Protecting Bees from Pesticides in Oregon Cherry Orchards

Top to bottom—An *Andrena* mining bee visits a cherry bloom; pollinator habitat in a cherry orchard; an *Agapostemon* bee visits pollinator habitat planted next to a cherry orchard in Oregon (photos: Xerces Society / Sarah Foltz Jordan; Oregon State University / Emily Carlson).

Good pollination is critical to Oregon tree fruit production. Managed honey bees (*Apis mellifera*) and native bees living around orchards, including bumble bees, mason bees, and mining bees, are important pollinators of commercial cherries and other fruit crops. Maintaining abundant, diverse, and healthy pollinator populations is critical for pollination success and setting a large, marketable crop of cherries. Growers can take steps to support pollinators in and around orchards by providing habitat and using a combination of management and mitigation strategies to reduce pollinator exposure to pesticides.

Research conducted by Oregon State University in 2020–21 detected a variety of pesticides in pollen collected by honey bees in and around cherry orchards in The Dalles and Hood River, including some at levels that could be harmful to honey bee health. Pollen samples were collected from hives in orchards during bloom through petal fall, and again after bloom. The researchers identified the pollen to plant type where possible and found that the bees were collecting pollen from cherry and other tree fruit, understory plants, mustard cover crops, and wildflowers outside of the orchards at different times during the season.

Pesticides detected at levels that can be harmful to honey bee health in samples collected from cherry bloom through petal fall included pyridaben (e.g., Nexter), bifenthrin (e.g., Brigade), tolfenpyrad (e.g., Bexar), and carbaryl (e.g., Sevin). After bloom, high-hazard pesticide detections in bee-collected pollen included bifenthrin (e.g., Brigade), chlorantraniliprole (e.g., Altacor), imidacloprid (e.g., Admire), and tolfenpyrad (e.g., Bexar). Some of these pesticides were likely applied in cherry orchards, while others may have been applied and picked up by honey bees elsewhere in the landscape. For more detail on the possible sources of these residues, see Table 1 (page 5).

In addition to the individual high-hazard detections, many pollen samples contained combinations of different pesticides that can interact to jointly increase toxicity to bees. Most of these synergistic interactions occur between certain

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common groups of fungicides and insecticides, such as DMI fungicides and pyrethroids or neonicotinoids. For examples of the synergistic interactions detected in pollen samples, see Table 2 on page 9.

These pesticide detections underscore the importance of taking precautions to better protect bee health in and around orchards. In some cases, pesticide label restrictions may not be protective enough for bee health, and growers may need to go beyond the label to reduce the use and off-target drift of bee-toxic pesticides in order to ensure the health of pollinator populations and continued crop pollination success. This factsheet outlines the key elements of pesticide risk for pollinators, summarizes results and takeaways from the recent Oregon State University cherry research, and provides actionable steps for growers to better protect pollinators from pesticides around cherry bloom.


A cherry orchard site in Oregon where pollen samples were collected for identification and pesticide residue analysis (photo: Oregon State University / Emily Carlson).

Pesticide Risk to Pollinators

What types of pesticide applications are high risk for pollinators?

Some pesticide applications pose a greater risk than others for pollinators. The risk of a pesticide depends on how harmful it is to bees (its toxicity), and the dose that bees receive (also called exposure). Highly bee-toxic, environmentally persistent, and systemic chemicals are more likely to lead to harmful exposures. In other words, if a pesticide is very toxic, sticks around in plants, soil, and water for a long time, and/or can be taken up into plants' pollen and nectar, bees are more likely to encounter a harmful dose.

There are a variety of resources available to look up the toxicity of different pesticides to honey bees, including the online UC IPM Bee Precaution Pesticide Ratings tool and the rankings table in the PNW Extension publication, How to Prevent Bee Poisoning from Pesticides. Residual toxicity, or how long residues remain toxic to bees after application, is also important for determining pesticide risk. The U.S. Environmental Protection Agency maintains a table of the currently available information on residual toxicity to honey bees (Residual Time to 25% Bee Mortality). While there is considerable variation in residual toxicity due to differences in formulations, application rates, and crops, this limited dataset can still offer a general understanding of how long different pesticides may remain toxic to bees after application (e.g., 3 hours vs. 60 hours).

