

## Pesticides Registered for the Nursery and Landscape and Their Impact on Beneficials and Nontarget Organisms

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Relatively few pesticides are labeled for use on woody ornamentals. Those currently available should be managed judiciously to retain their efficacy against target pests while preserving the environment and worker safety. One detrimental effect of chemical pesticides that often is not considered is the mortality caused to beneficials and other nontarget organisms such as birds and bees. Beneficials are arthropod predators and parasites that prey on pests and are considered helpful to the grower. This article provides a brief discussion of the problems with conserving beneficials when pesticides are used and a table of the registered pesticides and an assessment of their impact.

Many species of beneficial insects and mites occur naturally on woody ornamental plants where they find food, moisture and shelter. Lady beetle larvae and adults (Coccinellidae) are well known predators of aphids and miscellaneous insects and mites, but many species specialize on scales. Lacewings, primarily the larvae, (green, Chrysopidae; brown, Hemerobiidae) also feed on aphids and mites as well as other miscellaneous arthropods they contact. Less commonly seen but important predators are the carabids, nabids, mirids, anthocorids, syrphids, thrips, reduviids, and non-webbing spiders. A large number of species of predatory mites also prey on the phytophagous mites associated with ornamental plants. Parasites are represented by many families and species of Hymenoptera (wasps) and Diptera (tachinid flies) that are often very specialized as to the host species they attack. Most species of insects including beneficials are attacked by some species of parasitic Hymenoptera (in this case termed hyperparasites). Populations of Lepidoptera (moths and butterflies), aphids, and scales are often regulated by parasites. Diseases also infect arthropods and are important sources of mortality to pests. Bacillus thuringiensis (BT) is a well known bacterial disease of Lepidoptera with many strains having EPA registration. Insect diseases will not be discussed further but they are often suppressed by fungicides and bactericides targeted to plant diseases. However, microbial pesticides like BT are usually not harmful to beneficials. So called natural or botanical (plant derived) pesticides such as rotenone and pyrethrins may or may not cause mortality to specific beneficials.

Theiling and Croft (1988) developed a computer database and reviewed the literature concerning response by beneficials to pesticides. The following comments were extracted from that work. Generally insecticides are the most toxic to beneficials, followed by herbicides, acaricides, and fungicides. There is a trend of increasing toxicity to beneficials from older inorganics to the synthetic pyrethroids. Predators are usually less susceptible to pesticides than are parasites but their response is more variable. Life stages of beneficials differ in their response to pesticides. The more protected egg and pupal stages of predators usually are less susceptible. For parasites the larval and pupal stages are usually less susceptible.

Direct mortality to beneficials is not the only detrimental effect imposed by pesticides. Sublethal effects such as decreased longevity and fecundity, interference with sensory modalities which influence the ability to locate and attack prey, and decreased mobility may also occur. Indirect mortality from starvation of the beneficial can occur when pesticides destroy nearly 100% of the prey. A dramatic decrease in prey populations from a nontoxic pesticide application may cause surviving beneficials to disperse from the crop in search of new prey.

Management choices concerning pesticides that affect beneficials, and which are under grower control, include the rate, method (type of sprayer, size of area treated), and frequency of application; population level of pest or damage level to plant when treated; and selection of chemicals to apply (formulation, chemical class, activity spectrum, relation to previously used chemicals, residual duration).

Application rate and thus the residual concentration and duration of the pesticide on the plant may be reduced when using some chemicals to the benefit of beneficials. This is directly related to the concentration or dose of the pesticide which is toxic to the pest and beneficials. The toxic dose of a specific pesticide is almost never the same for beneficials and pests; it is usually much lower for beneficials. The degradation or breakdown rate of pesticides is related to their chemistry, climate and weather and to plant chemistry. Pesticides with acute toxicity but short residual times may have less total mortality on beneficials than those with less toxicity but long residuals. Dursban (chlorpyrifos) has a long residual on most organic substrates, Malathion does not. Use of reduced rates may also help conserve beneficials by allowing the survival of low levels of prey. Continuous availability of food is necessary to stop dispersal by surviving beneficials after pesticide treatments. Spot treatment of pests is recommended to minimize the area in which beneficials may contact toxic pesticides. The use of an airblast sprayer may not deliver pesticides into the plant interiors allowing untreated refuges for beneficials. Less frequent applications and the acceptance of higher pest populations or damage levels also will decrease the amount of time when pesticides are present to affect beneficials.

