

Protecting bee health

through integrated pest, crop, and landscape management

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The unprecedented rate of annual bee die-offs in recent years has made worldwide news. While the exact cause of these losses remains elusive, research suggests that modern agricultural production practices play an outsized role as a changing agricultural landscape puts pressure on both wild and domesticated bee species. What are some of the ways that farmers and CCAs can promote bee health?

Saving the bees probably isn't listed on any CCA's job description. But with one out of every three mouthfuls of food depending on these pollinators, bee specialists argue that crop advisers play an integral role in protecting their numbers.

The agriculture industry has plenty of reason to worry. Since 2006, the unprecedented rate of annual bee die-offs has made worldwide news with domesticated European honeybee colony losses in the U.S. now averaging 30 to 40% annually, up from the pre-2006 level of 10 to 15%.

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This spike in losses stems from many possible causes, researchers say. In addition to general increases in honeybee losses each year, beekeepers in 2006 saw for the first time Colony Collapse Disorder, or CCD, a phenomenon where most of a hive's worker bees that forage for pollen suddenly abandon the hive, leaving behind the queen and a handful of young workers.

The exact cause of CCD remains elusive, bee specialists say. But according to an accumulation of scientific research, modern agricultural production practices play an outsized role as a changing agricultural

landscape puts pressure on both wild and domesticated bee populations.

According to USDA's 2012 report on CCD, the varroa mite—a parasite that sucks blood from host bees while also introducing diseases and viruses—has been the single most detrimental pest of pollinators like honeybees. However, the increase in the prevalence of the varroa mite has coincided with major changes in how crops are produced in the U.S.

"Bee losses have accelerated, but this has actually been going on for decades," says Amy Toth, entomologist at Iowa State University who specializes in bee nutrition and habi-

tat. "Bee colony losses have been increasing since mid-20th century. If you look at what's been happening over the past 50 to 60 years, bee health has been declining, and a lot of it has to do with the transformation of the agricultural landscape."

In addition to other stressors related to beehive management, bees are increasingly coming into contact with sublethal doses of pesticides and are also foraging on fewer native flowering plants as monoculture crop production acreage expands nationwide.

As a result of the changing agricultural environment, bees are struggling to come back from drops in populations, says Gordon Wardell, apiculturist for Paramount Farming in Bakersfield, CA, and chairman of Project Apis m., a nonprofit organization that funds research on honeybees and promotes bee health.

"There've been bee die-offs in the past, even going back into the 19th century. It usually lasts for a year or so, and then the bees are healthy again," Wardell explains. "But this time, there's just no let up. You literally have to plan for 30 to 40% mortality in your operation every year."

Meanwhile, the demands on apiculturists to provide enough bees to pollinate flowering crops are expected to continue growing as the need for food increases worldwide.

Currently 75% of all honeybees nationwide are required for just the almond pollination in California in February and March, Wardell notes. In the next five years, that number

will be closer to 100% as almond acreage increases just as bee populations struggle with high die-off rates. Almond acreage alone in the U.S. has nearly doubled in the last 15 years to more than 870,000 acres.

Faced with these facts, pollinated crops are at risk of not having enough bees to meet the demands of modern agriculture, warns USDA. And of the bees that currently make 33% of agricultural production possible, their health and ability to perform necessary pollination tasks are increasingly at risk.

The urgency of the matter is hard to overstate, says Matt O'Neal, entomologist at Iowa State University.

"Bees pollinate 90% of the flowering plants around the

planet, and about a fourth of all the fruits and vegetables that we eat," O'Neal explains. "And there's some evidence that crops like soybeans see a 10 to 30% yield improvement if they are visited by a bee. Added together, about \$16 billion worth of ag receipts are due to honeybee pollination, and another \$3 to \$4 billion from native bees."

The economic effect of bee health extends far beyond what is taken out of the field, adds Mace Vaughan, pollinator



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program director at the Xerces Society for Invertebrate Conservation and pollinator conservation specialist at USDA's Natural Resources Conservation Service (NRCS).

"When alfalfa, for example, is fed to cows or sheep, we get dairy and meat products," Vaughan says. "So, it comes to more than a third of all the food that we eat."

Understanding how farmers and CCAs can promote bee health starts with understanding how hives suffer from sharp declines in bee populations, Wardell says.

The collapse of a colony, he says, begins with adult bees dying sooner with younger and more vulnerable bees replacing them.

