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Protecting Bees from Pesticides

Introduction

Bees play a major role in pollinating seed, nut, and fruit crops, and as well as plants in natural environments. All bees, including honey bees, bumble bees and a wide diversity of native bees, are highly sensitive to insecticides. There are a number of things to consider when using insecticides to help protect these important pollinators:

Spraying insecticides

Do not spray insecticides on any plants in flower during the time they are being visited by bees. When spraying insecticides on plants that are not in flower or that are not attractive to bees, avoid drift, where pesticides are carried by air currents downwind onto other plants in flower that may be attracting bees.

Systemic insecticide treatment of plants

Systemic insecticides are insecticides that incorporate into and move through tissues of plants. Insects ingest these insecticides while feeding on treated plants and are killed. Neonicotinoids are systemic insecticides and may pose a special hazard to pollinators because even when they are applied to plants before flowering, they remain active in plant tissues until bloom, and can translocate into nectar and pollen.

What are neonicotinoids?

Neonicotinoids are a group of systemic insecticides related by their mode of action on the nervous system of insects. Some insecticides in this group, including imidacloprid, thiamethoxam, clothianidin, and dinotefuran, are notable for their very high level of toxicity to bees. Others, including acetamiprid and thiacloprid, have a lower acute toxicity.

Neonicotinoid treatment of plants

The neonicotinoids most widely used by home owners are imidacloprid and dinotefuran. Both are highly toxic to bees. They have several trade names, so read the fine print under "Active Ingredients" to see if you are applying these particular chemicals, and be cautious when using them. If you decide to use them, make sure the insecticide is applied only to plants that are <u>not</u> in bloom, with no drift onto neighboring plants. If you apply these insecticides to the soil, restrict the application tightly to the target plant, because other plants may take up the insecticide from soil. Use the minimum labeled rate (amount), which will be effective against most insect pests. Allow as much time as possible for the pesticide to break down before plants bloom. In the case of many perennials, shrubs, and trees, pesticide applications should be done just after bloom, since these plants generally do not bloom again until the following year. Please read the manufacturer's treatment instructions carefully for guidance.

Neonicotinoid treatment of lawns and trees

If you choose to use the neonicotinoid imidacloprid (which is a common ingredient in some grub insecticides) on your lawn, consider other plants in the lawn that may be a resource for honey bees. These may include flowering plants such as dandelions, low growing meadow plants, and clover. Avoid applying this systemic insecticide to ornamental flowering plants, trees and shrubs in the lawn and around the perimeter. Some trees, such as maples, do not have obvious flowers, but are important sources of pollen and nectar for many species of pollinating bee species. All of these plants may take up the neonicotinoid insecticides and translocate them into pollen and nectar to some extent. Do not apply neonicotinoids to linden and basswood trees (*Tilia* spp.), or rhododendrons. The toxins in the nectar of these plants combined with neonicotinoid insecticides have caused "bee kills." Certain plants, such as Eastern hemlocks, are not visited by honey bees, so systemic insecticide treatment of these plants for hemlock woolly adelgid does not pose a hazard, as long as the insecticide is carefully applied only to the target tree(s).

The fungicide connection

There is growing evidence that fungicides may be more of a hazard to honey bees than was recognized in the past. Although applying fungicides to blooming plants will probably not harm honey bees directly, it may make them more susceptible to diseases and interfere with fungi that live naturally in honey bee colonies. Fungicides may also interact with insecticides to make them more toxic to bees.

What you can do to help bees:

Reduce all pesticide use wherever possible. Apply pesticides only when you have a serious pest problem. Find out if there are effective alternatives to pesticides for your problem.
The most effective action to help honey bees is to plant a succession of flowers attractive to honey bees that bloom throughout the growing season and protect those flowering plants from all pesticides.

The Problems: Important pollinator species, including honey bees and bumble bees, are in trouble. Beekeepers nationwide have been suffering winter losses from 23% to 36% of their honey bee colonies each winter for the last seven years (1). Bumble bee diversity is also in severe decline nationwide, with formerly common species now greatly restricted in range and abundance (2).

