Understanding Pesticide Exposure Risks for Bees

The impact of pesticides on bees depends on two main factors: toxicity (how harmful the pesticide is to bees) and exposure (how much a bee encounters it). Even a less toxic pesticide can be dangerous if bees are directly exposed during application, while a few amount of residues of highly toxic pesticides drifting onto flowering weeds can also cause serious harm (May et al., 2015).

How Bees Are Exposed to Pesticides

There are several ways that bees can encounter pesticides:

1. **Direct Contact During Application:** This happens when bees are flying or visiting flowers while pesticides are being sprayed. Direct exposure can kill them immediately or cause them to carry a high dose of toxins back to the colony, affecting other bees.
2. **Indirect Contact from Treated Surfaces:** Bees can pick up pesticide residues when they land on leaves or flowers that have been sprayed. The risk decreases once the pesticide dries or breaks down under sunlight. However, some pesticides create harmful secondary compounds as they degrade. The impact of these residues varies between products and isn't well-documented for most pesticides. Those that are quickly absorbed by plants may pose a lower risk of indirect exposure.
3. **Pesticide Drift:** Pesticides can be carried by wind onto nearby blooming plants, bee nests, or hives. Drift can be reduced by using coarser sprays and avoiding application in windy conditions. The type of pesticide formulation also matters—water-based and oil-based sprays behave differently in the air.

   Another major risk occurs during planting, especially with treated seeds. Many coated seeds release contaminated waste talc as dust when they are planted using pneumatic planters. This pesticide-laden dust can spread into the environment and expose bees to high concentrations of toxins (Krupke et al., 2012).
4. **Ingesting Contaminated Pollen or Nectar:** Some pesticides, like neonicotinoids, are systemic, meaning they are absorbed by plants and spread through their tissues. These pesticides can be applied as sprays or seed treatments and are then taken up by plant roots. They work well against

sucking pests like aphids but can also contaminate nectar, pollen, and even plant guttation fluid (small droplets released by leaves). Some systemic pesticides are more toxic to bees than others, and certain chemicals are far more dangerous when ingested than when touched.

5. **Contaminated Water Sources and Spills:** Bees collect water, so they can be exposed to pesticides through contaminated water sources or accidental spills. Keeping clean water sources on the farm and preventing pesticide spills are key steps to reducing bee exposure.

Pesticides can accumulate inside the hive and be found in honey, bee bread, wax, royal jelly, and propolis. When forager bees are not immediately killed by pesticide exposure (lethal dose), they may bring contaminated food or carry pesticide particles on their bodies, leading to the buildup of toxic substances within the hive and the spread of sublethal doses. If the dose is not high enough to cause immediate mortality (sublethal dose), it can still have detrimental effects, such as immune system impairment, making bees more susceptible to diseases and parasites. Additionally, it may cause locomotor difficulties, memory loss, reduced foraging activity, impaired colony development, and negative impacts on the queen's reproductive success (de Castro Lippi et al., 2024a;2024b).

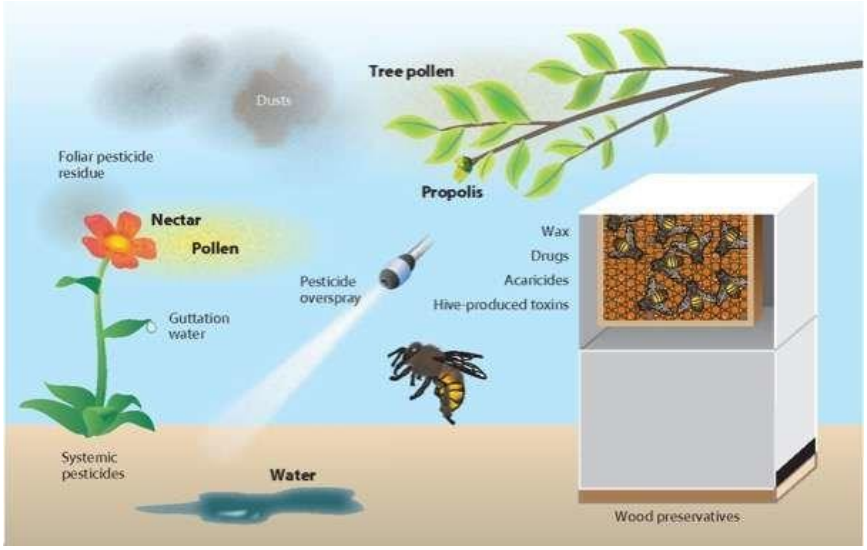

Figure 1. A summary of the different routes by which honey bees may be exposed to potentially toxic pesticides. Materials collected by foraging honey bees are in bold letters (Olgun et al., 2020)

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Pesticides Table

Analyte	Notes (e.g. spray mostly used for what pests/disease on what crops etc)	LD50 for Honey Bees: mg/bee	Notes
Acephate	Organophosphate Insecticide. Use: Bananas, Crucifiers, Macadamias, Ornamentals, Potatoes, Tomatoes and Tobacco	Contact LD50: 0.00178 mg/bee / Oral LD50: >0.00023	Foliar Spray. It is highly soluble in water and most organic solvents and is volatile. It is not expected to leach to groundwater. Whilst it is mobile, it tends not to be persistent in soil or aquatic systems. It has moderate to high toxicity to honey bees
Aldicarb	Insecticide. Use: Cotton, sugarcane, citrus	Contact LD50: 0.00028mg/bee / Oral LD50: 0.00016mg/bee	Soil application (granular). It is highly soluble and volatile. It is not persistent in soil but may be in in aqueous systems. It is highly toxic to humans but has a low potential to bioaccumulate. Highly toxic to birds and honey bees
Aldrin	Organochlorine Insecticide. It was banned in Australia in the mid-1990s.		Seed treatment, soil application. It is banned from most of the developed world. It is virtually insoluble in water, quite volatile but unlikely to leach to groundwater. There are field studies that have shown that aldrin can be persistent in soils. It has a high toxicity to honey bees
Aldrin bhc	It is now banned in Australia and is considered toxic to humans and animals.		Seed treatment, soil application. It is banned from most of the developed world. It is insoluble in water, quite volatile but unlikely to leach to groundwater. There are field studies that have shown that aldrin can be persistent in soils. High toxicity to honey bees
alpha-Endosulfan	Organochlorine Insecticide. Use: On crops such as cotton, fruit, vegetables, grains, teas, and tobacco. Australia banned the use of endosulfan, including alpha-endosulfan, in 2010.		Foliar Spray. Alpha-endosulfan has a low aqueous solubility and moderately. It is moderately persistent in the soil but has a low mobility. It is moderately toxic to honey bees
Atrazine	Herbicide used in Australia to control weeds in crops and plantations	LD50: 0.097 mg/bee	Foliar Spray. It has a moderate aqueous solubility, it is volatile and, based on its physico-chemical

