Recommendations to Protect Pollinators from Neonicotinoids

Suggestions for Policy Solutions, Risk Assessment, Research, and Mitigation

Jennifer Hopwood, Aimee Code, Mace Vaughan, and Scott Hoffman Black

Introduction

Bees provide essential services in agriculture, in natural ecosystems, and in the support of overall biodiversity. A large—and growing—body of research demonstrates that neonicotinoid insecticides cause numerous harmful effects to both managed and wild bee species. They can kill bees on contact soon after an application. Less understood, but just as harmful are the more subtle effects caused by sublethal doses which can impede bees' ability to forage, find their way home, combat disease, avoid predators, and reproduce. Further complicating the issue of neonicotinoid risks are the substantial knowledge gaps which remain.

Based on the existing body of research, coupled with our commitment to preserve wild pollinator species, the Xerces Society for Invertebrate Conservation has created the following recommendations. With these recommendations, we respond to the considerable research indicating that current neonicotinoid use practices are causing harm. We also acknowledge the many data gaps creating uncertainty about persistence, toxicity, and the magnitude of risk. In response to these unknowns, the Xerces Society uses a conservative and cautionary approach with our recommendations in order to avoid underestimating risk or causing unnecessary harm. While most of our recommendations are specific to neonicotinoids and their unique concerns, we also provide recommendations to improve upon existing regulation to more broadly ensure that the use of federally approved pesticide products will not cause unreasonable harm to pollinators and the ecosystems on which we all depend.

The recommendations are broken into sections that include policy solutions, suggestions for risk assessment and research design, and general mitigation efforts that the users of neonicotinoid products can implement.

Finally, as new pesticides become available, these recommendations may apply to those pesticides with chemistries similar to neonicotinoids (e.g., sulfoxaflor, flupyradifurone). While these newer chemistries are not assessed in this report, they are systemic insecticides with similar behavior and toxicity as neonicotinoid insecticides.

Contents

Recommendations for:
Improving Federal Regulation

Initiate cancellation proceedings for prophylactic and cosmetic uses of nitroguanidine neonicotinoid products

Preemptive treatments, without documentation of need, are contrary to the philosophy of integrated pest management (IPM). For example, the increasing prophylactic use of systemic insecticides, such as the planting of neonicotinoid coated seed without scouting and confirming need, do not consistently show benefit in yield and can impede biological pest control.

Cosmetic insecticide applications are not in response to a challenging economic pest, nor do cosmetic pests pose a risk to human health or the health of an infested plant. Considering the risks associated with the four nitroguanidine neonicotinoids (clothianidin, dinotefuran, imidacloprid, and thiamethoxam), unnecessary uses such as prophylactic and cosmetic uses should be cancelled.

Prohibit applications of all neonicotinoid products on bee-attractive crop plants during bloom

Recent EPA label changes prohibited some foliar applications of products containing clothianidin, dinotefuran, imidacloprid, and thiamethoxam during bloom. This restriction should be extended to all neonicotinoids. Due to the systemic nature of neonicotinoids, soil drenches, trunk injections, basal bark applications, and other uses should also be included in the prohibition of application during bloom.

Prohibit applications of neonicotinoids on non-crop ornamental plants that are bee attractive and/or pollinator host plants

The EPA should make national Oregon's 2014 condition of registration which limits the use of some neonicotinoids on certain bee attractive trees. After multiple bee kill incidents were reported in Oregon, the Oregon Department of Agriculture (ODA) made it a condition of registration that use of clothianidin, dinotefuran, imidacloprid, and thiamethoxam is prohibited on *Tilia* trees. *Tilia*, also known as linden and basswood, are a key forage plant for many bee species.

The EPA should also consider prohibiting or severely restricting use of all neonicotinoids on other non-crop plants that are attractive to pollinators, or that serve as pollinator host plants. This action would eliminate a significant pollinator exposure route.