Granular systemics are usually less harmful to beneficials than foliar sprays. Although, feeding on the nectar of systemically treated plants, which beneficials often do, may be toxic to them. Unfortunately, few systemic chemicals are

available. Some species of predators are almost completely tolerant of certain classes of pesticides as for example green lacewings and pyrethroids. This concept is termed selectivity. Pesticides which are less broad spectrum against pests will generally be less toxic (more selective) to some predators. To delay the onset of the development of resistance to pesticides by pests, it is suggested that the available pesticides be used in a rotation, rather than repeated use of one or a few (this issue needs further discussion elsewhere).

Other nontarget organisms harmed by pesticides include earthworms and fish. Potter (1991) reported that Dursban, Triumph, Sevin, Turcam, and Diazinon significantly reduced earthworm populations two weeks after treatment to lawns. Earthworms are important recyclers of organic matter and aerate the soil. The information concerning fish is muddled by the test methods. However, Crenshaw (1991) reported that most pesticides are extremely toxic to fish in the low ppb or ppm range. All precautions should be taken to reduce the contamination of water resources with pesticides.

There are many new insecticides registered for use on nursery crops that have not been tested against a broad range of beneficials. Many of these new chemicals have new modes of action and a narrow spectrum of activity. The trend for newly registered chemicals is one of decreasing impact on non-target organisms.

Table 1 presents a list of insecticides and acaricides (and a few fungicides for which data is available) currently registered by EPA. These materials are for use on landscape ornamentals, woody ornamentals in nurseries, forest nurseries and/or field-grown plants with an accompanying assessment of their potential toxicity to beneficials, bees and birds. (Please note that the pesticides listed may lose their registration and become illegal to use at anytime. Furthermore, other chemicals (particularly those off patent and marketed by small formulator companies) not on the list and unknown to the author may also be available. Listing here does not constitute an endorsement or advocacy of any products to the exclusion of other chemicals or other control methods). These data were gleaned from pesticide labels, published literature (Ripper 1951) and my own research (Mizell and Schiffhauer 1989, Mizell and Schiffhauer 1991, Mizell unpublished 1989-1995). It is very difficult to make a general assessment for specific species of beneficials and individual pesticides without testing. Therefore, these data should be used as a guide only. Growers should be able to recognize the life stages of beneficial species as well as pest species. (Slides and fact sheets with pictures of the most common predatory arthropods are available from your county cooperative extension office). When in doubt about a pesticide's impact on the beneficials present, test the pesticide first in small plots before spraying large blocks. Read the pesticide label! THE LABEL IS THE LAW! Pesticide labels and literature will usually contain at least some information concerning the toxicity of the pesticide to nontarget organisms.

### References Cited

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Table 1: EPA labeled pesticides for landscape, nursery and field-grown ornamentals. Insecticides are inclusive as far as I know. Only a few of the available fungicides are included, as little data on them is available. L=<50%, M=50-80% and H=>80% mortality.

