A FARMER AND LANDOWNER GUIDE TO POLLINATORS AND NEONICOTINOIDS

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Pollinators are vital to wildlife and our food supply and yet clearly in distress, with pollinator decline reported on every continent. Farmers and landowners are in the best position to help.

Introduction to Pollinators

Pollinators are essential to the environment and our food supply. Nearly one out of every three mouthfuls of food we eat relies on a pollinator, and they have been shown to boost crop yield and quality, providing clear economic benefits to farmers.[1] Most people know that bees are pollinators, but there are many others, including butterflies, moths, beetles, flies, bats and hummingbirds. They carry seeds and pollen between plants, facilitating plant reproduction. Without them, we would lose much of our food supply, put wildlife food and habitat at risk, and compromise plants that stabilize soils against erosion and buffer waterways.

Yet pollinators throughout the U.S. and other parts of the world are clearly in distress. Pollinator decline has been reported on every continent, and hundreds of pollinator species are on the verge of extinction. Even so, many pollinator species have not been able to to maintain stable and healthy populations. While there are many complex, interrelated causes of declining pollinator populations and health, recent research identifies several fundamental problems that are having a negative impact, including pesticide exposure, habitat loss and disease.

Farmers know how critical pollinators are to agriculture and their ability to make a living. That is important, since farmers and landowners are the ones who can do the most to help. But farmers and landowners need to have accurate information to better understand and address these problems. This guide is intended to fill that role, by providing current research pointing to some of the major causes of pollinator declines. Beyond clarifying the science, this guide also gives landowners and farmers information on ways that they can directly help pollinators survive and thrive on their land and beyond.

Current status of pollinators

Right now, bees and other pollinators are in a serious state of decline. Since 2006, bees in the U.S. have been dying off or seemingly abandoning their hives—a phenomenon known as Colony Collapse Disorder—and beekeepers have reported losing about a third of their hives each year.[2] While this data is

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specific to commercial honeybees (which are the most studied pollinators), similar declines have been seen among wild pollinators. Scientists believe a combination of factors are to blame, including pathogens, loss of food and habitat, and pesticide use. The impacts are generally devastating. For example, over just a few months in the early spring of 2014, over 80,000 hives were killed or damaged while pollinating California's almond crop, according to a story in the Sacramento Bee.[3]

While there are many problems facing pollinators, the two primary threats are loss of high-quality habitat and pesticide use. Pollinator habitat is quickly being replaced by roads, lawns, and crops that do not support their survival. Monoculture plantings and the removal of fencerows and buffer strips on farms also limit pollinator habitat. This habitat conversion jeopardizes pollinators' food, nesting, and egg-laying needs. Furthermore, remaining patches of habitat are often small and fragmented. If the distance between suitable habitat patches is too great, pollinators can die traveling between them.

Pesticides are another primary cause of pollinator decline, and according to many scientists, they are the major reason pollinator populations around the world have suffered significant, sustained losses in the past decade. A specific pesticide concern centers on a relatively new class of systemic insecticides—called neonicotinoids—which are often applied as a seed coating. This insecticide and the way it is taken into the plant appears to be particularly harmful to bees and other pollinators.[4]

Introduction to Neonicotinoids

Neonicotinoids are an increasingly popular kind of insecticide that control a wide variety of insects. The first neonicotinoid, named imidacloprid (Admire), became available in the United States in 1994 and is currently present in over 400 products on the market. Other neonicotinoid insecticides include acetamiprid, clothianidin, dinotefuran, nitenpyram, thiocloprid, and thiamethoxam. In 2006, neonicotinoids accounted for over 17 percent of the global insecticide market. Two of them—clothianidin and thiamethoxam—dominate the global market for insecticidal seed treatments and are used to coat the seeds of most of the annual crops planted around the world. In fact, more than 94 percent of the corn, and about half of the soy, planted in the United States is pretreated with neonicotinoids. However, non-neonicotinoid coated seeds do exist for all plants, including corn.[5]

Neonicotinoids are water soluble and systemic, meaning they travel through a plant's vascular system when applied and are transported throughout all parts of the plant, including leaves, stems, flowers, fruit, pollen and nectar. Their systemic nature and persistence creates multiple avenues for pollinators to be exposed, from feeding on pollen and nectar, to drinking water with neonicotinoid residues in it, or even walking on the leaves of treated plants. As the name suggest, neonicotinoids are similar in structure to nicotine and paralyze insects by blocking a pathway that transmits nerve impulses in the insect's central nervous system. Although thought to be less harmful to birds and mammals than many other insecticides, neonicotinoids are incredibly toxic to bees and other insects (Xerces, 2012).

In addition to their toxicity, neonicotinoids remain within plants much longer than most other insecticides, thereby compounding their impact on pollinators. They can reside in plant tissues for over a year, and some can persist for even longer in the soil. This means pollinators and other animals are exposed to the chemicals for extended periods of time, and in some regions, year round.