Where and how bees are exposed?

Most bees roam farther than a single orchard. While small native bees may only fly a few hundred feet away from their nest, managed honey bees can travel up to several miles from their hive looking for high-quality food resources. This wide flight range means that pesticides applied in far-off fields, orchards, and backyards can affect the health of bees in our own orchards, and our pest management activities can affect bees living elsewhere in the community.

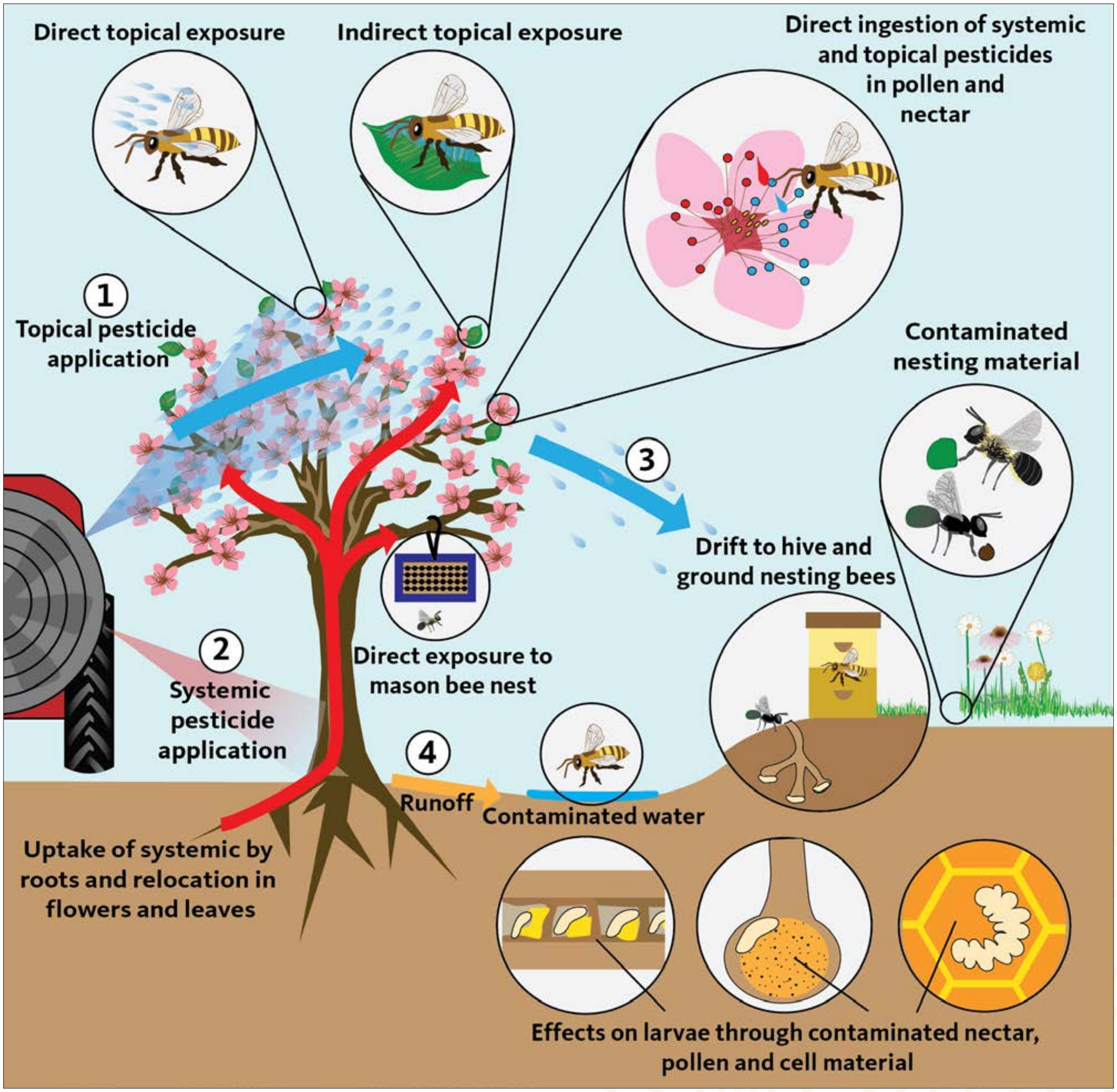
Bees can be exposed to pesticides directly if they are applied when bees are active, or to residues on leaves or in the pollen and nectar of flowers they visit, including crop flowers and flowering weeds in the understory and margins. Pesticides applied end up in soil, where most native bees build their nests. Mason bees, which build their nests in hollow stems, collect mud to make walls inside their nests. Contaminated soil is an important route of exposure to pesticides for native bees.

