dicofol (Dicofol, Griffin dicofol) diflubenzuron (Dimilin)dinobuton (Dessin) dioxathion (Delnav) ethion (Ethiol)Heliothis virus metaflumizonemethoxychlor (Marlate) multimethylalkenols (Stirrup) nicotine | Nosema locustae (Canning) oxythioquinox (Morestan) polynactinspropargite (Comite, Omite) pymetrozine (Fulfill, Endeavor) pyrethrumpyriproxyfen rotenone ryaniatetradifon (Tedion) tetraflubenzuron (CME) trichlorfon (Dylox)Z-11-hexadecanol (tomato pinworm pheromone) |

#### Fungicides

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| --- | --- | --- |
| acibenzolar-S-methyl (Actigard) anilazine (Dyrene)anilazine (Kemate) azoxystrobin (Heritage) benomyl (Benlate) bordeaux mixture captafol (Difolatan) captan (Orthocide) chloropicrincopper 8-quinolinate copper hydroxidecopper oxychloride sulfate copper sulfate—monohydrated cuprous oxide | cyclanilide (Finish) cymoyanil (Curzate 60DF) cyprodinil (Vangard WP) dazomet (Mylone) dicholonedimethomorph (Acrobat MZ) diniconazole (Spotless) dinocap (Karathane) dithianon (Thynon)dodine (Cyprex) fenaminosulf (Lesan)fenhexamid (Elevate 50 WDG) fluazinam (Omega 500F) folpet (Phaltan)glyodin (Glyoxide) | mancozeb maneb (Manzate)metiram (Polyram)nabam (Parzate) polyphase P-100 (Troyson) prochlorazprochloraz/carbendazin (Sportac) sulfurthiramthiramlmethoxychlor (Atasan) trifloxystrobin (Flint, Stratego, Compass) triforine (Funginex )triphenyltin hydroxide (Du-Ter) ziram (Zerlate)zoxamide (Zoxium 80W) |

#### Herbicides, Defoliants, Desiccants, and PGRs

|  |  |  |
| --- | --- | --- |
| 2,3,6-TBA (Trysben) | diquat | naptalam (Alanap) |
| 2,4,5-T | diuron (Karmex) | nitrofen (TOK) |
| 2,4-D (2, 4-D) | EPTC (Eptam) | norflurazon (Zorial) |
| 2,4-DB (Butoxon) | etephon (Ethrel) | ovasyn |
| 2,4-DB (Butyrac) | ethalfluralin (Sonalan) | paraquat |
| acetochlor | EXD (Herbisan) | pendimethalin |
| alachlor (Lasso) | flufenacet (Axiom DF) | phenmedipham (Betanal) |
| amitrole | fluometuron (Cotoran) | picloram (Tordon) |
| ammonium sulfate | flumioxazin (Valor WDG) | prohexadione calcium (Apogee PGR, Baseline) |
| atrazine (AAtrex) | fluridone (BRAKE, Sonar) | prometryn (Caparol) |
| benomyl (Benlate) | fluroxypyr (Starane EC) | pronamide (Kerb) |
| bensulide | fluthiacet-methyl (Action) | propanil (Stam F-34) |
| bentazon (Basagran) | foramsulfron (Option) | propazine (Milogard) |
| bromacil (Hyvar) | glyphosate (Roundup) | propham (Ban-Hoe, IPC) |
| butifos (DEF) | hydrogen cyanamide (Dormex) | PT807-HCl (Ecolyst) |
| chlorbromuron (Maloran) | imadagylin (Arsenal) | quinchlorac (FACET) |
| chloroxuron (Tenoran) | imazamox (Raptor) | simazine (Princep) |
| clodinafop-propergyl (Discover) | isoxaflutole (Balance) | sodium chlorate (KNOCK ‘UM OFF) |
| clofencet (Genesis) | linuron (Lorox) | terbacil (Sinbar) |
| cloproxydim (Select) | MCPA (Mapica) | terbutryn |
| cloransulam-methyl (First-Rate) | metaldehyde propazine (Milogard) | terbutryne (Igran) |
| cyanazine (Bladex) | methazole (Probe) | thiadiazuron (DROPP) |
| cyhalofop-butyl (Clincher) | metribuzin (Lexone) | tralkoxydim (Achieve 40DG) |
| dalapon | metribuzin (Sencor) | tribufos (DEF) |
| dicamba (Banvel) | mesotrione (Callisto) | tribuphos (6EC) |
| dichlobenil (Casoron) | metolachlor | tribuphos (Folex) |
| diflufenzopyr (Distinct) | monuron | tributyl phosphorotrithioite (Folex) |
| trifluralin |

#### Table 5-1B. Pesticide Use Inside and Around Honey Bee Hives — Formulations for use by the general public, unless otherwise noted

