

## What's the Problem with Neonicotinoids?

*A massive killing of bumblebees in Oregon, concerns about impacts on honey bees, and tight new regulations imposed by the European Union have kept neonicotinoid insecticides in the news. The neonicotinoid group includes imidacloprid, one of the most popular garden insecticides sold in stores.*

**F**irst developed in the late 1980s, neonicotinoids represented the first new class of insecticides in over 50 years. They are insect nervous system toxins widely used in horticulture, agriculture, and structural settings for a broad range of pests. Desirable qualities such as reduced toxicity to people and pets (as compared to some organophosphates and carbamates) and systemic activity in plants, led to rapid and widespread use. Imidacloprid, the first neonicotinoid developed, is now the most widely used insecticide in the world (see Table 1 for other active ingredients and common product names).

The high water-solubility and environmental persistence of neonicotinoids meant they could be applied to the soil or tree trunks and taken up by the tree and translocated into leaves and stems where pest insects feed. When considering large trees or shrubs in an urban environment, this approach is clearly an efficient method of insecticide delivery. Garden neonicotinoid products are usually applied with soil drenches (Fig. 1), but professional products are often applied as soil injections, trunk injections, or bark treatments. Since leaves were not treated and pesticide drift was minimized, these types of nonfoliar applications were believed to reduce the risk to nontarget organisms.

From the beginning it was recognized that foliar applications of neonicotinoids, listed on some labels, are quite broad-spectrum in their effect and would negatively impact beneficial insects and bees. Now, however, after 20 years of use, soil and trunk applications of neonicotinoids have also been associated with serious nontarget effects and environmental contamination. Negative impacts due to neonicotinoids have been documented for earthworms, soil microorganisms, predatory beetles, bees, and parasitic wasps. Also, unexplained increases in spider mite reproductive rates in response to imidacloprid have been described.

The systemic action of neonicotinoids means that in some cases the active ingredients can be transported to a treated plant's pollen and nectar, potentially injuring pollinators and other beneficial insects. In fact, the widespread use of neonicotinoid insecticides has been cited as a possible contributor to the global honey bee decline phenomenon known as Colony Collapse Disorder.

In April 2013, European Union member states voted to forbid the application of three neonicotinoids—imidacloprid, clothianidin, and thiamethoxam—to flowering plants. In June 2013, a mass die-off of native pollinators attributed



L. L. Strand, UC

*Figure 1. Application of imidacloprid as a soil drench with a bucket.*

to applications of neonicotinoid insecticides led Oregon authorities to adopt permanent restrictions on dinotefuran and imidacloprid. In August 2013, the United States Environmental Protection Agency unveiled new label language requirements and a new graphic, "Protection of Pollinators" (Fig. 2), on all products containing clothianidin, dinotefuran, imidacloprid, or thiamethoxam that are labeled for outdoor use.

Of special interest to retail nurseries and garden centers is a 2013 study conducted by environmental advocacy groups (Pesticide Research Institute and Friends of the Earth) that found more than half of the plants, including those labeled "bee-friendly", sampled from garden centers at national retail chain stores contained neonicotinoid residues. The report recommended that garden retailers voluntarily demand neonicotinoid-free stock from suppliers, remove home-use neonicotinoids from

... continued on Page 2



# Neonicotinoids ... continued from Page 1

their shelves, and use the opportunity to market themselves as environmentally conscious and proactive.

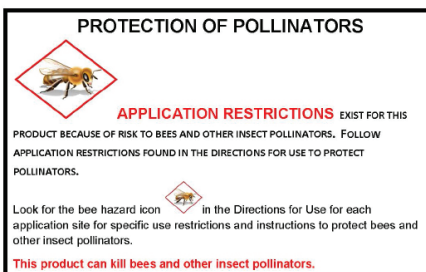
The water-solubility qualities of neonicotinoids create another problem in urban settings. Runoff from improperly applied soil drenches or irrigation or rain can wash these long-lived materials into creeks and stormwater systems, where aquatic organisms may be injured or killed. A study published in 2012 by researchers with the California Department of Pesticide Regulation revealed that imidacloprid was found in

about half of the urban creeks sampled.

Retail products containing imidacloprid or other neonicotinoids are very popular; many are combination products that deliver a fertilizer, herbicide, or fungicide in addition to the insecticide. Improper application and improper disposal of such products may be contributing to contamination as highlighted in this article. Consumers do have choices. Most applications are made for pests such as aphids or soft scales for which other safer, effective products, such as horticultural oils or soaps, are available.

Retailers have the ability and the opportunity to act as environmental stewards by advising customers to limit the use of neonicotinoids to pest situations where there are no effective alternative tactics, delay applications of systemic insecticides until after plants have flowered, take precautions to avoid insecticide runoff into aquatic ecosystems, and follow all pesticide label guidelines.

—Andrew Sutherland, San Francisco Bay Area Urban IPM Advisor, [amsutherland@ucanr.edu](mailto:amsutherland@ucanr.edu)



Source: U.S. EPA

Figure 2. Part of a new graphic the EPA will require on most neonicotinoid insecticide product labels that have directions for outdoor use.