Halt use of neonicotinoid products by backyard gardeners and other unlicensed applicators

The vast majority of neonicotinoid products are designated "general use" by the EPA. As such, backyard gardeners can use neonicotinoids without any training other than that which is provided on the product's label. Employees at farms, nurseries, and other businesses can also often apply these pesticides at their place of employment without obtaining a pesticide applicators license. In other words, most neonicotinoid products can be used by unlicensed, untrained individuals.

Since their initial registrations, many harmful effects of neonicotinoids have come to light. The EPA should reassess neonicotinoid products to determine whether they should be re-categorized as restricted use.

Strengthen neonicotinoid product labels by expanding and clarifying pollinator warning language

The EPA requires that labels for clothianidin, dinotefuran, imidacloprid, and thiamethoxam products, designed for foliar application, include an "infographic" and warning about the risk to pollinators. Other products containing these chemicals that are applied via soil drench, basal bark spray, or trunk injection do not require a warning. Due to the systemic nature as well as the persistence of these chemicals, all products containing a neonicotinoid, regardless of the application method, should contain the pollinator warning. Furthermore, the infographic's icon of a bee must be revised in order to clearly express that bees are at risk. The existing icon is a healthy bee, which is misleading.

The EPA also must eliminate inconsistency on labels. The new EPA pollinator protection information required on labels has led to inconsistency in enforceable language. For example, the Environmental Hazard statement for the clothianidin product Arena 50WDG's (EPA Registration Number 59639-152) says: "This product is toxic to bees exposed to treatment and for more than 5 days following treatment. Do not apply this product to blooming, pollen-shedding, or nectar-producing parts of plants if bees may forage on plants during this time period." The same label's Bee Hazard section states that applications can occur if certain conditions to protect managed bees are met, such as notifying the beekeeper, so that s/he can cover or remove the hives (Arena label 2014). This inconsistency is in urgent need of correction.

Ensure products have clear limits on the amount that can be applied per season

The EPA should require registrants of neonicotinoid products to review all their product labels to ensure each one includes a stated seasonal maximum application rate. Clarity on the legal limits on the amount of a pesticide that can be applied during a single growing season can significantly reduce the amount of a pesticide used, thus reduce pollinator exposure. Prompting the necessary corrections will reduce the likelihood of seasonal over-applications.

Initiate Endangered Species Act consultations with Fish and Wildlife Service on the risks of neonicotinoids to threatened and endangered pollinators

The systemic nature of neonicotinoids combined with their high-toxicity and persistence puts pollinators at risk. Therefore, the EPA should fulfill its basic Endangered Species Act obligations and initiate consultation with the U.S. Fish and Wildlife Service in order to ensure these already imperiled populations are not further jeopardized by the use of neonicotinoids.

Temporarily suspend the uses of clothianidin, dinotefuran, imidacloprid, and thiamethoxam until it can be ensured that their use is not causing unacceptable harm

The weight of scientific evidence demonstrates a significant risk from clothianidin, dinotefuran, imidacloprid, and thiamethoxam to pollinators. Therefore, the Xerces Society stands in support of an immediate suspension of uses of these neonicotinoids linked with pollinator exposure, until EPA has made a determination that such uses will not cause unreasonable adverse effects to pollinators.

Bring coated seeds under pesticide regulation and mandate fully enforceable label warnings and use directions on seed bags

The EPA should register coated seeds as pesticides. The lack of a pesticide designation provides little to no enforcement mechanism against the potential misuse of or harm from these seeds. The current advisory language and use directions on seed bags are inadequate to address the broad risks the use of coated seeds can have bees, other pollinators, and wildlife generally.

Close the "conditional registration" loophole for the pesticides brought to market without robust review

Conditional registration allows a new active ingredient to enter the market for an unspecified period of time while the registrant gathers safety data requested by the EPA. Analyses by the EPA and the Government Accountability Office confirm that this process has been misused in a majority of cases. The EPA should end the conditional registration process as Canada has proposed (see http://www.hc-sc.gc.ca/cps-spc/pest/part/consultations/_noi2016-01/index-eng.php). Or at a minimum the EPA should strengthen the system to clarify if and when conditional registration can be used to avoid further misuse of this system.