			properties there is some concern that it could leach to groundwater. It is not persistent in the field nor in aquatic systems.
Azinphos ethyl	Organophosphate Insecticide, Broad-spectrum : To control sucking and chewing pests.	Contact LD50: 0.00139mg/bee	Foliar spray. It is moderately toxic to honey bees. It may be moderately persistent in some soil systems but is not expected to be persistent in water. Concerns regarding its potential to bioaccumulate. It is moderately toxic to honey bees.
Azinphos methyl	Organophosphate Insecticide. Use: On some fruit and nut crops (apples, apricots, blueberries, cherries, citrus, grapes, kiwifruit, lychees, macadamias, nectarines, peaches, pears, plums, and quinces)	Contact LD50: 0.00042mg/bee	Foliar spray. Is not expected to bioaccumulate but it is highly toxic to birds, honey bees and the most aquatic life
Bensulfuron methyl	Herbicide that controls weeds in crops like rice and wheat	Contact LD50:> 0.00034mg/bee / Oral LD50: 0.0514mg/bee	Soil application (herbicide). It is sparingly soluble in water, non-volatile and moderately mobile. It would not be expected to persist in soil but could be persistent in water systems under certain conditions. It shows a moderate toxicity to honey bees
beta-BHC	Banned in Australia		
beta-Endosulfan	Banned in Australia in 2010		Foliar spray. Little is known about this particular isomers environmental fate, ecotoxicology or impact on human health or how these differ from endosulfan.
Bifenthrin	Pyrethroid insecticide. Use: for the control of borers and termites in timber, insect pests in agricultural crops (bananas, apples, pears, ornamentals) and turf, as well as for general pest control (spiders, ants, fleas, flies, mosquitoes).	Contact LD50: 0.000016mg.bee / Oral LD50: 0.0001mg/bee	Foliar spray, soil treatment. There are some concerns about bioaccumulation and it shows a high oral toxicity to mammals. It is toxic to birds, most aquatic organisms, honey bees and earthworms.
Bioresmethrin	Pyrethroid insecticide. Use: Household insecticide used for the control of flies, mosquitoes, spiders, ants, cockroaches, fleas, silverfish, and moths.	Fot resmethrin: 0,000045 mg/bee	Foliar spray. It has a low aqueous solubility and is moderately volatile. It is not thought to be environmentally persistent. Is highly toxic to fish, aquatic invertebrates and honey bees.

Bromacil	Herbicide. Use: Control of weeds and grasses in fruit orchards and plantations, commercial and industrial areas, rights of way and around agricultural buildings.	Contact LD50: >0.011 mg/bee	Soil application. It tends to demonstrate a low to moderate toxicity to most fauna and flora. It may be persistent in soil and water systems depending on local conditions.
Bromophos ethyl	Obsolete organophosphate insecticide that is highly toxic to aquatic invertebrates and honey bees. Use: To control biting and sucking pests, used on stored wheat grain, maize, rice, cotton, fruit, vines, and in forestry	Contact LD50: > 0.00044mg/bee	Foliar spray. It is highly toxic to honey bees. It has a low aqueous solubility and is quite volatile. It is not persistent in soil systems
Bupirimate	Pyrimidinol Fungicide to control powdery mildew. Use: apples, melons, Pumpkins; Squash; Strawberry; Blackcurrant; Raspberry; Gooseberry; Hops; Courgette; Ornamentals	Contact LD50: >0.05 mg/bee. Oral LD50 >0.2mg/bee	Foliar spray. It has a moderate aqueous solubility and a low volatility. Depending on local conditions, bupirimate may be moderately persistent in both soil and aquatic systems
Buprofezin	Insecticide. Use: Selective insecticide controlling scale, mealybugs and jassids in citrus, grapes, pears, persimmons, custard apples, passionfruit and mangoes.	Contact LD50: >0.2 mg/bee. Oral LD50 >0.1635mg/bee	Foliar spray. It has low aqueous solubility and low volatility. Depending on local conditions it can be moderately persistent in soils and very persistent in water systems. Might have low toxicity to honey bees
Carbaryl	Insecticide. Use: To control pests in gardens, poultry, and domestic situations. However, the Australian Pesticides and Veterinary Medicines Authority (APVMA) has restricted the use of carbaryl.	LD50: 0.0000428 mg/bee / Different study: LD50: 0.000004331 mg/bee after 48h ; 0.000000715 mg/bee after 96h	Foliar spray, wettable powder. It has a low aqueous solubility and is volatile. It is not persistent in either soil or water systems. It is highly toxic to mammals but it is not expected to bioaccumulate. High toxicity to honey bees
Carbendazim	Benzimidazole Fungicide, control Botrytis fabae and grey mould Botrytis cinerea. Use: ONLY in pulse crops - faba beans, lentils, vetch and chickpea	Contact LD50: >0.05 mg/bee / Oral LD50: >0.756mg/bee	Foliar spray. It has a low aqueous solubility, is volatile and moderately mobile. It is moderately persistent in soil and can be very persistent in water systems under certain conditions. It is moderately toxic to honey bees and most aquatic organisms
Carbofuran-3-hydroxy	3-hydroxy Carbofuran is an active metabolite of carbofuran (Item No. 25635), which is an insecticide that inhibits acetylcholinesterase in mammals and insects.		

Carbofuran	Carbamate Insecticide. Use: rice, sugarcane, tobacco, and wheat, is also used as a nematicide to control worms	Contact LD50: 0.000036mg/bee / Oral LD50: 0.000038mg/bee	Soil application. It is moderately soluble in water, is relatively volatile and, based on its chemical properties, has a high potential for leaching to groundwater. It is highly toxic to birds and honey bees
Carbophenothion	Non-systemic Organophosphorus Insecticide and Acaricide. Use: for pre-harvest treatments on deciduous fruits, citrus fruits, small fruits, vegetables and field crops, and for ectoparasite control on cattle and sheep. It is also used as a cereal seed dressing.	Contact LD50: 0.0014mg/bee	Foliar spray. It has a low aqueous solubility, low volatility and, based on its chemical properties, would not be expected to leach to groundwater. It may be quite persistent in soil systems. Moderate toxicity to honey bees.
Chlorfenvinphos (E)	Organophosphate Insecticide. Chlorfenvinphos is partially banned in Australia for use on crops, but is still used for some veterinary purposes (control ectoparasites on cattle and sheep)	Contact LD50: 0.0041 mg/bee / Oral LD50: 0.00055 mg/bee	Foliar spray, seed treatments,wettable powders. Moderate aqueous solubility and is miscible with many organic solvents. Relatively volatile and there is some risk that it may leach to groundwater, moderately persistent in soil systems. Highly toxic to honey bees
Chlorfenvinphos (Z)	Organophosphate Insecticide. Chlorfenvinphos is partially banned in Australia for use on crops, but is still used for some veterinary purposes (control ectoparasites on cattle and sheep)	Contact LD50: 0.0041 mg/bee / Oral LD50: 0.00055 mg/bee	Foliar spray, seed treatments, wettable powders. Moderate aqueous solubility and is miscible with many organic solvents. Relatively volatile and there is some risk that it may leach to groundwater, moderately persistent in soil systems. Highly toxic to honey bees
Chlorothalonil	Organochlorine Fungicide: Use: To control fungi that threaten vegetables, trees, small fruits, turf, ornamentals, and other agricultural crops. A broad spectrum, non-systemic fungicide.	Contact LD50: 0.1353 mg/bee / Oral LD50: >0.04 mg/bee	Foliar spray. It has a low aqueous solubility, is volatile and would not be expected to leach to groundwater. It is slightly mobile. It tends not to be persistent in soil systems but may be persistent in water. Moderately toxic to honey bees
Chlorpyrifos methyl	Organophosphate Insecticide.The Australian Pesticides and Veterinary Medicines Authority (APVMA) has canceled the use of chlorpyrifos in Australian homes and gardens.	Contact LD50:0.00015 mg/bee / Oral LD50: 0.00018mg/bee	Foliar spray. It has a low aqueous solubility, is quite volatile and is non-mobile. There is a low risk of leaching to groundwater based on its chemical properties. It tends not to be persistent in soil or