Active ingredient	Representative products registered for home use in outdoor settings
acetamiprid	some Ortho 'Insect Killer' products
clothianidin	some Bayer Advanced products, Green Light Grub Control with Arena
dinotefuran	Green Light Tree and Shrub Insect Control with Safari 2G
imidacloprid	many Bayer Advanced products, some Ortho 'Tree and Shrub' products, Monterey Once a Year Insect Control
thiamethoxam	Maxide Dual Action Insect Killer

## Oils: Important Garden Pesticides

**O**ils are often the best pesticide choice for controlling soft-bodied insects and mites, as well as several foliar diseases including powdery mildew in the garden and landscape (Table 1). They can be safely used on both woody and herbaceous plants. Not only do oils leave no toxic residues, they are safe to use around people, pets, and wildlife; have low impact on beneficial insects; and won't harm honey bees unless applied directly to flowers during the time of day that bees are foraging.

Oils used for managing pests on plants are most often called horticultural oils.<sup>1</sup> These oils may be derived from petroleum sources and are sometimes called mineral oil, narrow range oil, or superior oil. Other pesticidal oils may be made from plant seeds, such as canola, neem, jojoba, or cottonseed.

### How They Work

The primary way oils kill insects and mites is the same—by suffocation. Insects breathe through structures called spiracles. Oils block spiracles, reducing the availability of oxygen and interfering with metabolic processes. When applied to insect or mite eggs, oils can penetrate the shells and kill the developing embryo. Oils may also act as a repellent, especially with some of the plant-based oils, and some oils, such as neem oil, have anti-feeding properties.

Because oils kill by suffocating insects, apply the product so it completely covers the target pests. Be sure to treat both the underside and topside of leaves, buds and shoots, and all locations where the insects or mites may be located. Spraying during the dormant season, when

... continued on Page 4



J.K. Clark, UC

The powdery growth on this rose leaf indicates an early-stage infection of powdery mildew—the best time to spray with oils.



J.K. Clark, UC

Aphids, such as the potato aphid pictured here, are well controlled with all types of horticultural oils.

<sup>1</sup> The food grade plant extract oils (rosemary, thyme, clove, cinnamon, etc.) function as antifeedants, repellents, or neurotoxins and thus affect pests differently than the traditional petroleum or plant/seed-based horticultural oils discussed here.



# Tell Your Customers about Mulch

**A**nthing used to cover the surface of the soil in a landscape or garden is called mulch.

Most retail nurseries and garden centers sell a variety of mulch products in smaller bagged quantities or rolls. Mulch may be inorganic, like rock or chipped rubber; organic, such as straw, shredded leaves, chipped wood or bark; or synthetic landscape fabric. Mulch is often confused with compost; but while compost may be used as mulch, its primary use is as a soil amendment. Generally, larger-sized organic materials used for mulch should not be dug into soil.

## Why use mulch?

Extensive research has been done over the years to determine the effects of using different types of mulch. The following benefits of organic mulch have been repeatedly confirmed:

- **Less water is lost from the soil.** With the surface covered, less evaporation occurs, reducing your water need.
- **Soil temperatures fluctuate less.** Soil stays cooler in summer and warmer in winter. This is a healthier environment for root growth and function, and fewer plants die from heat stress or frost damage. This is especially important for shallow-rooted plants.
- **Weeds are reduced.** Excluding light reduces the number of weed seeds that sprout and those that do are easier to remove.
- **Water infiltration increases.** Covering the soil surface prevents crusting that causes water to run off.
- **Soil and plant health is improved.** Soil structure, nutrient levels, beneficial microbial activity, and other factors of soil health are all increased over time with the use of organic mulch.

## Organic vs. Inorganic mulches

Although inorganic mulch may have some of the same benefits as organic mulch, it does not improve soil health over time.

- **Rocks** are appropriate for specific landscape situations, such as dry river

beds, sections for succulents and other rock garden plants, or gravel for paths that allow water to infiltrate. Rocks absorb and hold a great deal of heat, and care should be taken to locate only heat-tolerant plants in or adjacent to rocks.

- **Rubber mulch** should be reserved for under jungle gyms where its greatest feature, shock-absorbency, can be of use. It adds nothing beneficial to the soil, and may release toxic heavy metals into the soil or runoff water, especially if the source is recycled truck tires.
- **Geotextiles or landscape fabrics** are synthetic mulches that are porous and allow water and air to pass through. These materials are great for long-term weed control, especially around trees and shrubs and should be covered with an organic mulch. Products with UV light inhibitors will last longer.
- **Black plastic** is not recommended because it is not permeable to air or water and tears easily.

## Organic Mulches: What type and how deep?

Organic mulches come in all types of sizes and from many sources. Each has appropriate uses and application recommendations. **Larger chunks** (1.5 inch) stay put in windy areas and are perfect for large-scale landscapes and for under trees. The weight and size, however, can cause them to roll off steep slopes. With large shrubs and trees, a 3 to 4-inch layer should last about 3 years before needing to be topped off. Be sure to keep the mulch at least 3 to 12 inches from the base of the trunks to prevent rot.