Require a national pesticide use reporting system

A national pesticide use reporting system would provide realistic and comprehensive data on how and where pesticides are used across the United States. Reporting of where coated seeds are planted should also be included in the reporting system. Currently, only the state of California requires comprehensive reporting of pesticide use.

Upgrade EPA's incident reporting system for dead bees, birds, and other wildlife

The EPA needs to make incident reporting a priority, for bees and other wildlife. The agency needs to coordinate its own internal databases, and sync its information with the newly developed U.S. Fish and Wildlife Service Injury and Mortality Reporting system. It is also critical that the EPA update the thresholds for FIFRA 6(a)(2) incident reporting. Currently, they are set so high as to severely limit the number of wildlife incidents reported. Furthermore, the EPA needs to make these data-systems electronic. The current data-gathering deficiencies means that Registration Review decisions are rarely informed by incident data from the field.

Upgrading the EPA incident reporting system would be a relatively simple and low cost measure, with enormous benefits in our understanding of pesticide impacts on wildlife.

Recommendations for:
Policy Options for State and Local Governments

State and local governments have significant ability to reduce pollinator exposure to neonicotinoids. Below are a few potential actions that local and state governments can take to better protect pollinators from neonicotinoids.

Halt use of neonicotinoid products by backyard gardeners and other unlicensed applicators

The vast majority of neonicotinoid products are designated "general use" by the EPA. As such, backyard gardeners can use neonicotinoids without any training other than that which is provided on the product's label. Employees at farms, nurseries, and other businesses can also often apply these pesticides at their place of employment without obtaining a pesticide applicators license. In other words, most neonicotinoid products can be used by unlicensed, untrained individuals.

Since their initial registrations, many harmful effects of neonicotinoids have come to light. Much like the EPA, states should reassess neonicotinoid products to determine whether they should be re-categorized as restricted use. Alternatively, states could take action similar to the state of Maryland, which recently passed a law that, starting in 2018, will put specific restrictions on the sale and use of neonicotinoids to stop their use by untrained backyard gardeners; the use of neonicotinoids will be limited to licensed applicators and a subset of people that use these chemicals in the course of business (e.g., employees of farms, nurseries and veterinarians). The sale of neonicotinoids will also be limited to retail establishments that sell restricted-use products. The bill can be viewed at: http://mgaleg.maryland.gov/2016rs/bills/hb/hb0211f.pdf

Require labeling of plants and plant materials that have been treated with neonicotinoids

To better inform consumers about the plants and seeds they buy, a state could require labeling of plants and plant materials that have been treated with a neonicotinoid. Retail establishments can also institute such labeling voluntarily, and some already have.

Stop the use of neonicotinoids on state and local property

Since 2014, more than twenty local governments have halted the use of neonicotinoids on public property. Other government entities can learn from these efforts, evaluate pesticide uses on public property, and make smart changes to reduce overall pesticide use and eliminate neonicotinoid use. For example, state natural resource departments could explore policy options to disallow the use of neonicotinoids, including the planting of coated seed, on leased lands. To see where local policies have been enacted and review these policies go to: http://www.xerces.org/pesticides/

Eliminate the use of neonicotinoids in the habitat of imperiled pollinator populations

Recognizing the unique risks that neonicotinoids pose to pollinators, state and local governments should consider mapping out areas, both on public and private lands, where at risk pollinator species occur and take action to protect them from exposure to neonicotinoids. The Xerces Society recommends governments consider prohibiting use of neonicotinoid products in the ranges of these species.

Halt aesthetic-only uses of pesticides

A significant amount of pesticide use, especially in urban areas, is for aesthetic purposes. In response, some governments have eliminated the vast majority of pesticide uses through halting aesthetic pesticide uses.