			water systems. It is highly toxic to fish, aquatic invertebrates and honey bees
Chlorpyrifos	Organophosphate insecticide. Use: to control a wide range of insect pests, including agricultural pest insects, ants, termites and mosquitos. Restricted in Australia due to health and environmental concerns.	LD50: 0.00025 mg/L/ LD50: 0.00000867 mg/bee after 48h ; 0.000001957 mg/bee after 96h	Foliar spray. It has a low aqueous solubility, is quite volatile and is non-mobile. There is a low risk of leaching to groundwater based on its chemical properties. Moderately persistent in soil systems but is not usually persistent in water. It is highly toxic to birds and honey bees
Chlorotoluron	Herbicide. Use: to control weeds in cereal crops	Contact LD50: >0.2mg/bee/ Oral LD50: >0.1001mg/bee	Foliar spray. It is moderately soluble in water, volatile with a high potential for leaching to groundwater. It is moderately persistent in soil but tends not to be persistent in water due to rapid aqueous photolysis. It has low toxicity to honey bees
Cis-Chlordane	Chlordane is a persistent organic pollutant (POP) that was banned in Australia in 1997. There are no registered products that contain chlordane in Australia, but de-registered compounds may still be detected in water.	Contact LD50: 0.006 mg/bee	Granules, dusts, wettable powders, and oils. It has low aqueous solubility, is quite volatile and is not normally expected to leach to groundwater. It can be very persistent in both soil and water systems. High toxicity to honeybees.
Coumaphos	Organophosphate Insecticide - Acaricide. Use: To treat ectoparasites on livestock and in beehives	Contact LD50: 0.02029 mg/bee to 0.024 mg/bee / Oral LD50: 0.00461 mg/bee	Foliar spray, livestock treatment. Detection in wax samples: Range 91900.0 to 1 ppb. Classified as an extremely hazardous substance in the United States. It has a moderate toxicity to honey bees
Cyanazine	Herbicide . Use: For the control of various weeds in field peas, processing peas, chickpeas, faba beans, lentil, vetches, onions, potatoes, sweetcorn	Contact LD50: 0.1mg/bee	Soil application. It is moderately soluble in water and many organic solvents, and it is relatively volatile. It is not persistent in soil systems but can often be persistent in water. It has a moderate toxicity to honey bees
Cyfluthrin	Pyrethroid insecticide. Use: broad-spectrum insecticides used for the control of spiders, ants, fleas, flies, silverfish, cockroaches, bedbugs and mosquitoes	Contact LD50: 0.000001mg/bee / Oral LD50: 0.00005mg/bee	Foliar spray. It has a low aqueous solubility and is non-volatile. It may be moderately persistent in some soil systems. Cyfluthrin is highly toxic to most biodiversity. It shows a high toxicity to honey bees

Cyhalothrin	Pyrethroid insecticide. Use: To control pests on crops and in public health settings. It's a broad-spectrum insecticide that's effective against aphids, caterpillars, beetles, mosquitoes, and cockroaches	Contact LD50: 0.000038 mg/bee / Oral LD50: 0.00091mg/bee	Foliar spray. It has a low aqueous solubility and is not volatile. It may be environmentally persistent depending on local conditions. There is a low risk of cyhalothrin leaching into groundwater. It has a high toxicity to honey bees
Cypermethrin	Pyrethroid insecticide. Use: A contact and ingested insecticide and repellent with good activity on caterpillars. Has repellent and anti-feeding action. Some insects will starve rather than eat treated plants.	LD50 79.58 to 44.76 mg/L / Different study: LD50: 0.00006 mg/bee	Foliar spray, livestock treatment (pour on). It has a low aqueous solubility and is volatile. It is considered a serious marine pollutant. It is moderately persistent is soils. It is highly toxic to most aquatic species and honey bees
Cyprodinil	Fungicide . Use: for control of a range of fungal diseases in cereals, grapes, pome fruit, stone fruit,strawberries, vegetables, field crops and ornamentals, and as a seed dressing for barley	Contact LD50: >0.784 mg/bee / Oral LD50: 0.1125mg/bee	Foliar spray. It has a moderate aqueous solubility, is unlikely to leach to groundwater and is volatile. In soil it is moderately persistent but may be persistent in water systems depending on local conditions. It has a moderate toxicity to honey bees
delta-BHC	Organo-chlorine pesticide		
Deltamethrin	Pyrethroid insecticide. Use: It is used on around 25 food crops including cereal, vegetables and is also used on cotton, tobacco and wildflowers. Deltamethrin has extensive household use in food preparation areas, and is also used on animals against external parasites and on timber against borers.	LD50: 0.0007 mg/bee	Foliar spray, pour-on or spot-on for livestock. It has low aqueous solubility, is semi-volatile and has a low potential to leach to groundwater. It is not persistent in soil and is non-mobile. It presents a high risk to most aquatic organisms and honey bees.
Dimethoate	Organophosphate Insecticide - Acaricide. Broad spectrum control of sucking and chewing pests in ornamentals and forestry situations.	Oral LD50: 0.00034mg/bee	Foliar spray. It is highly soluble in water, has low groundwater leaching potential and is volatile. It is non-persistent in soil, mobile but does not normally persist in aerobic aquatic systems. It has a high toxicity to honey bees
Demeton-S-methyl	Organophosphate Insecticide/ Acaracide. Use: Registered in Australia for over 50 uses, mainly against aphids, mites and flies in around 10 food crops, including fruit, cereal and vegetables, plus	Contact LD50: 0.0026mg/bee / Oral LD50: 0.00019mg/bee	Foliar spray. It is highly soluble in water, volatile and, based on its physico-chemical data, it is not expected to leach to groundwater. It is not persistent in soil systems.It is highly toxic to birds, aquatic invertebrates and honey bees