"The adult bees foraging in the fields are not living as long as they used to. And when the adult bees die off early, it means that the younger bees have to come out of the hive and do the fieldwork before they're physiologically ready," he says. "It'd be like us sending out a six-year-

old to do heavy construction work. They're not going to last long. And so you get this cycle going and the whole hive just starts spiraling down."

Poorer nutrition and increased toxicity from farm fields

Adult bee mortality is especially high in the Midwest corn and soybean states like Iowa, Vaughan says, where beekeepers lost 54% of their hives in 2013 compared with about 30% nationwide. The increase in monoculture cropping where one single plant species populates a field

Pollen laced with agrichemicals has played a role in the decline of bee health. CCAs can help their clients create bee-friendly habitats by promoting integrated pest management practices and eliminating prophylactic spraying whenever possible. Flickr/ Graham Rawlings.



More than a third of the food we eat depends on pollinators like the alfalfa leafcutting bee, including meat products that come from animals grazing pollinator-dependent crops like alfalfa. Grazing

photo courtesy of The Samuel

Roberts Noble Foundation/Broderick Stearns.

Bee photo by USDA-ARS/Peggy Greb.

has resulted in a poorer diet for bees, he says.

Midwestern states are also the resting ground for more than 65% of the commercially managed honeybees in the country from June to September, according to USDA, where abundant and diverse forage is necessary to build up hive strength for the winter.

But monoculture crops that cover nearly 80% of the land area of Iowa are commonly free of weeds, Toth notes. With the advent of Roundup Ready crops that keep fields clean from weeds and other plant spe-

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cies, bees have a very limited pollen source from which to feed.

“Plant diversity is very important for bees, and soy and corn are not really the right plants for them,” she says. “So, bees that don’t have a wide diversity of flowers to forage on just don’t do well. It can affect their ability to withstand other types of stresses, including pesticides and diseases, which can lead to a colony death chain of events.”

The increased toxicity of farm fields worldwide has also played a role in the decline of bee health, bee specialists say.

Eric Mussen, extension apiculturist at the University of California–Davis, says pollinators today are foraging and eating pollen from a toxic soup of agricultural chemicals, but are consuming them in small sublethal levels that gradually wear down the bees.

“The number of residues of agricultural chemicals in beehives is staggeringly high,” Mussen explains.

“They’re in small amounts; otherwise the bees would be dead. But they’re there. Practically any ag chemical you can think of. The adult bees get into those chemicals when they’re foraging and bring back contaminated pollen. Young bees in the hive then eat the pollen that’s got the residues in it, and they become contaminated. All these chemicals are at sublethal levels, but they are at a level that physiologically makes changes in the bees—and not for the better.”

When combined with parasites and poor nutrition, adds Mussen, the immune system of the bees is substantially weakened, making it more difficult for them to fight off disease. The accumulation of sublethal amounts of chemicals also reduces the detoxification capabilities of the bee, further complicating their ability to handle the barrage of chemicals they come into contact with.

In one corn field, for example, Mussen found 17 different chemicals in the corn pollen. While the

chemicals were at low levels and not killing the bees outright, he says, it was further evidence that bees are foraging in a less-than-healthy environment and bringing pesticide-infused pollen back to the hive to feed to younger bees.

“They’re working in a sea of chemicals out there,” Mussen says. “It’s just surprising they’re doing as well as they are.”

Perhaps the most controversial of all crop protection products is the neonicotinoid class of insecticides, including clothianidin, imidacloprid and thiamethoxam, that are commonly used in seed treatments to protect germinating seeds from pests in the soil. Neonicotinoids, also known as neonics, are highly toxic to bees.

Mary Harris, entomologist at Iowa State University who last year studied how bees come into contact with neonicotinoids, says corn planting season is precisely when bees experience the greatest exposure. The insecticide becomes airborne



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during planting and settles on nearby flowering plants or trees where bees forage for pollen.

“We collected the pollen from the honeybees returning to the hive and found that the week of the peak of corn planting saw pretty high levels of contamination among all of the pollen that we tested,” Harris explains. “The level of contamination waned then over the next two weeks and then dropped off to undetectable levels.”

Dry powdered lubricants such as talc and graphite, which are used to help the treated seed move through pneumatic planters, become contaminated with the seed treatment during planting. The dust then travels through the air and settles on flowering plants and trees where bees forage for pollen, Harris explains.

This connection between bee health and neonicotinoids, which are

the most common insecticides on the market, caused the European Union last year to prohibit the sale and use of seeds treated with any of the three chemicals under the neonicotinoid classification.