Takoma Park, Maryland, as well as six Canadian provinces have adopted restrictions on use of pesticides for purely aesthetic purposes. These policies apply to both public and private property. More information about aesthetic bans can be accessed at: http://www.ontario.ca/environment-and-energy/pesticides-home-lawns-and-gardens.

Recommendations for:
Strengthening Pollinator Risk Assessment

Neonicotinoids and other systemic insecticides present unique challenges for pollinator risk assessment. Some of these compounds are used in reduced-risk IPM programs that are arguably less acutely toxic to people. However, the translocation of neonicotinoids to pollen and nectar, and the persistence of these chemicals in plants, soil, and the environment, results in direct and potentially long-term exposure to bees and other beneficial insects which can lead to a cascade of effects on the broader environment.

In order to make accurate evaluations and determine appropriate risk mitigation methods, risk assessors need expanded and improved bee toxicology studies that address the multiple risks posed by these chemicals.

Resources for the development of the following recommendations include a guidance document from the European Food Safety Authority (EFSA 2013), and a book that emerged from the Society of Environmental Toxicology and Chemistry Pellston Conference on Pesticide Risk Assessment for Pollinators (Fischer and Moriarty 2014).

Strengthen tier one laboratory trials

Risk assessment should include, at a minimum, testing of acute and chronic oral toxicity for adult and larval honey bees, bumble bees, and at least one solitary bee species (in United States there are approximately 3,600 species that vary in habitat, size, and behavior). Acute contact toxicity testing should be conducted for adults of all three bee groups. Data from these tests should result in dose response curves and establish a no observable effects level (NOEL).

To more accurately determine when mortality and sublethal effects might occur in the field, laboratory tests should be designed to ensure bees have to travel to gather food. Chronic exposure tests should last for the duration of bloom for each plant registered for use. Observation of bees should continue up to 30 days after exposure is stopped. Ideally, chronic exposure tests should last for the approximate lifespan of the bee being studied (frequently 4 to 8 weeks) because exposure to contaminated wildflowers or other crops is possible. If testing a social bee species, laboratory studies should control for variability in colony health, genetic variability, and the age of individual bees.

Strengthen semi-field and field studies

Semi-field studies should test acute exposure from applications, as well as chronic exposure to contaminated pollen and nectar for honey bees, bumble bees, and a solitary bee species.

Field studies should demonstrate that bees are adequately exposed to contaminated food sources. Exposure can be confirmed by monitoring foraging activity on treated plants and the analysis of residues in stored food. Field trials should also include sufficient distance between control and treatment plots, and field sizes should reflect real world conditions where the product would be used.

For honey bees and bumble bees, using a minimum and replicated field treatment size of at least 5 acres (2 ha) is an improvement over many existing field studies, but larger areas would be better. Field trials should take advantage of the limited foraging range of managed solitary bees to help model the impact on honey bees at larger scales where field testing is impossible because of honey bees' large foraging area (the foraging area of a typical hive covers more than 8,000 acres, and up to 18,000 acres [about a 3 mile radius]). Individual bee mortality, foraging activity, and colony health (of social species) should be monitored over a full year (for honey bees), growing season (for bumble bees), or larval development cycle (for solitary bees) to identify possible delayed effects, such as stored food being later consumed and fed to honey bee brood.

When applicable semi-field and field studies should assess residues in treated plants, the time interval between application and appearance of residue in floral resources, and the persistence of residues (even for many years in the case of perennial crops). Crop plant species vary in their ability to uptake systemic chemicals. Similarly, application rates, methods, and subsequent translocation of neonicotinoid residues into pollen and nectar should be documented for every crop on which the product is registered for use.

Complete cumulative ecological risk assessments

A pollinator risk assessment of any neonicotinoid cannot be separated from other key stressors that interact with neonicotinoids to amplify risks.