	cotton, ornamental plants, tobacco, and various pastures		
Diazinon	Nonsystemic organophosphate insecticide. The Australian Pesticides and Veterinary Medicines Authority (APVMA) has banned the use of diazinon for certain purposes, including in food production and on livestock.	Contact LD50: 0.00013 to 0.00038mg/bee / Oral LD50: 0.00009 to 0.00021mg/bee	Spray. It is moderately soluble and highly volatile and it should be considered a potential groundwater pollutant. It is listed as a severe marine pollutant. It is highly toxic to aquatic organisms, birds and honey bees
Dichlofluanid	Fungicide. Use: widely used to control many fungal diseases in plants. It is also added as an antifouling agent to copper-based boat paints.	Contact LD50: 0.016mg/bee	Wettable powders or dustable powders. It has low aqueous solubility and is volatile and, based on its chemical properties, it is unlikely to leach to groundwater. It is not persistent in most soil or aquatic systems. It is moderate to highly toxic for most biodiversity including bees.
Dichlorvos	Insecticide. Use: Commonly used in Australia against a large variety of insects that infest domestic, public and commercial buildings, recreational areas, abattoirs, , wineries (non-food producing areas), animal houses,mushroom growing facilities, glasshouses, greenhouses and food storage areas. The major use of dichlorvos is as a disinfestant fumigant or spray for stored grain and for grain handling equipment.	Oral LD50: 0.0001376 mg/bee	Aerosol spray. It has high aqueous solubility, quite volatile and is unlikely to leach to groundwater. It is not usually persistent in soil or water. It is highly toxic to mammals and has a high tendency to bioaccumulate. It has a high toxicity to honey bees
Dicloran	Fungicide. Use: Fruit including apricots, nectarines, oranges, grapes, peaches, plums, cherries, rhubarb; vegetables including beans, celery, onions, shallots; Sweet potatoes; Tomatoes; Ornamentals including Christmas trees	Contact LD50: 0.18mg/bee / Oral LD50: >0.113mg/bee	Dust, wettable powder and liquid. It has a low aqueous solubility and is volatile. Based on its chemical properties, it may leach to groundwater. It can also be quite persistent in soil but not usually so in water. It has a low toxicity to honey bees
Dicofol	Acaricide. Use: An acaricide used to control many species of phytophagous mite on a range of food and ornamental crops. Was phased out in Australia in 2020	Contact LD50 : 0.019mg/bee / Oral LD50 : >0.01mg/bee	Foliar spray. It has low aqueous solubility, volatile and, based on its chemical properties, is unlikely to leach to groundwater. It is moderately persistent in soil but does not normally persist in water. It has a moderate toxicity to honey bees

Dieldrin	Insecticide. Dieldrin is a banned chemical that was used as an insecticide in Australia	LD50 range: 0.00133–0.00220mg/g of honey bee	Spray. It has a low aqueous solubility and is volatile. Based on its chemical properties, it is not expected to leach to groundwater. Its data suggests it is very persistent in soil and is non-mobile. It has a high toxicity to honey bees and mammals
Difenoconazole	Fungicide. Use: Controls target spot of potatoes and tomatoes, leaf blight of carrots, leaf spot diseases of bananas and husk spot on macadamias.	Contact LD50: >0.1 mg/bee / Oral LD50: > 0.177 mg/bee	Foliar spray or seed treatments. It has potential for particle bound transport. It is slightly volatile, persistent in soil and in the aquatic environment. There are some concerns regarding its potential for bioaccumulation. It has a low toxicity to honey bees
Dimethomorph	Fungicide. Use: Control diseases in cucurbits, grapevines, lettuce, onions, oilseed poppies and potatoes. sphinx fungicide packshot.	Contact LD50: >0.01 mg/bee to >0.102mg/bee / Oral LD50: > 0.0324 mg/bee	Foliar spray. It has a moderate aqueous solubility and a low volatility. It may be moderately persistent in both soil and water systems. Risks to biodiversity are generally in the moderate to low range. It has a moderate toxicity to honey bees
Dioxathion	Non-systemic insecticide and acaricide. Use: Dioxathion products are used on livestock principally cattle in Australia	Unknown mode acute LD50: >0.05mg/bee	Spray. It has a moderate toxicity to honey bees
Diphenylamine	Fungicide and Antioxidant. Use: Is used for control of superficial scald in stored apples. Diphenylamine is one of several salts of glyphosate, a broad-spectrum herbicide.		Spray. Detected in wax comb: 100.7 ppb
Diuron	Herbicide and algaecide . Use: For the control of weeds in asparagus, bananas, cereals, cotton, lupins, pulse crops and sugarcane.	Contact LD50:> 0.1017mg/bee / Oral LD50: >0.08675mg/bee / Chronic: > 0.03051mg/bee	It has a moderate aqueous solubility, a low volatility and may, under certain conditions, leach to groundwater. It may be moderately persistent in soil systems and may also persist in water. It has moderate toxicity to honey bees.
Endosulfan sulfate	Organochlorine Insecticide. Use: Pest management strategy of various crops, particularly cotton in inland northern NSW and Queensland. Used as insecticide and acaricide on a variety of other crops, including vegetables, fruit, nuts, cereal as	Contact LD50: 0.00635 to >0.00781mg/bee / Oral LD50: > 0.0156 mg/bee	Foliar spray. It has a low aqueous solubility and is volatile. Based on its chemical properties it may tend to leach to groundwater. Endosulfan is moderately persistent in soil but does not tend to

	well as in plant nurseries, on lawn, pasture and fodder. flowers and ornamentals		persist in water systems. It is moderately toxic to honey bees
Endothal	Herbicide. Use: for the control of winter grass in turf crops and lawns.		Aquatic suspension or a granular formulation. It is highly soluble in water and semi-volatile. Based on its chemical properties it is not expected to leach to groundwater. It is generally non-persistent in soil.
Endrin aldehyde	Termiticide. Endrin has not been used in Australia for at least 30 years and is banned in the country.	Contact LD50: >0.00046mg/bee	
Endrin Ketone	Endrin has not been used in Australia for at least 30 years and is banned in the country.	Contact LD50: >0.00046mg/bee	
Endrin	Endrin has not been used in Australia for at least 30 years and is banned in the country.	Contact LD50: >0.00046mg/bee	Soil application. It has a low aqueous solubility and is non-volatile. Based on its chemical properties it is not expected to leach to groundwater. Endrin tends to be persistent in soil systems. It has a high toxicity to honey bees
Ethion	Organophosphate insecticide and acaricide. Use: Fruit including apples, pears, citrus; Onions; Cotton; Cereals/ To control: Red spidermite (Tetranychus urticae); Planthoppers; Aphids; Scale insects; Codling moth	Contact LD50:0.011mg/bee / Unknown mode acute LD50: 0.0206 mg/bee	Spray and livestock treatment. It has low water solubility but is miscible with most organic solvents. It is moderately persistent in soil but can be persistent in water bodies. It is not mobile. Eethion is not expected to leach to groundwater. It has a moderate toxicity to honey bees
Fenamiphos	Organophosphate Insecticide. Use: For the control of nematodes and sucking insects in crops and turf.	Contact LD50: 0.00028mg/bee / Oral LD50: 0.00045 mg/bee	Drip irrigation, spray, soil incorporation. It is moderately soluble in water, has a low volatility and would not normally be expected to leach to groundwater. It is not normally persistent in soil or water systems. It has a high toxicity to honey bees
Fenarimol	Pyrimidine fungicide. Use : Fruit including bananas, chrry, filberts, grapes, pears; Ornamental plants and trees; Turf/ To control:Powdery mildew, Dollar spot, Snow mould, Scab, leaf spot, Rusts	Contact LD50: 0.1mg/bee / Oral LD50: 0.01mg/bee	Wettable powder, spray. It has a moderate aqueous solubility but is soluble in many organic solvents. It is not considered to be volatile. Fenarimol may be very persistent in soils and aquatic systems. It has a moderate toxicity to honey bees