Pesticides can move away from where they are sprayed, including drift through the air, runoff across the soil surface, and leaching into soil and groundwater. Only about one-third to two-thirds of pesticides applied by airblast sprayers reach the orchard canopy, with the rest drifting to the ground or other off-target locations (Hulbert et al. 2020; Vercruysse et al. 1999). Bees can encounter pesticides in flowering weeds in and around crop fields, as well as in contaminated soil and water.

All of the pesticides listed were detected in honey bee-collected pollen samples at Hazard Quotients (HQ) above 500. HQs of these levels are associated with colony losses and other individual and colony health impacts, such as honey bee queen death or replacement in managed colonies (Traynor et al. 2016). For more information on HQs, including how they are calculated and their value for assessing pesticide hazards to honey bees, see Carlson et al. (2022)and Stoner & Eitzer (2013).

Figure 1. Pollinators such as bees can be exposed to pesticides in multiple ways:

(1) direct contact with pesticides or pesticide residues that remain active on foliage and flowers, (2) in nectar and pollen for systemic pesticide treatments that are drawn up through a plant's vascular system, (3) pesticide drift into areas where bees are foraging, nesting or gathering nesting material, and (4) pesticide runoff that contaminates water that bees forage on or the nesting beds of ground-nesting bees (figure: Oregon State University / Iris Kormann and Andony Melathopoulos).



Honey bee hives were placed in a blooming cherry orchard, with pollen traps installed at the hive entrances to capture pollen loads from the bees as they returned from foraging. Pollen loads collected from the traps over a 24 hour period were taken to a research laboratory for pollen identification and pesticide residue analysis (photos: Oregon State University / Emily Carlson).

Figure 2. The percentage of sites where the highest hazard pesticides were detected in honey bee-collected pollen during cherry bloom.

Residues were sampled from 19 cherry orchard sites located throughout the major cherry production regions of The Dalles and Hood River in Oregon.