Over time, the EPA should build its capacity to evaluate combined risks from multiple stressors. In the short term, the EPA should undertake a cumulative risk assessments of all neonicotinoids jointly and furthermore should address specific environmental agents that could increase the risks of neonicotinoids. More specifically, EPA risk assessments should address: (a) the amplified toxicity caused by combined exposure of neonicotinoids and ergosterol inhibiting fungicides; (b) potential additive and synergistic effects from co-formulated pesticides; and (c) the ability of neonicotinoids to increase the risk of bee diseases.

Evaluate use across the landscape overtime

Neonicotinoids are widely used throughout the United States. If we are to understand the impacts of this large-scale use the EPA must undertake a landscape-wide approach to evaluate the impacts of overarching use. Furthermore, due to the persistence of most neonicotinoids, this analysis should also consider the effects of residue buildup over time.

EPA's pesticide risk assessments generally evaluate risk by crop, and application method over a single growing season. While these narrow assessments can be very useful to understand priority risks and target mitigation, they fail to provide a broader view of the ecological risks posed by overarching neonicotinoid use in the landscape.

Broaden risk assessment to better represent factors unique to solitary bees

Honey bee populations are buffered from harm caused to individual workers due to the size of their colonies, which have thousands of workers that are not directly responsible for colony reproduction. In contrast, if a female solitary bee dies due to insecticide contact while foraging, her nest remains incomplete. These differences between bee species has a significant impact on population level risk analysis. EPA's current pollinator risk assessment uses social honey bees to assess population level effects for all bee species.

When estimating exposure levels risk assessors should include all routes of exposure. While direct spray and eating pollen and nectar are primary exposure routes for all bees, other exposure routes are also high priority to native bees. For example, the 70% of solitary bees that nest in the ground, including in agricultural fields, have a high potential for contact exposure from soil drench and the planting of coated seed.

Ensure risk assessment takes into account the risks of persistence and carryover

Carryover, whereby a pesticide is still in the soil, available for uptake, or in the plant months to years after an application, can lead to pesticide exposures long after an application has been completed and can cause chemical build up, thus increasing exposure levels that bees and other beneficial insects face. EPA's risk assessment should take into account persistence and carryover and change labels accordingly to reduce the potential for harm caused by residue levels that build up over time.

Recommendations for:
Advancing Research

The current level of knowledge about neonicotinoids clearly indicates a need for action to better protect pollinators and the broader environment. Still, a number of significant data gaps remain. Greater understanding of how these chemicals act in the environment and their risks will be useful in fine tuning regulatory actions, and in developing effective and protective pest management strategies. Priority areas of study for future research are listed below.

Expanded understanding of how neonicotinoids function within plants.

Specifically, there is limited publicly available information on:

- How residue levels in nectar and pollen vary with different application rates and application methods (e.g., treated seeds, foliar spray, soil drench, or trunk injection). To date, most research has focused on treated seed, but other application methods are also commonly employed.
- How residue levels vary in plants grown under differing field conditions (e.g., drought), soil types (e.g., sandy vs. loam), and under variable nutrient levels and ground cover.
- How neonicotinoid residue levels vary between pollen and nectar.
- How and when neonicotinoid concentrations within a plant increase over time following repeated applications.
- How soil residues increase over time and how they are taken up into plants or crops that are subsequently planted.
- Which neonicotinoids are most likely to move into pollen and nectar.
- How that movement might vary with type of plant (e.g., herbaceous vs. woody), by functional group (e.g., forbs vs. legumes vs. grasses), and by plant size.
- How and at what concentrations neonicotinoids move into nontarget plants (e.g., contamination of wildflowers in habitat surrounding treated crops or trees).
- How different application methods affect residues in plants.

A broader understanding of how neonicotinoids affect bees, which are diverse in biology, habitat requirements, and body size.

Within that, the following areas of uncertainty should be researched and resolved:

- Differences in effect and response to consumption of contaminated pollen versus contaminated nectar sources.