Fenchlorphos	Organophosphate insecticide. Obsolete. Fenchlorphos is not registered for use in Australia, Use: To control Cockroaches; Flies		Spray
Fenitrothion	Insecticide. Use: for the control of certain insect pests in broadacre and horticultural crops, in stored grain, in grain storage facilities and in poultry houses.	Contact LD50: 0.00016mg/bee / Oral LD50: 0.0002 mg/bee	Spray. It has a moderate aqueous solubility, is highly soluble in many organic solvents and is volatile. I have a low potential for leaching to groundwater and is not expected to be persistent in soil or water systems. It has a high toxicity to honey bees
Fenoxycarb	Carbamate Insecticide. Use: for the control of Codling Moth and Light Brown Apple Moth in Apples and Pears. It's also used as a bait to control insects on fruit, vines, and stored products, and fire ant control	Contact LD50: >0.204mg/bee/ Oral LD50: >0.204mg/bee	Foliar spray. It has a low aqueous toxicity and is not considered to be volatile. It tends not to be persistent in soil systems but may be much more persistent in water systems. Is not expected to leach to groundwater. It has low toxicity to bees
Fenthion	Organophosphate insecticide, avicide, and acaricide. Use: To control pests in agricultural, commercial and domestic situations and external parasites on cattle. Fenthion is also used to control pest birds in and around buildings.	Contact LD50: 0.00022mg/bee to 0.000308	Foliar spray. It has a low water solubility but is generally highly soluble in organic solvents. It is volatile and is not expected to leach to groundwater. Its persistence in soil and water systems depends on local conditions. It is highly toxic to birds and honey bees
Fenvalerate	Pyrethroid Insecticide. Use: To control insects on crops, animal feed, and in stables.	Contact LD50: 0.00023mg/bee	Spray, fog, or granule. It has a low aqueous solubility and has a low volatility. Evidence suggests it is moderately persistent in both soil and water systems. It is not expected to leach to groundwater. It is highly toxic to most aquatic organisms and to bees.
Fipronil	Termiticide and Insecticides. Use: has a range of agricultural uses, including seed dressings, control of pests in bananas, cotton, sorghum, vegetables and turf. Fipronil is also included in insect baits for household and commercial uses, and in home veterinary products for cats and dogs.	LD50: 0.00019 mg/bee / Different study: 0.00000405 mg/bee	Foliar spray, braits. domestic pets/livestock treatment. It has a low aqueous solubility, a low volatility and is not greatly mobile in the environment. It can be quite persistent in soil systems but is less so in aquatic and sediment systems. It is highly toxic and might bio-accumulate.

Flusilazole	Organosilicon fungicide. Use: To control fungal infections in a variety of crops, including fruits, vegetables, and soybeans	Contact LD50:0.165 mg/bee / Oral LD50: 0.0338 mg/bee	Foliar spray. It has moderate aqueous solubility and a low volatility. It can be persistent in soil and water-sediment systems. The risk of leaching to groundwater is low. It is moderately toxic to honey bees
Formothion	Insecticide and acaricide. An obsolete systemic, broad spectrum. Use: Tree fruit; Vines; Olives; Hops; Cereals; Sugarcane; Rice. To control: Spider mites; Aphids; Psyllids; Mealy bugs; Whiteflies	Contact LD50: 0.00015mg/bee	Spray. Exposure to Formothion can cause severe and rapid Organophospate poisoning. It is highly toxic to honey bees
gamma-BHC(Lindane)	Insecticide, is a neurotoxin that interferes with GABA neurotransmitter function. Use: To treat lice and scabies.	Contact LD50:0.00023 mg/bee / Oral LD50: 0.000011 mg/bee	Seed treatment, spray. It has a low aqueous solubility by is readily soluble in organic solvents. It is quite volatile and has a high potential for leaching groundwater. It can be very persistent in soil and water systems. It is highly toxic to fish and honey bees
HCB			
Heptachlor epoxide	Heptachlor metabolite. Heptachlor epoxide, an oxidation product of heptachlor, is not commercially available.		
Heptachlor	Organochlorine Insecticide, is persistent in the environment and accumulates in the food chain	Contact LD50: >0.000526 mg/bee	Spray. It has a low aqueous solubility but is highly soluble in most organic solvents. It is volatile and has low potential for leaching to groundwater. Heptachlor can be persistent in soil systems but is not generally persistent in water systems. Highly toxic to honey bees
Hexaconazole	Fungicide. Use: on a variety of crops, including apples, coffee, peanuts, rice, vines, bananas, cucurbits, and peppers. Used to control powdery mildew, scabs and rusts.	Contact LD50: 0.1mg/bee / Oral LD50: 0.1mg/bee	Spray. It has moderate aqueous solubility and a low viscosity. It tends to be environmentally persistent in both soil and aquatic systems. It has low toxicity to honey bees
Hexazinone	Herbicide. Use: Against a variety of annual and perennial weeds in tree plantations, sugarcane, pineapple and alfalfa. In Australia it is commonly used in bark treatments of woody weed species, as	Contact LD50:> 0.1mg/bee / Unknown mode acute LD50: 0.6mg/bee	Spray. It is moderately toxic to honey bees

	well as on a variety of weeds in pine plantations, commercial/industrial areas and rights-of-way		
Imazalil	Fungicide. Use: widely used in agriculture, particularly in the growing of citrus fruits.	Contact LD50:0.039 mg/bee / Oral LD50: 0.0351 mg/bee	It can be applied to crops by spraying, drenches, waxing, or foaming equipment. It can also be applied to seeds. It is moderately toxic to honey bees
Imazethapyr	Herbicide. Use: To control of certain weeds in Centrosema (Cavalcade), chickpeas, faba beans, field peas, lucerne, mung beans, peanuts, serradella, soybeans and subterraneum clover	Contact LD50: >0.1mg/bee / Oral LD50: >0.0246mg/bee	Spray. It is moderately toxic to honey bees
Imidacloprid	Neonicotinoid insectide. Use:Effective against beetles, aphids, thrips, and psyllids. Versatile Use: Ideal for cotton, fruits, vegetables, and ornamentals	LD50: 0.000081 mg/bee / Different study: LD50: 0.000002359 mg/bee after 48h ;0.000000477 mg/bee after 96h	Spray, seed treatment. It is highly soluble, non-volatile and persistent in soil. It is moderately mobile. It has a low risk of bioaccumulating. It is highly toxic to birds and honey bees
Iprodione	Fungicide and Nematicide. Use: To treat Almonds, Boysenberries & Grapes, Kiwifruit, Macadamias, Mandarins (non-bearing), Passionfruit, Raspberries, Stone Fruit.	Contact LD50: >0.1 mg/bee / Oral LD50: >0.1 mg/bee	Foliar spray, seed treatment, or postharvest dip. It has low toxicity to honey bees
Isoproturon	Herbicide. Isoproturon is not registered in Australia	Contact LD50: 0.2mg/bee / Oral LD50: 0.195mg/bee	Spray. It has low toxicity to honey bees
Linuron	Herbicide. Use: For control of certain weeds in cereals, potatoes, carrots, coriander and other crops	Contact LD50: >0.0978 mg/bee / Oral LD50: >0.1121 mg/bee	Spray. It is moderately toxic to honey bees
Malathion	Organophosphate Insecticide, Use: Used outdoors to control a wide variety of insects in agricultural settings and around people's homes. In public health mosquito control and fruit fly eradication programs	Contact LD50: 0.00016 mg/bee to 0.00047 mg/bee / Oral LD50: 0.00040 mg/bee to 0.00917 mg/bee	Foliar spray, aerosol. It is moderately soluble in water and readily soluble in many organic solvents. It is quite volatile and has a low potential for leaching to groundwater. Malathion is not usually persistent in soil or water systems. It is highly toxic to honey bees
Metalaxyl	Phenylamide Fungicide. Use: It is used on many food and feed crops, and on non-food, residential and greenhouse crops such as tobacco, ornamental	Contact LD50: >0.1mg/bee to	Spray, drenching, or incorporating into the soil. It has low toxicity to honey bees