Pesticides	Pred. Mites	Other <sup>1</sup> Pred.	Birds	Bees	Comments
Acetamiprid 70WP(TriStar)	?	?	L	L	Aphids, whiteflies, mealybugs
Adept (see Dimilin)					Fungus gnats,greenhouse and nursery
Affirm	L	L	L	L	Fireant bait (abamectin)
Akari (fenproproxiifen)	M	L	L	L	mites
Ambush 25W, 2EC	H	L-H	L	H	Caterpillars, aphids, sawflies, R.U. <sup>2</sup>
Amdro	L	L	L	L	Fireant bait, growth regulator
Asana 1.9EC	H	L-H	L	H	Caterpillars, aphids, sawflies, R.U.
Ascend (acephate)					
Astro (see Pounce)					
Attain TR (bifenthrin)					
Avid 0.15EC	L-H	L	M	L	Mites, leafminers
Award					Fireants
<i>Bacillus thuringiensis</i>	L	L	L	L	B.T., caterpillar disease, Brands: Able, Dipel, Javelin, Steward, Xentari, M-Press, Agree, Attack
Bendiocarb	H	H	H	H	Dycarb, Turcam, broad spectrum (gone by end of year)
Bioneem -see Neem products					
Carbamate WDG	M-H	L	L	L	Ferbam, fungicide
Carbaryl (see Sevin)					
Chipco 60818					Imported fire ants, thrips, fungus gnats
Cinnamite	L	L	L	L	Mites
Citation	L	M	L	L	Leafminers, thrips, fungus gnats
Confirm	L	L	L	L	IGR mimic
Conserve SC	L	L	L	L	Thrips, whiteflies, caterpillars
Crop Oil	L-H	L	L	L	Omni, Volck, Target, Sunspray, scales, aphids, mites
Decathlon	H	L-H	L	H	Broad spectrum pyrethroid
Demand CS	H	L-H	L	H	Broad spectrum
Di-Syston 15G	L	L	H	H	Granular systemic, broad spectrum, R.U.
Diazinon 4E, 50W	H	H	H	H	Broad spectrum
Diazinon AG500, D2N6000	H	H	H	H	Broad spectrum
Dibrom 8	?	L-H	L	H	Naled, broad spectrum
Dimethoate 2EC	H	L-M	L	H	systemic, broad spectrum
Dimilin 25 WP	L	L-M	L	L	Growth regulator, caterpillars, R.U.
Discus 5%G	L	L	L	L	Ants and grubs, soil
Distance	L	L	L	L	IGR, whiteflies, fungus gnats, leafminers, scales, fireants
Dithane DF, F-45	L-M	L	L	L	Fungicide, mancozeb
Dursban Pro, 50W	H	H	M	L	Borers, grubs, broad spectrum
Duraguard PT1325ME	H	H	M	L	chlorpyrifos, Same as Dursban
Dycarb, Turcam*	H	H	L	L	Bendiocarb, broad spectrum
Dylox 80SP	H	H	H	H	Broad spectrum
Endeavor	L	L	L	L	Aphids, whiteflies; translaminar

<b>Pesticides</b>	<b>Pred. Mites</b>	<b>Other<sup>1</sup> Pred.</b>	<b>Birds</b>	<b>Bees</b>	<b>Comments</b>
Enstar II (5E)	L	L	L	L	Growth regulator, whiteflies, aphids, scales
Extinguish					Fireant bait
Flagship (Meridian)					
Floramite WP	L	L	L	H	Mites
Flomite	?	?	?	?	Mites
Furadan 4F	H	H	H	H	Root weevils only, R.U.
Gemstar	L	L	L	L	Corn earworms, tobacco budworms
Gnatrol					Fungus gnats, (B.T)
Guthion 2S, 2L 30, 50WP	H	H	H	H	Broad spectrum, R.U. nursery stock only
Hexygon	L	L	L	L	mite eggs only
ICON					
Imidan 70WSP	H	H	L	H	Caterpillars, weevils
Karathane WD	L-M	L	L	L	Roses, Gardenia, Euonymus, powdery mildew, mites, limited label
Kelthane 50 WS	H	L	L	L	Mites
Ketch DF (Bt)					
Knack	L	L	L	L	Immature fungus gnats, whiteflies and scales
Knoxout 2FM, PT1500R	H	H	H	H	Encapsulated diazinon
Kryocide	L	L	L	L	Fluorine family, caterpillars, katydids
Award Fire Ant Bait	L	L	L	L	Fenoxycarb, growth regulator
Mach II					Allofenzidwe, white grubs
Malathion 4EC, 25WP	H	H	H	H	Broad spectrum
Marathon 1G, 60WSP, II	L	M	L	L	Whiteflies, thrips, aphids, imidacloprid
Mavrik AF	H	M	L	L	Mites, aphids, whiteflies
Merit 75WP, 75WSP, 2.5% & 0.62% gran., 2EC	M	M	L	L	Imidacloprid, systemic, whiteflies, aphids, thrip, broad spectrum
Mesurool 2E, 75W	L	L	L	L	Thrips, slugs, snails, aphids, mites
Naturalis O	L	L	L	L	Fungus for whiteflies, thrips, scale, aphids, mites
Neem products	L	L	L	L	Azadiractin: mites, scales, whiteflies, aphids, mealybugs, NeemGuard, Ornazin
Nematodes (entomopathogens)					BioVector, Scanmask,Guardian, Cruiser, Grubstake
Ornamite	L	L	L	L	Spider mites
Orthene TTO, PT1300TR	H	H	M	H	Turf, tree & ornamental spray
Ovation					Greenhouse, mites, mite eggs
Pestroy, Sumithrin	?	M-H	?	?	Sumithion, broad spectrum
Pentac	L	L	L	L	Mites
PFR-97 (fungus)	?	L	L	L	Fungus, whiteflies, aphids, mites, scale
Pounce 3.2EC, 25WP	H	L-H	L	H	Aphids, beetles, caterpillars, whiteflies, R.U.
Pramex 13.3%	H	L-H	L	H	Permethrin, aphids, scales
Precision	L	L	L	L	IGR, whiteflies, fungus gnats, scales, shoreflies
Preclude PT2100TR	L	L	L	L	Fenoxycarb, whiteflies, thrips, scale, aphids
Pylon					Mites, thrips
Pyrenone CS	H	H	L	H	Broad spectrum, quick knockdown
Pyrellin E.C.	H	L-H	L	H	Broad spectrum, pyrethrin + rotenone

