

The Empty Honeycomb

By [Deniza Gertsberg](#) | October 17rd, 2011

It is hard to overestimate the importance of bees in the food chain. Almonds, carrots, melons, apricots, cherries, pears, apples, prunes, plums, cantaloupe, onions, avocados, kiwi, blueberries, cranberries [and many more](#) fruits and vegetables depend on honeybee pollination. In [fact](#), of the 100 crop species that provide 90% of the world's food, over 70 are pollinated by bees. Meat, milk and cheese production are reliant on pollinated crops that animals eat. The [monetary](#) value of honey bees as commercial pollinators in the United States is estimated at about \$15-\$20 billion annually. "It's hard to imagine American agriculture without bees," stated Dan Rather recently in an investigative report, [Bee Aware](#). And while bees struggle against many obstacles to survive — environmental pollution, climate change, infections, and poor diet from low-protein [monoculture](#) crops — the role of pesticides, particularly systemic pesticides, has been initially [played](#) down.

The industry has said all along that this class of pesticides is safe. In the meantime, many critics contend that the Environmental Protection Agency (EPA) has not been asking the right questions, focusing on the short term lethal impact of pesticides rather than analyzing the complicated ways in which pesticides interact, the sublethal doses of pesticides and the interaction with other stressors.

Honey Bees and Colony Collapse Disorder

About six or seven years ago, beekeepers started to notice massive disappearance of bees which led to the collapse of bee colonies. Beekeepers were reporting collapses of anywhere between 30-90% of bee [colonies](#) each winter. Some beekeepers feared the loss of nearly [all](#) of their colonies. This was far worse than anything witnessed before. And while the health of beehives has been on a [decline](#) since the 1980s, as a result of new pathogens and pests, such as Varroa and tracheal mites, this new phenomenon, which came to be known as Colony Collapse Disorder (CCD), had no immediate explanation.

CCD is often [associated](#) with: a) rapid loss of adult worker bees, b) few or no dead bees found in the hive, c) presence of immature bees (brood), d) small cluster of bees with live queen present, and e) pollen and honey stores in hive.

"I have never seen colonies collapse like this," stated Dennis vanEngelsdorp, State Apiarist with the Pennsylvania Department of Agriculture (PDA) and senior extension associate in entomology for Penn State, for a [Penn State publication](#). Maryann Frazier, a senior extension associate at Penn State, similarly [stated](#), "[t]hey're leaving behind their brood, the honey, the pollen, all their resources. For bees, this is very, very odd behavior."

"We could be seeing the end of beekeeping," Tom Theobald, a Colorado beekeeper and one of the founders of the [Boulder County Beekeepers' Association](#), told me in an interview earlier this month. Mr. Theobald has been concerned about the impact of pesticides, and in particular,

systemic pesticides, on bees for a long time. Ever since he experienced heavy losses of his hives sometime in 2006, however, he has been critical of the EPA's approval of one particular systemic pesticide, clothianidin, and asking questions which challenge the core basis of America's pesticide policy.

What's All the Pesticide Buzz About?

Many factors were considered as the cause of CCD. "We blamed it on mites, viruses and a lot of other stuff because we didn't know what to blame it on," [commented](#) another beekeeper, David Hackenberg. It was not until recently, however, that pesticides were given a serious consideration. Researchers like James Frazier, Ph.D, a professor of entomology at Penn State's College of Agricultural Sciences, and his team have been actively studying CCD and paying particular attention to pesticides since at least 2007. In a study [published](#) in March 2010, Professor Frazier and his team found in hives across the United States, on average, six different pesticides, and in some cases, as many as 39 pesticides. Such a high level of pesticides is "beyond the level that was expected when the chemicals were introduced and approved for [use](#)." While the study did not focus on any one particular pesticide, but rather analyzed the presence of multiple pesticides and demonstrated the presence of high pesticide levels in pollen and wax, "[a]lmost 60% of the 259 wax and 350 pollen samples contained at least one systemic pesticide..." The authors' concluded that the "98 pesticides and metabolites detected in mixtures up to 214 ppm in bee pollen alone represents a remarkably high level for toxic contaminants in the brood and adult food of this pollinator."

Professor Frazier's concern and that of an increasing number of other researchers and beekeepers is that the long term exposure to pesticides may cause sublethal impact on honey bees that alters their behavior, learning, memory and development. [Furthermore](#), "[w]hile exposure to many of these neurotoxicants elicits acute and sublethal reductions in honey bee fitness, the effects of these materials *in combinations* and their direct involvement in CCD remain to be determined."

Strangely, pesticide manufacturers are [not required](#) to test for the interaction with other chemicals. But the results of recent studies "certainly indicate that pesticides are very likely involved and that interactions with other stressors are very likely factors contributing to CCD and the decline of honey bee health," stated Professor Frazier in a recent [article](#).