	plants, trees, shrubs and vines, and lawns and turf. It is specifically registered to control Pythium Leaf Blight, Phytophthora Heart Rot and Root Rot	0.2mg/bee / Oral LD50: 0.269mg/bee	
Methacrifos	Methacrifos is no longer registered for use in Australia		Fumigation
Methamidophos	Organophosphate Insecticide. In Australia, the use of methamidophos, a highly toxic organophosphate insecticide, was phased out between June 2012 and June 2014	Oral LD50: 0.00022mg/bee	Spray. Highly soluble in water and many organic solvents and is volatile. It would not normally be expected to be persistent in soil or water systems. It is highly toxic to honey bees
Methidathion	Organophosphate Insecticide. Methidathion, an organophosphate insecticide, is no longer registered for use in Australia	Contact LD50: 0.00013mg/bee	Spray. It is highly toxic to honey bees
Methomyl	Cabamate Acaricide - Insecticide. Use: In Australia, methomyl has up to 57 uses on crops, fruit and ornamentals against Lepidoptera, Diptera, Hemiptera, Homoptera and Coleoptera, as well as mites. It is also used against flies on garbage tips and in animal areas.	Contact LD50: 0.00016mg/bee / Oral LD50: 0.00028mg/bee	Spray. It is highly soluble in water but has low volatility and would not normally be expected to leach to groundwater. It is not normally persistent in soil or water systems. It is highly toxic to honey bees
Methoprene	Insect growth regulator used in Australia to control mosquitoes, fleas, mites, lice, and other insect pests	Contact LD50: 1mg/bee / Oral LD50: 0.0002mg/bee	Foliar spray. It is highly toxic to honey bees
Methoxychlor	Organochlorine insecticide. Use: Has been used against a wide range of chewing insects in crops, fruit and vegetables as well as against insect pests in animal houses, dairies and industrial premises.	Contact LD50: >0.0236mg/bee / Oral LD50: 0.00502mg/bee	A spray to agricultural crops to control a variety of insects. Also used on livestock, in animal feed, in barns and grain storage bins. It is highly toxic to honey bees
Metolachlor	Herbicide. Use: A selective herbicide for the control of annual grass weeds, yellow nutsedge, and some broadleaf species	Contact LD50: 0.11mg/bee / Oral LD50: 0.11mg/bee	Soil application, usually applied to moist soil before weeds and grasses germinate. It has low toxicity to honey bees
Metsulfuron methyl	Herbicide. Use: for the control of certain broadleaf weeds in winter cereal crops and broadleaf weeds and brush species	Contact LD50: >0.05mg/bee / Oral LD50: > 0.0443	Spray. It is moderately toxic to honey bees
Mevinphos	Insecticide and acaricide. Mevinphos is no longer registered for use in Australia,	Contact LD50: 0.000094mg/bee	Spray. Readily soluble in water, volatile, slow aquatic hydrolysis, rapidly degrades in soil. Whilst

			the molecule is potentially mobile, it would not be expected to leach into groundwater due to rapid soil degradation. It is highly toxic to honey bees
Molinate	Herbicide. Use: for the control of grass weeds in rice only, post-emergence	Oral LD50: >0.011mg/bee	Spray. It is highly soluble and persistent in water. It is also quite volatile. It would not normally be persistent in soil systems. It is moderately toxic to honey bees
Monocrotophos	Organophosphate Insecticide. Use: To sorghum, sunflowers, tomatoes, cotton, potato, lucerne, soybean and tobacco. For pests: Helicoverpa spp., spurthroated locust, sorghum midge, western flower thrips, aphids, the green vegetable bug, mites, the stem Borer, potato tuber moth.	Oral LD50: 0.00002mg/bee	Foliar spray. It is highly toxic to honey bees
Omethoate	Organophosphate: Insecticide - Acaricide. The Australian Pesticides and Veterinary Medicines Authority (APVMA) has banned the use of omethoate on food-producing crops and pastures.	Oral LD50: 0.000048mg/bee	Spray. It is highly toxic to honey bees
o-Phenylphenol	Disinfectant, fungicide, and germicide. Use: Used as a post-harvest treatment for citrus fruits / Used in the leather industry, and to preserve aqueous products like glues and concrete additives /	Contact LD50: >0.1mg/bee	Used to protect crops in storage. It is moderately soluble in water, moderately volatile but is not expected to be persistent in the environment. 2-phenylphenol has a moderate to low toxicity to biodiversity. It has low toxicity to honey bees
Oxamyl (Thixamyl)	Carbamate Insecticide. Use: For the control of weevil borers and nematodes in agricultural crops. Available as a liquid concentrate formulation applied by stem injection and hand spray to banana crops, and by irrigation to tomato and capsicum crops.	LD50: 0.000379 mg/bee	Applied directly to the soil before drilling or planting. It is highly soluble in water, has a low volatility and may have the capacity to leach to groundwater. It is not expected to be persistent in soil or water systems. It is highly toxic to honey bees
p,p-DDD	DDD (dichlorodiphenyldichloroethane) is a banned organochlorine pesticide that was once used in Australia. It was banned in the mid-1990s		It is practically insoluble in water and is not highly volatile. It is, like DDT, very environmentally persistent in both soil and water.
p,p-DDE	Australia banned the use of DDT, DDD, and other organochlorine pesticides in the mid-1990s		Spray. It has a low aqueous solubility, is relatively volatile and has a low potential to leach to