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| **Pests** | **Chemical (Brand)** | **Formulation** | **Precautions and Remarks (Always follow product label directions for handling, product application, and disposal)** |
| **Tracheal Mite** | menthol (Mite-A-Thol) | Crystalline granules | Both products generate vapors that kill tracheal mites. Apply onto inner cover/top super according to label directions. Best if used when ambient temperatures are above 70 degrees F for menthol and 50 degrees F for formic acid. Use gloves when handling crystals or gel packets. |
| formic acid (Mite-Away Quick Strips) | Various delivery methods |
| **Varroa Mite** | tau-fluvalinate (Apistan) | Plastic strip; pesticide- impregnated | Strips contain contact poison to kill mites. Use protective gloves when handling strips. Hang strips in brood-chamber according to label directions. Caution should be used, as mites have evolved a resistance to this particular chemical, and it may not be effective in many instances. |
| formic acid (Mite-Away Quick Strips) | Various delivery methods | Product generates vapors to kill mites. Kills mites in sealed brood cells. Treat colonies according to label directions. |
| coumaphos (Check-Mite+) | Plastic strip; pesticide- impregnated | For varroa mites, product should be used **only** when fluvalinate-resistance has been confirmed by NCDA Bee Inspectors. Caution should be exercised, as mites have evolved a resistance to this particular chemical and may not be effective in many instances. |
| amitraz (Apivar) | Plastic strip; pesticide- impregnated | Strips contain active ingredient to kill mites upon contact. Use protective gloves when handling strips. |
| thymol (ApiLife VAR or Apiguard) | Pesticide-impregnated vermiculite tablets or gel | Essential oils volatilize to kill mites outside of brood cells. |
| sucrose octonoate (Sucrocide) | Liquid; mix with water | Spray all adult bees with fine mist; must be completely wetted to kill mites. |
| **Small Hive Beetle (adults)****(pupae)** | coumaphos (Check-Mite+) | Plastic strip; pesticide- impregnated | Use protective gloves when handling strips. Attach to cardboard or other material as specified on label direction and place strip-side down on bottom board to kill adult beetles. Application for varroa mites (see above) is **not** simultaneously effective for SHB. |
| permethrin (GardStar) | Liquid; mix with water | For ground treatment around hive(s) only. Kills larvae/pupae during soil-inhabiting phase of beetle life cycle. Mix and apply to soil according to label directions. |
| **Wax Moth** | paradichlorobenzene (Para-Moth) | Crystalline granules | Use to prevent infestation of stored hive equipment (drawn-comb) only. Do not use in hives containing honey bees. Use protective gloves when handling crystals.Store product in sealed container when not in use. |

Always follow label directions, which require the removal of honey from beehives prior to most pesticide treatments.

# Reducing the Risk of Pesticide Poisoning to Honey Bees

Pesticide poisoning of honey bees can usually be kept to a minimum if the pesticide applicators and the beekeepers take several precautions.

#### Precautions for the Pesticide Applicator

1. Always read and follow any warning statements regarding honey bees on the pesticide label.
2. If more than one product gives good control of the target pest, select a pesticide from Group 2 or 3 instead of Group 1 from the preceding “Relative Toxicity of Pesticides to Honey Bees.”
3. Avoid applying any bee toxic pesticides on blooming plants that attract bees. Keep pesticide drift from nearby blooming weeds that are attracting bees.
4. Time of pesticide application is very important. Apply pesticides that are toxic to bees in the late afternoon (after 3 p.m.) or in the evening if at all possible. Most honey bees have stopped foraging and have returned to their hives by 3 p.m. This allows maximum time for the pesticide to decompose before the bees come into contact with it the next day.
5. Select the safest formulation of the pesticide that is available for the intended use. “Drifting” of the pesticide from the target pest and/or crop to areas frequented by bees should be minimized and formulation selection is the key to this problem.
	1. “Dusts” almost always drift more than other pesticide formulations and are generally more dangerous to bees than are sprays or granular applications.
	2. Spray formulations are usually safer to bees than are dusts , but there are differences among the spray formulation types. Generally, water-soluble formulations are safer than are emulsifiable-formulations, and fine sprays are less dangerous than are coarse sprays. Sprays of undiluted technical pesticide (ULV) may be more dangerous than diluted sprays.

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* 1. **Granular applications generally are the least likely to drift and accidentally kill bees**. Consider a granular formulation if it is suitable for destroying the target pest.
	2. Microencapsulated pesticides present a very distinct and serious threat to honey bees. The particle size of this pesticide formulation is very similar to that of pollen, and adult honey bees may carry this pesticide back to the hive where it will be

combined with stored pollen. This pesticide will not kill the adult bees that collected it, but the microencapsulated pesticide will kill the brood (immature) stages of the bees and the young adult (nurse) bees that feed the brood when it is later fed to those bees. Bees have little protection against these products.

1. The mode of pesticide application is also important, particularly from a drifting standpoint. Aerial applications are generally more dangerous than applications by ground equipment. If a pesticide application is being made by air, it is the contractor’s responsibility to notify any beekeepers that have *registered* apiaries (one or more hives of bees) within 1/2 mile of the area to be aerially sprayed. These regulations are defined in the N.C. Pesticide Laws, and the person responsible for the notification is the person who contracts for the aerial application.
2. Never apply any pesticide directly over a beehive.
3. Notify beekeepers who have beehives near an area to be treated with a pesticide so that they may attempt to protect their bee s.
4. Follow proper precautions in disposing of unused pesticides and pesticide containers. Be particularly careful not to contaminate water with pesticides, as the water may be collected by bees and result in bee kills.

#### Precautions for the Beekeeper

1. If your bees are located in any area where pesticides are commonly used, then identify yourself as a beekeeper to your neighbors who may use pesticides.
2. Identify your apiaries with your name and address or telephone number if the apiary is not associated with your resid ence so that you may be notified if pesticides are to be used by a neighboring individual.
3. Explain the importance of your bees in the pollination of crops being grown on nearby fields to those growers so that they may consider the value of the bees in pollination before applying any pesticides that may kill the pollinating insects.
4. Be aware of the precautions that apply to the pesticide applicator (above) so that you can serve as a resource in providing solutions to reducing bee kills.
5. Do not place apiaries in areas used to grow crops that require heavy and frequent usage of pesticides.
6. Register your apiary locations with the N.C. Department of Agriculture if aerial applications of pesticides are used in your apiary locations.
7. As a very last resort, move your beehives if possible when bee-toxic pesticides are being applied near your apiary. Covering the hives (e.g., with wet burlap) is usually not possible for large apiaries and can cause bees to overheat or suffocate.