Neonicotinoids can be applied in a number of ways: as seed coatings, placed in a furrow or incorporated in the soil in a granular form, or sprayed as a liquid on the foliage of a growing plant. They became popular as a substitute for high-risk organophosphate and carbamates insecticides that had been implicated in numerous worker poisoning episodes and had resulted in very negative impacts on birds, fish, bees and beneficial insects. Neonicotinoids also gained popularity because applying them in the soil—either as seed treatments or granulars—markedly reduced several risks associated with spraying insecticides, including reducing insecticide drift from the intended area. However, there is no evidence that they increase crop yields.

Far and away, the most widely deployed method of neonicotinoid application is as a seed coating. Seeds can be coated for precision placement of insecticide near the young, growing roots of a just-emerged plant. This is a period when plant root systems are at greatest risk for root feeding damage. As the neonicotinoid coating dissolves, the chemical kills nearby insects that might otherwise damage roots, and it is also absorbed into the roots as they grow and spread. As the plant grows, the insecticide travels inside the plant and becomes part of its tissues.

Neonicotinoid impacts on pollinators

Although there is more to learn about neonicotinoids' effects on pollinators, strong correlations exist between pollinator decline and neonicotinoid application. Honeybee studies have shown that neonicotinoids are more toxic by oral consumption than by contact; however, chronic exposure to neonicotinoids, even in small doses, can cause or contribute to death. Such chronic exposure is likely to occur when pollinators are foraging in agricultural settings where almost all crops have been treated with neonicotinoids in some form.

Death is not the only outcome of pesticide exposure. Sublethal doses of neonicotinoids can disrupt pollinators' cognitive abilities, communication, and physiology. A honey bee colony's ability to collect and store food depends on coordination and communication among workers, so the health of the entire colony is jeopardized by insecticide exposures that disrupt normal communication and coordination within the hive. There is also the potential for neonicotinoids to work in combination with other chemicals in the field, possibly compounding their effects. Scientists have shown in multiple studies that the combined presence of neonicotinoids and some fungicides can increase the potency of neonicotinoids by more than 1,000-fold.[6]

Pollinator friendly approaches

The first step in reducing pesticide-triggered impacts on pollinators is to reduce or eliminate the use of these products. One way is to adopt biointensive Integrated Pest Management (bioIPM). BioIPM systems combine multiple tactics in a systems-based approach to: 1.) keep pests from gaining a foothold in a field, 2.) keep pest populations below treatment thresholds by blocking the pest's access to things it needs for survival, 3.) disrupt the pest's reproductive process and/or morphological development, 4.) enhance populations of natural predators of the pest or tap into soil microbial biocontrol, and 5.) only as a last resort spray some sort of chemical to reduce pest populations back down below impact thresholds.[7]

For row crop and grain farmers, a diverse crop rotation is the soundest foundation upon which to build bioIPM systems. Not only do diverse crop rotations break weed, insect, and plant disease cycles, they also boost yields by 15 percent to 25 percent.[8] When a solid crop rotation system is coupled with the planting of fall and spring cover crops, dramatic changes occur in the biology of above-ground and below-ground ecosystems. Positive outcomes include:

- Weed seedbanks decline and annual weed pressure gradually subsides, as long as farmers do a good job with early season control;
- More complex soil food webs are created, including insects that eat weed seeds and other potentially damaging critters;
- Soil organic matter levels trend upward, increasing water infiltration rates, soil water-holding capacity, and the amount of nitrogen cycling in the soil system;
- **Healthier, more diverse populations of beneficial insects, including pollinators, will find ways to thrive within and near agricultural landscapes because of the greater diversity in crop cover.**

When pest populations reach possibly damaging levels and require chemical application, farmers and landowners should choose interventions that pose little or no risk to bees, including applying the chemical at a time of year when few bees are foraging in or near fields. In all circumstances, bee-toxic pesticides should never be sprayed when bees are actively foraging in a field. This recommendation appears on hundreds of pesticide product labels.

In many systems, applying an insect growth regulator that is non-toxic to bees in the late spring or early summer can help keep insect populations below treatment thresholds. Whenever a farmer expects that insect populations will require active treatment interventions during the part of the year when bees are in the field, farmers should either introduce or build populations of predatory insects. Building and sustaining beneficial insect populations requires assuring that they have access to high-quality habitat along field borders and in non-crop areas on a farm.

When insecticides must be applied to avoid economic losses, avoid active ingredients known to be harmful to bees, especially neonicotinoids, organophosphates and carbamates, and synthetic pyrethroids.

Farmers need to work with their bioIPM advisers to seek out active ingredients that pose the least risk to bees. Commercialized insecticides that pose little or no risk to bees exist, and should be chosen whenever possible. Farmers need to be diligent in assessing relative risks and tradeoffs, since even some relatively new "reduced risk" pesticides pose serious risks to bees and other pollinators. For example, the bacteria-derived insecticide spinosad is approved for use by organic farmers, yet is highly toxic to all pollinators.[9]

Landowners can also support pollinator populations by cultivating pollinator habitat. Planting an array of pollinator-friendly plants along field and farm road edges,in ditches and on farmsteads provides a place for pollinators to thrive. When choosing pollinator-friendly plants, farmers and landowners should be sure to choose plant species that are appropriate to their region with flowering times that span throughout the growing season.

Supporting healthy pollinator populations will support thriving farmland.

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