Both of these problems are present in Connecticut. Our state apiary inspector receives many reports of "dead-outs" each spring, and of the 16 bumble bee species recorded to occur in the state, four are in severe decline, including one species considered extirpated from the state and two listed as species of special concern (3).

Both problems are also happening internationally. Increased honey bee die-offs in recent years have been reported in many European countries and in Canada, as well as across the U.S. (4), and 24% of Europe's 68 bumble bee species are threatened with extinction (5).

There are many other species of bees in Connecticut – over 325 species in total – but we know very little about whether these bees are in trouble. The same is true of flies, some of which are important pollinators, too.

What is causing these problems with honey bees and bumble bees? The scientific consensus is that there are many significant stresses on both honey bees and bumble bees. In general, honey bees and bumble bees are affected by changing land use practices that decrease the availability of nutritious pollen and nectar over the growing season, by the spread of parasites and pathogens, and by exposure to pesticides. Since the late 1980s, honey bees in the U.S. have been severely affected by a parasitic mite, *Varroa destructor*, and by the viruses spread by this mite; and most bee experts agree that this mite and its associated pathogens are the biggest problem beekeepers face. There is some evidence that pathogens of bumble bees, spreading from commercial bumble bee colonies into neighboring populations of related species, may be responsible for the devastating decline of some bumble bee species (6). As discussed below, pesticides may interact with these pathogens in ways that magnify their effects.

What is the connection between neonicotinoids and problems with bees?

There have been many reports of honey bee kills associated with the large-scale use of seed treated with neonicotinoids as a result of highly concentrated dust separating from the seed during planting, landing on soil and blooming plants in the surrounding environment, and being picked up by honey bees (7,8,9). Bumble bees have also been killed in substantial numbers by application of a neonicotinoid to linden trees in bloom (10).

These bee kills were the result of direct exposure to high concentrations of neonicotinoids. However, there are other situations where bees are exposed to neonicotinoids that have traveled through the plant and are found in pollen and nectar (11). This movement has been studied in very few plants, so range of concentration to which bees are exposed through this route is uncertain, and may depend on many specific factors – the plant species, when the insecticide was applied, how it was applied, and how much was applied.

It is also not clear at what concentrations the neonicotinoids have measurable effects on the health and survival of honey bee and bumble bee colonies. A wide variety of sublethal effects of neonicotinoids on bees have been identified, but whether those effects happen at doses actually encountered in the field and on a scale that affects colony survival is still controversial (12,13). Perhaps the most important sublethal effect of neonicotinoids on bees may be suppression of the immune system, making honey bees more susceptible to viruses (14).

What about other pesticides?

Honey bees and bumble bees are exposed to a wide diversity of other pesticides in addition to neonicotinoids. In our study of pollen trapped by honey bees, we found 22 other insecticides in addition to the neonicotinoids, and some were at concentrations equivalent or higher in acute toxicity to the neonicotinoids (15). We also found 19 fungicides in the trapped pollen (15). Because fungicides are generally not acutely toxic to bees, growers can apply fungicides to blooming plants while bees are active, so bees can be exposed to relatively large amounts of fungicide. Some studies have found direct effects of fungicides on development of bee larvae (16) sublethal effects of fungicides on honey bees, including increased susceptibility to some pathogens (17), and synergistic effects of fungicides and insecticides increasing the overall toxic effects (18,19).

Conclusion

The use of pesticides frequently has unintended consequences for non-target animals or other organisms in the environment. That is one reason why pesticides should be used only to manage clearly identified pest problems, and they should be used carefully to minimize exposure of non-target organisms and contamination of the environment. Pollinators are very important to our food supply and also play a crucial role in plant reproduction in the natural world. Pesticides are probably not the only cause of the losses suffered by honey bees and bumble bees, but by reducing any unnecessary exposure, we can take action to reduce one of the hazards they face.

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