POLLINATOR STEWARDSHIP COUNCIL

TYPES OF EXPOSURE

Acute Exposure

Acute kill exposure of pesticides to pollinators can have severe consequences for both individual organisms and entire populations. Pesticides feature labels indicating their toxicity to bees, measured by the LD50, which is the lethal dose for 50% of bees. The EPA employs a tiered approach to evaluate pesticide toxicity to honey bees. The initial tier involves conservative tests with high concentrations to detect acute toxicity. If no toxicity is initially observed, no further testing is required. If toxicity is detected, subsequent tiers involve semi-field and field studies to assess real-world exposure and effects. These evaluations do not capture synergistic or sublethal effects. This is highly concerning because pollinators are regularly exposed to a multitude of chemicals.

Sublethal Exposure

When we think of pesticide exposure, we typically think of an acute kill after a spray application but more bees are killed through sublethal exposure over time. With this type of exposure, the basic functions of bees are impaired and they lose their ability to communicate, forage, reproduce, and fight off pathogens and parasites due to weakened immunity and lack of vigor--similar to the effects of lead poisoning in humans. Although chronic sublethal exposure is by far the most common type of exposure, most beekeepers are unaware of the myriad of symptoms and often blame poor outcomes on mismanagement or issues that are actually secondary causes. For example, sublethal exposure has been proven to alter grooming behaviors in bees, which can cause high increases in varroa mite loads, resulting in colony loss. Beekeepers treat for varroa, not realizing that this may be a secondary symptom and not the cause of colony loss.

Synergystic Effects

Although some types of pesticides individually may pose low toxicity to bees, their combined presence can heighten toxicity due to synergistic effects. In an analysis from Penn State of 1300 pollen samples, 91% were contaminated with pesticides, with an average of six pesticides per pollen sample and as many as 31. The synergistic effect of this chemical cocktail should not be underestimated. We know that it is critical to disclose all current medications as it is clearly understood that interaction between multiple chemicals is complex and the synergistic effect can change benign medications into lethal combinations. It is not surprising that pollinators also experience increased toxicity due to these synergistic effects--but it is highly concerning that agencies do not include this type of evaluation as part of the regulatory process.

Loss of forage due to pesticide damage

Indirect impacts can also be catastrophic to bees. Dicamba is a highly volatile herbicide used in soybeans and other crops to control weeds and is prone to drift, causing massive damage to non-target plants and in 2021 the EPA received more than 3,500 damage reports from farmers and landowners due to off-target movement of dicamba. This type of damage results in a significant reduction of forage for bees, with some commercial beekeepers reporting massive colony losses due to reduced forage in surrounding areas where dicamba use is common. With this type of exposure, the reduction in forage may cause colonies to slowly starve.

- **Neonicotinoids are so toxic that one treated corn seed contains enough insecticide to kill over 80,000 honey bees.**
- **The western bumble bee (Bombus occidentalis) was historically very common throughout the western United States and Canada. In the last 20 years it has declined by more than 90%. (Graves et al. 2020).**
- **Since 2007, some bee populations have fallen by more than 80%, as reported by USDA Forest Service. The number of butterflies in the study declined by nearly 60%.**
- **According to Penn State, domestic honey bees hives are down by 59% compared to 60 years ago with rapid declines over the last forty years.**

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HOW TO TELL

Symptoms of acute exposure

- 100 or more dead bees in/around the hive, for every live frame of bees

Symptoms of sublethal exposure

- Behavioral Changes: Monitor changes in bee behavior, such as altered foraging patterns, reduced food collection efficiency, impaired navigation abilities, increased aggression, or decreased colony activity.
- Developmental Abnormalities: Assess the development of bee larvae and pupae for abnormalities, such as malformed wings, delayed development, or reduced survival rates.
- Reproductive Effects: Evaluate reproductive parameters in bees, including egg laying rates, sperm viability, or queen health.
- Long-term survival rates: Monitoring bee populations over time can reveal trends in mortality rates and colony health.

WHAT TO DO

Performing chemical analysis is crucial when investigating suspected pesticide exposure in bees.

In case of suspected pesticide exposure:

1. Contact the state agency responsible for pesticide regulation and beekeeping to request an investigation. (http://npic.orst.edu/reg/state_agencies.html)In many states, they will conduct a site visit and take responsibility for steps 2-4. If not, you may need to take these steps on your own.
2. Collect samples of bees, wax, or other relevant materials.
3. Send the samples for testing to determine the presence and concentration of pesticides.
4. Report the test results to the state agency for further action and investigation.
5. Report the findings to the Environmental Protection Agency (EPA) for regulatory compliance and enforcement purposes. beekill@epa.gov

Honeybees serve as critical indicators, much like the canary in the coal mine. Their sensitivity to pesticides makes them invaluable for assessing needed changes in farming methods. In addition to the steps above, another important action is to share your experience with state legislative contacts to help them understand the need for policy changes to protect pollinators.

WHY DO POLLINATORS NEED PROTECTION?

For beekeepers, annual losses now average around 50%, reflecting the significant challenges facing pollinators. This high rate of loss underscores the urgency of addressing threats to bee health and the importance of implementing changes to the pesticide regulatory system. For many who work close to pesticide-intensive farming practices, the losses have run much higher—often 70-95%. This devastatingly high rate is in stark contrast to the "normal" seasonal loss of 10-15% that is still enjoyed by those who forage on pesticide-free wildlands or open range. Between 1992 and 2014, U.S. agricultural landscape became 48 times more toxic to pollinators, with neonicotinoids accounting for 99% of that increase.

Honey bees are a critical component of our country's food supply, and provide pollination to more than 90 crops and one out of every three bites of food we eat. In 2018, the USDA estimated that honey bee pollination accounted for $15 billion in added crop value alone. By protecting pollinators, we can protect the future of our food system and our selves.

WHAT ELSE CAN I DO?

- **Become a PSC Member!**
- **Make a tax-deductible donation** to PSC. Your contribution helps support legal and legislative advocacy to protect bees.
- **Host a PSC speaker** at your local beekeeping meeting or event to help beekeepers learn more about pesticides and pollinators.
- **Add as a signer** to legislative campaigns to help remove and prevent registration of dangerous pesticides.
- **Talk about the issue,** share news and information within your beekeeping community.
- **Contact PSC** if you've seen or experienced bee damage from pesticides, we want to share your story!

Visit us!
Use the QR code to learn more, host a speaker, become a member, or donate!

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