For Tom Theobald, who has experienced significant honey bee losses, the answer was in his bee yard. An analysis of his hives in the spring and fall of 2006, in which he did not find a high population of mites, and based on what he knew about clothianidin, led him to further research this pesticide and the EPA's approval process. Clothianidin, a systemic pesticide of neonicotinoid family, [affects](#) the an insect's central nervous system, resulting in paralysis and death. Mr. Theobald's [article](#) in July 2010 about the impact of clothianidin on bees and the pesticide registration process that allowed it to be marketed, despite serious concerns of the EPA's scientists, further confirmed what Professor Frazier and many others have been saying: that the EPA's registration process for systemic pesticides is inadequate.

EPA and Systemic Pesticides

Professor Frazier and other researchers and beekeepers are concerned that the EPA is not adequately evaluating pesticide interaction, sub-lethal impacts, and interaction with other stressors on honeybee fitness. Like Tom Theobald, Professor Frazier criticized the EPA for using the same approach to evaluating systemic pesticides that is used for older generation pesticides. He explained to me that the EPA had sixteen years to develop a different protocol for evaluating systemic pesticides but the agency still relies on a risk-benefits analysis model it has used all along. Under the risk-benefits analysis, scientific evidence is only one of the factors considered when evaluating a pesticide for approval. The other factors include economic, technological, political, and social. Another serious problem with the EPA approval process is that ultimately it is the EPA administrators, not the EPA scientists, who make approval decisions.

By comparison, the European Union adopted the [precautionary principle](#) which, in essence, directs that action be taken to reduce risk from chemicals in the face of uncertain but suggestive evidence of harm to human health and the environment. While the system is far from perfect (see, for example, *RoundUp and Birth Defects, Is the Public Being Kept In The Dark?*, a [report](#) by international scientists challenging the European pesticide approval process for failing to consider independent scientific research and the lack of regulatory enforcement), there is, nonetheless, a formal process which allows for the removal from the market of chemicals suspected of causing harm, even when scientific evidence is insufficient, inconclusive or uncertain but preliminary scientific evaluation indicates that there are reasonable grounds for concern.

Systemic pesticides call out for a different system of approval since they differ in many respects from older generation pesticides.

Being one of the most widely used pesticides in the United States, systemic pesticides became popular in U.S. in 2000s and have increased with the increased planting of transgenic seeds (a.k.a. GMOs). “Unlike older pesticides that evaporate or disperse shortly after application, neonicotinoids are systemic [poisons](#). Applied to the soil or doused on seeds, neonicotinoid insecticides incorporate themselves into the plant’s tissues, turning the plant itself into a tiny poison factory emitting toxin from its roots, leaves, stems, pollen, and nectar.” With systemic pesticides, “the chemical is in the [bloom](#). So bees searching for nectar now can come into contact with pesticides too.”

And they persist in the soil for longer than the older generation pesticides. Professor Frazier explained that systemic pesticides could remain in the soil anywhere between two to three years, and in some cases up to six years, depending on the nature of the soil and the chemical formulation of the pesticide.

Systemic pesticides are of a particular concern to beekeepers because they [kill](#) sucking and chewing insects by disrupting their nervous systems. While the routes of exposure have previously focused on contaminated food that is taken up by bees, new evidence is emerging that suggests additional ways in which bees are exposed to neonicotinoids. Recent studies performed in Italy suggest that bees become contaminated by insecticide (neonicotinoid) dust emission during foraging activity when they fly near a drilling machine at levels “sufficient to kill the bees.” Specifically, the researchers concluded that their trials “indicate that when a bee travelling

towards a food source flies over a seeder that is sowing insecticide-coated maize seed, the bee may be exposed to a lethal dose of active ingredient, probably even in a single flight.” (Marzaro, *et al.*, 2011; APENET Project, 2011).

The chemical companies say that neonicotinoids are safe when properly applied and the EPA has been reactionary in its approach to this class of bee-killers. Based on internal memos that have now surfaced, there are even suggestions that the EPA administrators ignored or discounted the advice of its own scientists.

For example, in 2003, before clothianidin was approved, an internal the EPA [memo](#) demonstrates that government scientists had serious concerns about the impact of [clothianidin](#) on bees:

The possibility of toxic exposure to nontarget pollinators through the translocation of clothianidin residues that result from seed treatment (corn and canola) has prompted EFED [Environmental Fate and Effects Division] to require field testing that can evaluate the possible chronic exposure to honey bee larvae and queen. In order to fully evaluate the possibility of this toxic effect, a complete worker bee life cycle study must be conducted, as well as an evaluation of exposure and effects to the queen.”