- Knowledge about the concentration in nectar and pollen a bee can consume and see no observable effects. Note that this should include chronic exposure to very low doses that may have sublethal effects that only appear after long-term exposure.
- Standardized methods for testing solitary bees and bumble bees to facilitate a movement away from the current use of honey bees as a surrogate for all terrestrial insects in risk assessment testing protocols.
- Increased knowledge about lethal and sublethal toxicity to larvae. It is probable that some substances may be more toxic to larvae than to adults or could cause sublethal effects on reproduction, development, or delayed mortality with larval exposures.
- Greater understanding of how chronic sublethal doses interact with bee pests, disease, or nutrition. Among other things, does a pollen-diverse diet increase the resilience of honey bees or bumble bees to neonicotinoid exposure?
- Greater understanding of whether honey bees experience effects of neonicotinoids during times of dearth (e.g., periods of adverse weather conditions such as winter or drought) when stored foods are consumed. Current field study timelines might miss such delayed exposure and resulting effects.
- Greater understanding of the possible effects of soil residue on ground-nesting bees. Areas of study should include contact exposure from soil drench, the planting of coated seed as well as foliar residues on tunnel-nesting bees that use plant materials for nest construction.
- Improved testing methods to measure the effects of insecticides on solitary bee learning, as some solitary species may not respond to proboscis extension reflex (PER) tests.

There is also a clear need for investigations into the effects neonicotinoids and other pesticides have on other beneficial insect species, such as butterflies, moths, beetles, flies, and wasps. These insects make minor contributions to crop pollination, but serve important roles within crop systems and other ecosystems (e.g., as larvae, many syrphid flies are predators of crop pests). To help address this need, the Xerces Society completed a review of the research conducted on neonicotinoid impacts to beneficial insects that manage crop pests. You can download a copy of the report, *Beyond the Birds and the Bees: The Effects of Neonicotinoid Insecticides on Agriculturally Important Beneficial Invertebrates* at http://www.xerces.org/beyond-the-birds-and-the-bees/

Additionally, insects such as butterflies are valued in residential and ornamental landscapes where neonicotinoid use is increasingly common.

Recommendations for:
Pest Management Practices to Protect Pollinators

Growers

- Create and restore habitat on farms to encourage beneficial insect predators and parasitoids. Read more at http://www.xerces.org/pollinator-conservation/
- Incorporate biological, physical, cultural and mechanical pest management methods such as intercropping, crop rotation and mating disruption. Read more about these strategies at http://www.xerces.org/conservationbiocontrol/
- Work with local pest management experts and land grant researchers to develop strategies that incorporate pollinator protection and use a broad range of pest management tools to reduce reliance on pesticides.
- If your land overlaps with the range of an at risk pollinator population, eliminate the use of neonicotinoids and reduce overall pesticide use. Local fish and wildlife agency staff, as well as lists such as the Species of Greatest Conservation Need and state and federal (Endangered Species Act) listings can help you determine if your property overlaps with the range of at-risk species.
- Avoid prophylactic treatments of neonicotinoids. Use scouting and monitoring to determine if and when pest pressure warrants management.
- If neonicotinoids must be used, use products containing acetamiprid rather than other more bee-toxic, long-lived neonicotinoids.
- Do not apply mixtures of DeMethylation Inhibiting (DMI) fungicides with neonicotinoids as they have been shown to increase the toxicity of neonicotinoids.
- Establish pesticide application setbacks and/or create non-flowering vegetative buffers around pollinator habitat.

Backyard gardeners

- Avoid use of all pesticides around your home. Instead, seek out alternative solutions. Non-chemical options will often help you address the problem at its root providing long-term relief, whereas pesticides are a short-term fix.
- Ask your nursery if potted plants—especially species that support pollinators—have been treated with neonicotinoids. When possible, purchase organic plants.
- Ask your local nursery to stop selling neonicotinoid products. Shelf space can instead be filled with ecologically sound options.
- Request that landscape and gardening companies not use pesticides on your property, and ask them to plant organic plants.
- Increase the amount of pollinator habitat in your home and garden. For plant selection ideas go to http://www.xerces.org/bringbackthepollinators/.