Mussen, though, says the bone of contention is that all chemicals, including neonicotinoids, are being discovered at sublethal levels, and that restricting one chemical will not necessarily help promote bee health. Overly restricting use of agricultural chemicals, he adds, could also be devastating for farmers.

“I’m not going to tell people to not use chemicals for pest control,” he says. “That’s not going to work. People have to control their pests.”

However, he says, farmers and their CCAs can still make a significant difference in bee health by getting back to integrated pest management, or IPM.

Below: Corn planting season is when bees experience the greatest exposure to neonicotinoid insecticides, according to Iowa State University research. Courtesy of Purdue Agricultural Communication/Jenn Stewart.

Opposite page: Seeds are often treated with insecticides to help control pests such as corn rootworm. Courtesy of USDA-ARS and Syngenta.

Getting smart with IPM

CCAs play a crucial role in getting farmers smart on bee health and promoting IPM practices that benefit both the farmer and pollinating insects, Vaughan adds. Specifically, CCAs need to help farmers eliminate prophylactic spraying whenever possible.

“We’ve really moved away from integrated pest management in a big way the last 20 years, especially with prophylactic use of some of the





insecticides that can go onto these plants before there's a demonstrated need," Vaughan warns.

In crops like corn, not all seed treatments are necessary, he says. A seed treatment might be effective at controlling corn rootworm. But, that pest occurs at an economically damaging level on only 20 to 30% of corn acres. If farmers only used a seed treatment where there is a dem-

onstrated need, he says, overall risk to pollinators can be greatly reduced. And, farmers benefit financially through cost savings.

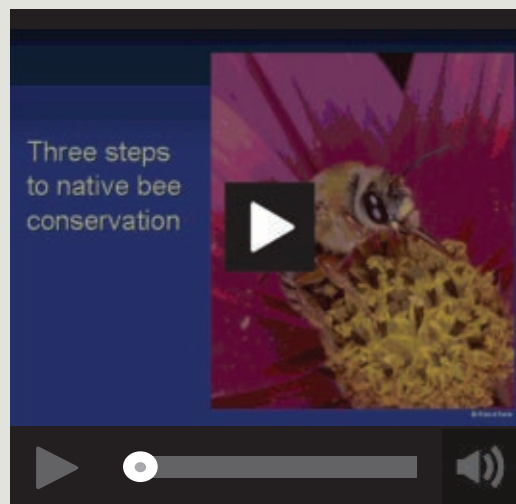
Eliminating prophylactic spraying also extends the useful life of the chemical, Harris adds.

"It is amazing how these treatments have become ubiquitous, and that's just not sound pest control," she says. "If we can switch back to only using treated seeds when necessary, we can prolong the effectiveness of the chemical by reducing the risk of pest resistance."

Digital Extra

Video: Three steps to native bee conservation

Click on the video to the right to view a presentation by Mace Vaughan, pollinator program director at the Xerces Society for Invertebrate Conservation and pollinator conservation specialist at USDA-NRCS, discussing the three steps to native bee conservation. Video courtesy of the Xerces Society and USDA-NRCS. Note: When you close out of a video when using Firefox or Internet Explorer browsers, you may still hear it playing in the background until you move to the next page.





That requires greater vigilance in the field, which is where CCAs can make the biggest difference, she advises.

"This is a tough decision to make because there's a time lag with the soil-borne pests that these insecticides are targeting," Harris points out. "When do you scout for them? We need to go back and make sure we're scouting in the fall to know what's going to be there in the spring,

or getting out there the season you're going to plant. CCAs need to take an active role in developing specific practices to address these issues so that we can have crops and maintain pollinators."

For foliar applications of agricultural chemicals, timing of spraying is also crucial, Mussen adds. If farmers are applying an in-season treatment like fungicides, Mussen advises spraying late in the day or at night after the bees are finished foraging for pollen. That recommendation goes

for all crops from corn to almonds, he says.

CCAs can find on the state registry who the beekeepers are and where they are located and use that information when aiding their farmer-clients on spray recommendations. Amy Toth (**left**) says farmers can also seed field borders (**bottom**) to native flowering species to help promote bee health. Image to the left courtesy of Iowa State University College of Agriculture and Life Sciences. Bottom image courtesy of Xerces Society/Jennifer Hopwood.

"If you felt you really had to spray a fungicide, wait until the pollen and the pollen-collecting bees have left the field, which they will do," he says. "They don't stay out there if there's nothing to collect. After they've left, go ahead and spray. If you haven't contaminated the pollen, then the bees should be fine."

Educating farmers on proper use of pesticides according to product labels, and helping them under-