Despite these concerns, however, two months later and “after further consideration,” the EPA granted Bayer Cropscience, the maker of clothianidin, [conditional registration](#) “contingent on [Bayer] conducting the chronic honey bee study that evaluates the sublethal effects of clothianidin over time.” Many [suspect](#) that the EPA scientists granted conditional registration in response to internal pressure from the agency’s administrators. The EPA also deferred a strong label warning requirement “until after the chronic study has been reviewed.”

It should not go unnoticed that it is the chemical company that design the tests and performs its own research, not the EPA.

The chronic bee study became available [only](#) in 2007, even though the EPA initially asked for it to be completed eight months after clothianidin was conditionally approved. In the meantime, clothianidin was marketed and sold to farmers nationwide for use on corn, canola, soy, sugar beets, sunflowers, and wheat.

This has become a common tactic in the corporate playbook, get these products out there by whatever means possible, get agriculture hooked, and then convince farmers they can’t live without them. ([Theobald](#), *Do We Have A Pesticide Blowout*).

When Bayer’s study became available many critics were dismayed that it was accepted by the EPA as “scientifically sound.” For starters, the study, consisting of only four bee colonies evaluated on a two-and-a-half acre plot. But, as Professor Frazier explained, bees can travel anywhere from 6 to 9 kilometers, *i.e.*, up to 28,000 acres, from the apiary.

Tom Theobald called Bayer’s study a “mockery of science” and “bogus”- especially given the prior experience in France with imidacloprid, the predecessor to clothianidin, and the 2008

German bee die off, in which 99% the dead bees showed high levels of clothianidin. Likewise, Professor Fraizer [noted](#) that Bayer's field study "was not a good test design." Furthermore, Bayer's study, much like other industry tests, was not subject to review by the independent scientific community so there is no independent verification of the company's data.

Another deficiency of the study noted by Tom Theobald and [others](#) was the location of the study. Initially, the company was required to perform the field study in U.S., but the study was actually performed in Canada. Furthermore, Bayer was allowed to test on canola only, dismissing the EPA's initial requirement that the study also include corn. This is significant since not only is canola less common than corn in U.S., canola is also predominantly grown in [one state](#), North Dakota, while corn planting is more ubiquitous, with major production happening in the Corn Belt and less intensive operations happening in other states around the country.

David Hackenberg, another beekeeper, was also concerned about the connection of bee die-offs to corn. Hackenberg told [FastCompany](#) that bee die-off seemed to follow corn crop plantings so much that "you can follow the trail of this stuff to where bees are collapsing."

In 2010, when Bayer sought to expand the use of clothianidin on cotton and mustard seed, the EPA [revoked](#) Bayer's prior study—the one the agency considered "scientifically sound" in 2007—and required "another field study ... to evaluate the effects of clothianidin on bees through contaminated pollen and nectar." It was noted by a consumer and environment watchdog [Beyond Pesticide](#) that "while the [2007] study may contain 'some' useful information, as stated by the EPA, it does not contain 'required' information necessary to registration and the protection of bees from a systemic pesticide that moves through the treated plant."

The EPA's 2010 [decision](#) noted that:

Acute toxicity studies to honey bees show that clothianidin is highly toxic on both a contact and an oral basis. ... information from standard tests and field studies, as well as incident reports involving other neonicotinoids insecticides (e.g., imidacloprid) suggest the potential for long term toxic risk to honey bees and other beneficial insects. An incident in Germany already illustrated the toxicity of clothianidin to honeybees when allowed to drift off-site from treated seed during planting.

And the EPA suggested the following strongly worded label be used:

This compound is toxic to honey bees. The persistence of residues and potential residual toxicity of Clothianidin in nectar and pollen suggests the possibility of chronic toxic risk to honey bee larvae and the eventual instability of the hive.

Despite the EPA's belated acknowledgment that Bayer's study was inadequate, the pesticide remains on the market. A review of the company's labels and the manufacturer's safety data sheets for clothianidin suggests that there is no labeling that would warn U.S. growers regarding the pesticides' impact on bees despite suggestions from the EPA to the contrary (see Appendix A for the full EPA suggested label).

GMO Connection

It is probably not a coincidence that Bayer, one of five biotech [giants](#), and the world's [leading](#) pesticide manufacturer, makes clothianidin for treatment on seeds most of which are genetically engineered—corn, canola, soy, sugar beets, sunflowers, and wheat (the only non-gm seed at this point).

In the U.S., corn is grown on approximately [92.3 million](#) acres nationwide. Eighty-eight percent of the corn planted was with seeds developed through biotechnology. Despite the fact that corn is wind pollinated, bees still work the corn because it is widely available and is a rich source of protein. Bees also work the soybean, another seed that is treated with clothianidin. In 2011, soybeans were planted on [75.2 million](#) acres nationwide. Ninety four percent of planted soybeans were transgenic.