<b>Pesticides</b>	<b>Pred. Mites</b>	<b>Other<sup>1</sup> Pred.</b>	<b>Birds</b>	<b>Bees</b>	<b>Comments</b>
Pyrellin Space & Crop	H	L-H	L	H	Broad spectrum, allethrin
PT 1100 Pyrethrum	H	L-H	L	H	Broad spectrum, natural pyrethrum
Resmethrin EC, PT1200TR	H	L-H	L	H	Caterpillars, aphids, beetles
Rotenone	L	L-H	L	H	Botanical, aphids, beetles, caterpillars
Sanmite 75WP	M	L	L	L	Mites, whiteflies, mealybugs
Secure	?	?	L	L	Mites & insects
Scimitar	H	L-H	L	H	Broad spectrum pyrethroid
Sevin 4F, 80S	H	H	L	H	Broad spectrum
Sevin SL, XLR	H	H	L	H	Broad spectrum
Soap, insecticidal	L-M	L	L	L	Mites, aphids, scales, Brands: M-pede, Ringer, Murphy
Talstar T&O 10WP, GC, N, GH	H	L-H	L	H	Mites, aphids, whiteflies, fire ants
Talstar T&OG, Lawn&Tree	L	L	L	L	Fireants and above
Tame 2.4EC	H	L-H	L	H	Mites, mealybugs, broad spectrum
Tempo 2, 20W	H	L-H	L	H	Aphids, caterpillars, whiteflies
Terraclor 75WP	L	L	L	L	Fungicide
Terrazole 25E	L	L	L	L	Fungicide
Terrazole 35WP	L	L	L	L	Fungicide
Tetrasan	?	?	L	L	Acaricide
Thiodan 3EC, 50WP	L	L	H	H	Borers, broad spectrum, not for greenhouse use
Triact 90EC - see neem products					
Tobacco dust, Nic.sulfate	L	L	L	L	Nicotine, broad spectrum
Topsin M	?	?	L	L	Fungicide
Turficide 2E	?	?	L	L	Fungicide
X-clude	H	M	L	L	Pyrethrins + piperonyl butoxide
Velocity	L	L	L	L	Fire ant granular
Vendex	L	L	L	L	Mites, 48h REI
Vision	H	H	L	M	Combination of cyfluthrin with imidacloprid
Ziram F-4, W-76	?	?	L	L	Fungicide

<sup>1</sup> Other predators include lady bugs (Coccinellidae), lacewings (Chrysopidae), parasitic wasp (Hymenoptera) and other miscellaneous but important insect predators.

<sup>2</sup> R.U. - restricted use pesticides.

\*Dycarb to be withdrawn from use after 2001.

**Changes In Labels:**