			groundwater. It is highly persistent in soil and non-mobile. It is highly toxic to honey bees
p.p-DDT	Australia banned the use of DDT, DDD, and other organochlorine pesticides in the mid-1990s		Spray. High chemical stability, low water solubility, high solubility in organic solvents and characteristic resistance to chemical and biological degradation. Such features allow to bioaccumulate and biomagnificate in animal fatty bodies
Parathion (ethyl)	Organophosphate insecticide and acaricide. Use: Alfalfa; Barley; Rapseed; Cotton; Sorghum; Soybeans; Sunflowers; Wheat; Broccoli; Brussel sprouts. The APVMA's concerns about parathion ethyl remain and it will not consider the registration of any product containing parathion ethyl unless all the concerns identified in the review are fully addressed.	Oral LD50: 0.00021mg/bee / Unknown mode acute LD50: 0.000175 mg/bee	Spray. It is highly toxic to honey bees
Parathion methyl	Organophosphorus insecticide and acaricide. Use: For control of sucking and chewing insects and mites in a variety of crops. In Australia used on fruit, grapes, and vegetables, as well as potatoes, clover, cotton and tobacco.	Contact LD50: 0.0195mg/bee	Spray. It is moderately toxic to honey bees
Penconazole	Triazole Fungicide: Controls black spot (apple scab and pear scab) of apples and pears, as well as powdery mildew of apples and grapes.	Contact LD50: >0.03mg/bee / Oral LD50: >0.112mg/bee	Spray. It is moderately toxic to honey bees
Pendimethalin	Dinitroaniline Herbicide. Controls weeds in crops such as corn, cotton, potatoes, soybeans, tobacco, peanuts, carrots, and more	Contact LD50: 0.0498 to 0.1mg/bee / Oral LD50: >0.1012mg/bee	Pre-emergent spray. It is moderately toxic to honey bees
Permethrin	Pyrethroid insecticide. Use: To treat head lice, scabies, and other pests.	Contact LD50: 0.00006mg/bee to 0.000024mg/bee / Oral LD50: 0.00013mg/bee	Fumigants, shampoos and spot-on treatments. It is not highly soluble in water, has low volatility and is not normally expected to leach to groundwater. It would also not be expected to persist in soil or water systems. It is highly toxic to honey bees

Phenothrin	Insecticide. Use: Domestic situations; Commercial and industrial sites; Gardens; Pet health products. To control: Flies; Mosquitoes; Fleas; Ticks; Mites; Lice	Contact LD50: 0.00013mg/bee / Oral LD50: 0.00016mg/bee	Spray. It is highly toxic to honey bees
Phorate	Organophosphate Insecticide. Phorate is a prohibited chemical in Australia.	Contact LD50: 0.00032mg/bee	Applied to crops and soil as a granule. It is highly toxic to honey bees
Phosalone	Organophosphate Insecticide and Acaricide. Use: fruits, vegetables, ornamentals, and other crops;	Contact LD50:0.0044mg/bee / Oral LD50: 0.102mg/bee	Spray. It is moderately toxic to honey bees
Piperonyl Butoxide	It is an organic compound used as an adjuvant component of pesticide formulations for synergy. Use: For the treatment of head, pubic (crab), and body lice	Contact LD50: 0.294mg/bee	Available in a range of formulations including dusts, emulsifiable concentrates, foggers, paper coatings, pressurized sprays, wettable powders, shampoos and as impregnated collars. It has low toxicity to honey bees
Pirimicarb	Carbamate Insecticide. Use: To control aphids on a variety of crops and pastures	Contact LD50: 0.01256 to 0.0178mg/bee / Oral LD50: 0.00301mg/bee to 0.004mg/bee	Often supplied as wettable granules that are mixed with water and used as a spray but also available in many other formulations. It is moderately toxic to honey bees
Pirimiphos ethyl	Obsolete insecticide . Use: Top fruit including apples, pears; Turf. To control Aphids		Available in a wide variety of different formulations including granules and emulsifiable concentrates
Pirimiphos methyl	Organophosphate and fumigant insecticide. Use: For control of pests such as cockroaches, fleas, ants, mosquitoes and flies in domestic, public, commercial and industrial areas, and agricultural buildings. It is also used as a fumigant to treat stored grain and peanuts.	Oral LD50: >0.00022mg/bee / Different study: LD50: 0.000066mg/bee	Available in a variety of formulations including emulsifiable concentrates and smoke generators. It is highly toxic to honey bees
Prochloraz	Fungicide. Use: For the control of certain diseases of Mangoes, Mushrooms, Proteas, Violas and some Lettuce Varieties.	Contact LD50: 0.1413mg/bee / Oral LD50: >0.101mg/bee	Often supplied as emulsifiable concentrates or wettable powder. It has low toxicity to honey bees
Procymidone	Systemic dicarboximide fungicide. Use: For the control of fungal diseases in canola, beans, lentils, grapes, stone fruit, onions, garlic, potatoes,	Contact LD50: >0.1mg/bee / Oral LD50: >0.1 mg/bee	Usually supplied as a wettable powder. It has low toxicity to honey bees

	ornamentals and turf grass. Also available as seed dressing.		
Profenophos	Insecticide. Use: in Australia is used to control insects on cotton crops	Contact LD50: 0.000095 mg/bee	Applied by spraying or dipping. It is highly toxic to honey bees
Prometryn	Herbicide. Use: Cotton; Celery; Pigeon peas; Dill; Potatoes; Sunflowers; Carrots; Peanuts	Contact: 0.099mg/bee	Often supplied as a wettable powder. It is moderately toxic to honey bees
Propargite	Acaricide (Miticide). Use: on a wide variety of food crops, ornamentals and cotton for the control of mites.	Contact LD50: 0.0479mg/bee / Oral LD50: >0.1 mg/bee	Often supplied as emulsifiable concentrates, oil-water emulsion, water-soluble bags or wettable powder. It is moderately toxic to honey bees
Propazine	Herbicide. Use: Sorghum; Corn; Some umbelliferon vegetables; Carrots; Fennel; Ornamentals; Greenhouse	Contact: 0.016mg/bee	Often supplied as water-dispersible granules or wettable powder. It is moderately toxic to honey bees
Propiconazole ||	Fungicide: For the control of certain fungal diseases of Bananas, Oats, Peanuts, Perennial Ryegrass, Pineapples, Stone Fruit, Sugar cane, Wheat and other crops		
Propiconazole	Fungicide. Use: For the control of certain fungal diseases of Bananas, Oats, Peanuts, Perennial Ryegrass, Pineapples, Stone Fruit, Sugar cane, Wheat and other crops.	Contact LD50:0.025mg/bee to >0.1 mg/bee / Oral LD50: >0.1 mg/bee	Often supplied as emulsifiable concentrates or wettable powder. It has low toxicity to honey bees
Prothiofos	Organophosphorus insecticide. Was banned in Australia for use on grapes in 2022.		Usually formulated as an emulsifiable concentrate or wettable powder
Pyrimethanil	Anilinopyrimidine Fungicide. Use: To treat molds, powdery mildew, and rusts in fruit and potatoes	Contact LD50: >0.1 mg/bee / Oral LD50: >0.1 mg/bee	It has low toxicity to honey bees
Pyriproxifen	Insecticide. Use: An insect growth regulator (IGR) used in Australia to treat fire ants, fleas, and other pests in citrus, cotton and a range of melon and fruiting vegetable crops.	Contact LD50: 0.074 mg/bee / Oral LD50: >0.1 mg/bee	Usually supplied as an emulsifiable concentrate that is mixed with water and applied as a spray for crops. Also available as bait and wettable powders. It is moderately toxic to honey bees
Sethoxydim	Herbicide. Use: For grass control in cotton, clover, pasture, ornamentals, Alfalfa; Citrus; Sorghum; Corn; Small grains; Rice; Ornamental grass; Oilseed rape; Sugarbeet; Vegetables	Contact LD50: >0.01mg/bee	Usually supplied as an emulsifiable concentrate. It is moderately toxic to honey bees