The lack of independent analysis of the synergistic impact of various pesticides and herbicides on bees is disconcerting by itself. Added to that concern is the lack of independent scientific analysis of the impact of transgenic crops like corn and soybeans and their formulaic pesticides on bees independently and in combination with other chemicals and neonicotinoids in particular. Also, beekeepers and researchers are concerned that systemic pesticides, which could remain in the soil for years after the initial application, could be taken up by other plants used during crop rotation and thus potentially remain a constant threat to bees.

Neonicotinoids also have the potential to contaminate ground water, a concern expressed by beekeepers like Tom Theobald and [researchers](#) alike. The EPA suggested that ground water contamination warning be given on clothianidin label stating that “[t]he use of this chemical in areas where soils are permeable, particularly where the water table is shallow, may result in ground water contamination.” The industry chose to go with different wording on the label.

The more genetically engineered crops like soybean and corn are planted, the more bees and other animals are exposed to potentially toxic pesticides, while the plants are growing and potentially years thereafter.

Furthermore, since the impact of these chemicals has not been independently studied and verified, the only thing that can be stated with certainty is that we do not really know much about the effects, especially long term, of transgenic crops and pesticides, alone, in combination or at sublethal levels, on bees or other animals.

Professor Frazier explained that independent research on transgenic crops and formulaic pesticides is hampered by the unavailability of information and materials and is “even less available than pesticide information” because it is regarded as proprietary information by the biotech companies. In a refrain often echoed by other [researchers](#), an intellectual property [wall](#) often stands between independent science and chemical makers.

Beekeepers Bee-ware

Currently, at least three European countries (France, Germany, and Italy) have either banned or imposed serious restrictions on systemic pesticides. Disturbingly for U.S. beekeepers and ultimately all consumers, if we are to think of bees as the canary in the coal mine, is that despite the threat posed by CCD and the link to pesticides, to date, there has been no well designed systematic survey of honey bee colonies performed in the United States. Nor do we currently have an [accurate](#) and complete picture of what pesticides are used, where and in what amounts, or the accurate measures of just what the maximum exposure is in agricultural or urban settings on blooming plants. This, despite the fact that the [number](#) of pesticides registered for use in the U.S. is over 1200 active ingredients distributed among some 18,000 products. In fact, in this day and age of pesticide addiction, it is astonishing that California is the only state requiring agricultural pesticide users to [report](#) to the government their chemical use on a monthly basis, detailing where, when, how much, and on what crop a pesticide was used. And even California's reporting requirement exempts home and garden use and most industrial and institutional uses.

Professor Frazier [warned](#) that “the underestimation of systemic pesticide hazards to bees in the registration process may well have contributed to widespread pesticide contamination of pollen, the primary food source of our major pollinator,” and beekeepers like Tom Theobald strongly advise us to [listen](#) to the bees as they are “telling us something” before it is too late.

It's not just the bees that may be telling us something.

Billions of dollars are annually spent on pesticides and insecticides. We fight epic battles with nature by pumping an ever increasing number of chemicals to destroy, it seems, all forms of life that we currently view as “pests” without much regard to the collateral impact such as the destruction of important insects (nature's biocontrol agents), not just pollinators, birds, aquatic life, or the degradation of soil, water and air, to say nothing of the impact of pesticides on [humans exposed](#) to them. While some are beginning to realize that such a scorched earth tactic is short-sighted and that we should be working with nature, not against it, many are still loyally wedded to the pesticide mentality.

[Achim Steiner](#), UN Under-Secretary-General and UNEP Executive Director put it best when he stated, “[t]he way humanity manages or mismanages its nature-based assets, including pollinators, will in part define our collective future in the 21st century.”

Appendix A

The full EPA suggested [label](#) is as follows:

This product is toxic to aquatic invertebrates. Do not apply directly to water or to areas where surface water is present or to intertidal areas below the mean high-water mark. Do not contaminate water when cleaning equipment or disposing of equipment washwaters. Do not apply where runoff is likely to occur. Runoff from treated areas may be hazardous to aquatic organisms in neighboring areas. Apply this product only as specified on the label.

This chemical has properties and characteristics associated with chemicals detected in ground water. The use of this chemical in areas where soils are permeable, particularly where the water table is shallow, may result in ground water contamination.

This compound is toxic to birds and mammals. Treated clothianidin seeds exposed on soil surface may be hazardous to birds and mammals. Cover or collect clothianidin seeds spilled during loading.

This compound is toxic to honey bees. The persistence of residues and potential residual toxicity of Clothianidin in nectar and pollen suggests the possibility of chronic toxic risk to honey bee larvae and the eventual instability of the hive.