The **shredded “gorilla-hair”** type product weaves together and holds best on slopes. **Smaller bark nuggets** or chipped wood work nicely in beds with smaller or delicate plants like annuals or tender perennials. A 2 to 3-inch layer will provide benefits without smothering plants. Be aware that it will break down and need to be replaced about every other year. In very windy areas, it may also be prone to blowing away.



K. Reid, UCCE San Joaquin

**Finely ground products** such as composts with less than ¼ inch particle size are less suitable as mulches. These particles can pack tightly, hold water away from roots, and remain undesirably soggy. Mulch breaks down rapidly into a substrate for weed growth. Peat moss is an especially poor mulch as it does not allow water to penetrate.

## Other things to consider:

- Never use mulch right next to the street curb. In heavy rains the mulch could float away, clogging storm drains and adding an excess of solid material if carried into the stormwater system.
- If gardening in a region with high summer temperatures, use black-dyed mulch only in shade. If used in sun, the mulch absorbs heat and actually raises soil and surface temperatures high enough to scorch plant leaves it contacts. In cooler, coastal climates, this effect can be used to your advantage by warming the soil in the early season to help your tomatoes get a head start.
- Mulch large landscape pots and planters. Though often overlooked, large landscape pots for small trees, shrubs, topiary, or seasonal color, benefit greatly from the addition of a 1 to 2-inch layer of organic mulch. Water use is significantly reduced by covering the pot soil.

—Karrie Reid, Environmental Horticulture Advisor, UCCE San Joaquin, [skreid@ucanr.edu](mailto:skreid@ucanr.edu)

# Oils ... continued from Page 2

leaves are off trees or shrubs, is recommended for scales and some other insects because it is easier to get good coverage on leafless trees.

Usually, immature stages of insects are most susceptible, especially with scale insects, mealybugs, and true bugs. Insects that feed within curled leaves, such as leaf-curling aphids, leaf miners, or gall-forming species, are protected from oil sprays and not well controlled. Oils don't control caterpillars, beetles, grasshoppers, and boring insects, with the exception of some caterpillars in the egg stage.

In some cases, oils improve the efficacy of other pesticides. For instance, applications of both codling moth granulosis virus (Cyd-X) and spinosad are more effective against codling moth when 1% oil is added to the spray. Addition of 1% oil to copper ammonium complex or copper soap sprays improves their effectiveness against peach leaf curl.

For managing certain foliar diseases such as powdery mildew, oils can act as both a preventive and a curative fungicide, smothering fungal growth and inhibiting spore production. In many

cases, oils are more effective than standard fungicides in reducing existing powdery mildew infections.

## Tips to Know

All oils now sold as pesticides are highly refined and can be used safely on most plants throughout most of the year, unless plants are water-stressed. Exceptions include maples, walnuts, and smoke tree. Redbud, juniper, cedar, spruce, and Douglas-fir are also sometimes injured. Oil injury to these plants usually involves discoloration of leaves or needles.

Many plants are sensitive to oil damage when water-stressed, so be sure plants have been adequately irrigated before application. Most oil labels also warn against applying oils when temperatures are below freezing or above 90°F. Oils shouldn't be applied in combination with sulfur, or within 30 days of a sulfur application, because of potential phytotoxicity. As with any pesticide, always check product labels for precautions or other restrictions before applying.

—Mary Louise Flint, UC Statewide IPM Program and Entomology, UC Davis, [mflint@ucdavis.edu](mailto:mflint@ucdavis.edu)

Dormant-season applications	
aphid eggs	overwintering mites or mite eggs
caterpillar eggs on bark (leafrollers, tent caterpillars, and tussock moth)	scale insects (nymphs)
Spring and summer—foliar applications	
adelgids	powdery mildew
aphids	psyllids
black spot on rose	sawflies feeding on foliage
eriophyid mites	scale insects (nymphs)
lacebugs	spider mites
leafhoppers	thrips
mealybugs	whiteflies



J.K. Clark, UC

*Oil sprays can reduce populations of spider mites.*

## New Resources

UC IPM recently released two new Pest Notes:

Bagrada Bug:

<http://ipm.ucdavis.edu/PMG/PESTNOTES/pn74166.html>

Myoporum Thrips:

<http://ipm.ucdavis.edu/PMG/PESTNOTES/pn74165.html>



To access more than 160 other titles, visit UC IPM's Pest Notes Web page:

<http://www.ipm.ucdavis.edu/PMG/PESTNOTES/index.html>

**University of California Statewide IPM Program**  
2801 Second Street  
Davis, CA 95618-7774



### Editors:

M. L. Flint and K. Windbiel-Rojas  
**Production:** K.E. Beverlin

**E-mail:** [UCIPMretail@ucdavis.edu](mailto:UCIPMretail@ucdavis.edu)

**Online:** [www.ipm.ucdavis.edu/RETAIL](http://www.ipm.ucdavis.edu/RETAIL)

Produced by the University of California Statewide IPM Program with partial funding from the USDA NIFA EIPM Coordination Program. To simplify information, trade names of products have been used. No endorsement of named products is intended, nor is criticism implied of similar products not mentioned.

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