Simazine	Herbicide. Use: For the control of a broad range of weeds in crops including TT canola, lupins, chickpeas and Faba beans.	Contact LD50: 0.097mg/bee	Available in a range of formulations including wettable powders, water dispersible granules, liquids and granules. It is moderately toxic to honey bees
Tebuconazole	Fungicide. Use: For the control of leaf spot and leaf speckle on bananas; rust; leaf spot and net bloch of peanuts; foliar diseases on cereal crops; and other diseases.	Contact LD50: >0.2 mg/bee / Oral LD50: >0.08305 mg/bee	Often supplied as an oil in water emulsion or concentrate that is mixed with water and used as a spray. It is moderately toxic to honey bees
Tebufenpyrad	Pyrazolium Insecticide and Acaricide, Use: In Australia to control spider and rust mites on crops	Contact LD50: 0.0067 mg/bee / Oral LD50: 0.0603mg/bee	Often supplied as water soluble bag formulations or emulsifiable concentrates. It is moderately toxic to honey bees
Tebuthiuron	Herbicide. Use: For control of Brigalow regrowth, Tea Tree regrowth, Mimosa pigra and certain problem woody weeds on grazing lands.	Contact LD50: >0.03 mg/bee	Usually supplied as wettable powders, granules or pellets. It is moderately toxic to honey bees
Temephos	Insecticide. Use: In Australia to control mosquitoes, midges, fleas, lice, and skin parasites on animals. It's also used to control the Small Hive Beetle (SHB) in beekeeping. Its use is restricted in Australia and New Zealand due to its toxicity	Contact LD50: >0.00155mg/bee	Usually available as emulsifiable concentrate, granules and capsules. It is moderately toxic to honey bees
Terbuthylazine	Herbicide. It is not currently registered for use in Australia	Contact LD50: >0.032 mg/bee / Oral LD50: >0.0226 mg/bee	Usually supplied as a suspension concentrate or suspended emulsion formulation. It is moderately toxic to honey bees
Tetradifon	Tetradifon is not currently registered for use in Australia	Contact LD50: 0.011 mg/bee	Available in a variety of formulations including emulsifiable concentrates, wettable powders and smoke generators. It is moderately toxic to honey bees
Thiabendazole	Fungicide. Use: Used in fruits including apples, pears, citrus; Seed potatoes; Peas & chickpeas; Lentils; Cereals including wheat, barley, oats, rye, triticale, field corn; Popcorn; Sweetcorn	Contact LD50: >0.034mg/bee / Oral LD50: >0.004	Formulations include dry powders, soluble liquids and suspension concentrates. It is moderately toxic to honey bees
Thiodicarb	Carbamate Insecticide. Use: To control pests on crops such as cotton, sweet corn, and soybeans	Contact LD50: 0.0031 mg/bee / Oral LD50: 0.000153 mg/bee	Usually supplied as read-to-use bait or pellets but may be applied via aerosol dispersal. It is highly toxic to honey bees

Thiometon	Insecticide and acaricide.Use: Fruit including strawberries, citrus, olives; Beet crops; Tobacco; Cereals; Cotton. There are currently no products containing thiometon registered for use in Australia	Contact LD50: >0.00055mg/bee	Usually formulated as an emulsifiable concentrate or ULV. It is highly toxic to honey bees
trans-Chlordane	Insecticide. Australia banned the use of chlordane in 1997. Chlordane is a persistent organic pollutant (POP) that was used	Contact LD50: 0.0006mg/bee	Dust, granules, spray, oils, wettable powders. It has a low aqueous solubility, is quite volatile and is not normally expected to leach to groundwater. It can be very persistent in both soil and water systems. It is highly toxic to honey bees
Triadimefon	Fungicide. Use: For the control of fungal diseases of wheat and barley	Oral LD50: > 0.025mg/bee	Usually formulated as an emulsifiable concentrate or wettable powder. It is moderately toxic to honey bees
Triazophos	Organophosphate Insecticide. Use: Can be used on a wide range of crops to kill Lepidopteran pests like cotton bollworms and pink bollworms	Contact LD50: 0.0598mg/bee	Usually supplied as an emulsifiable concentrate, wettable powder, granules or ULV. It is moderately toxic to honey bees
Trifluralin	Herbicide. Use: for grasses and broad-leaved weeds in a variety of vegetables, fruit, winter cereals and cotton. In Australia, trifluralin has around 2700 uses in about 35 food crops, as well as cotton, flowers and improved pasture.	Contact LD50: >0.1 mg/bee / Oral LD50: 0.1mg/bee	Usually formulated as an emulsifiable concentrate or granules. It has low toxicity to honey bees
Vamidothion	Organophosphate Insecticide . Use:Cotton; Apples; Citrus; Rice; Beans; Maize; Sorghum. Pests: Aphids including wooly apple aphids, citrus aphid, cotton aphid; Spidermites; Thrips. / No longer approved in European Union.	Contact LD50: 0.00056mg/bee	Usually supplied as an emulsifiable concentrate. It is highly toxic to honey bees
Vinclozolin	No products containing vinclozolin are currently registered for use in Australia.	Oral LD50: >0.1mg/bee	Usually formulated as a wettable powder. It has low toxicity to honey bees

Note:

BANNED/ NOT REGISTERED

For toxicological studies and pesticide analysis reports, many laboratories use an average value of 0.1 g (100 mg) per worker bee.

Converting Pesticide Concentration to per Bee Exposure

To convert milligrams (mg) to micrograms (µg), you need to multiply the value by one thousand: 1 mg = 1000 µg

- When pesticide concentration is given in **mg/g** (milligrams per gram)
  Considering that the average weight of a worker honey bee is **0.1 g**, the exposure per bee (**mg/bee**), can be calculated as:

Pesticide per bee = Concentration × Bee weight

For example, if the concentration of pesticide is 0.1 mg/g:

0.1mg/g × 0.1g = 1mg/bee

Therefore, the individual exposure to the pesticide in the sample would be approximately 0.01 mg/bee (or 10 µg/bee).

This conversion helps assess pesticide exposure levels and potential toxicity in honey bee colonies.

Ecotoxicity Categories for bees

Toxicity Category	Acute Concentration (mg/bee)	Acute Concentration (µg/bee)
highly toxic	<0.002	<2
moderately toxic	0.002 – 0.011	2-11
Low toxic	>0.011	>11

USEPA ecological risk assessments for pesticide.

< meaning lower and **>** meaning higher

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