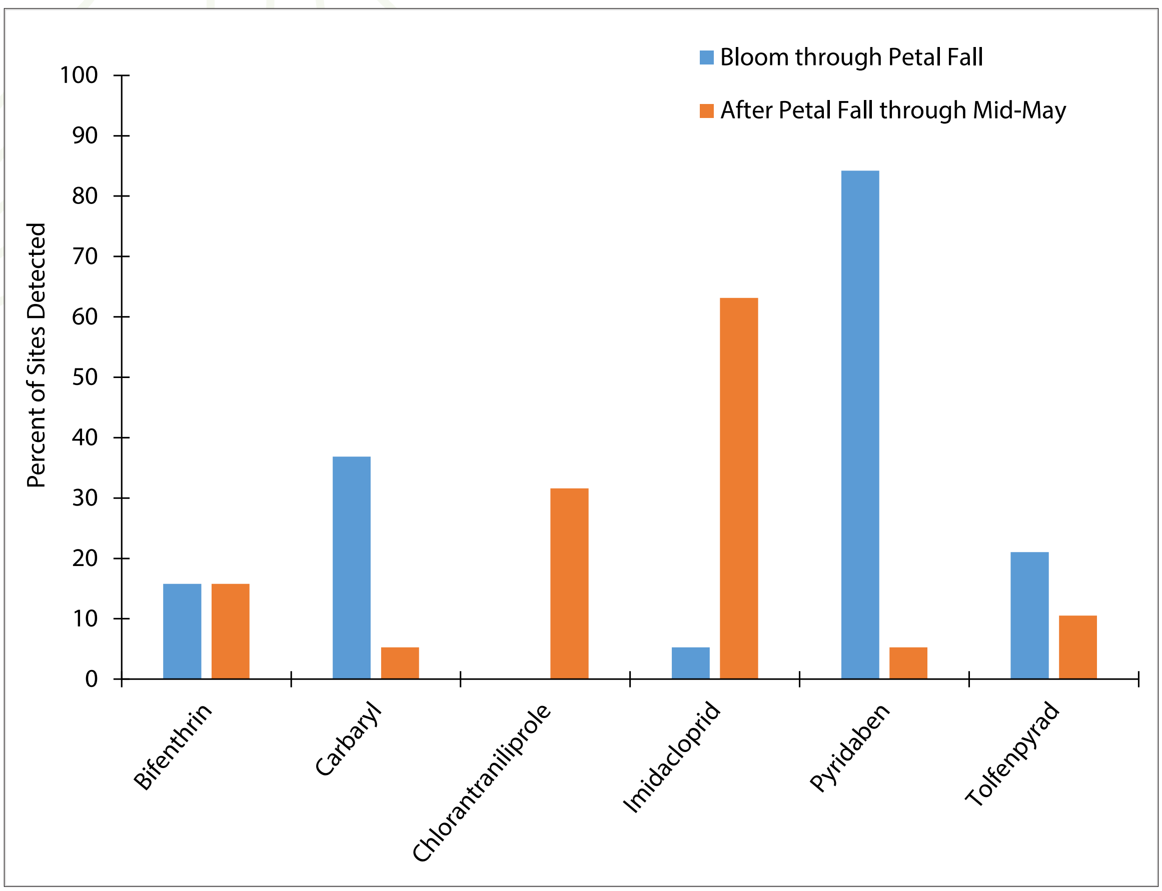


Table 1. Pesticide residues and possible sources.

Several insecticides were detected at levels that can be harmful to honey bee health in pollen collected by honey bees during cherry bloom and petal fall, as well as after bloom, continuing through the end of sampling in mid-May.

PESTICIDE	POLLEN SOURCE	POSSIBLE RESIDUE SOURCES BASED ON LABELED USES
TIMING OF DETECTIONS: CROP BLOOM THROUGH PETAL FALL		
Bifenthrin (e.g., Brigade, Sniper)	Tree fruit*	Bifenthrin has no labeled uses in production cherry orchards, suggesting that the likely source of these residues was drift from applications in other nearby crops.
Carbaryl (e.g., Sevin)	Unspecified (mix of pollen sources)	Because carbaryl is prohibited from being applied to blooming crops, possible sources include: • Popcorn or petal fall applications in cherry orchards to control aphids, leafrollers, or bud moths. • Drift from pre-bloom applications in nearby apple or pear orchards.
Pyridaben (e.g., Nexter)	Tree fruit*, understory plants, wildflowers	With a 300-day preharvest interval in cherries, pyridaben should not be applied to bearing cherry orchards anytime near bloom. Therefore, the residues likely originated from applications to other nearby crops. Possible sources: • Drift from pre-bloom applications in apple and/or pear orchards targeting aphids, leafrollers, mites, and pear psylla. • Honey bee visitation to early blooming pear orchards treated with pyridaben for pear psylla control.
Tolfenpyrad (e.g., Bexar)	Tree fruit*, understory plants, wildflowers	• Bloom and petal fall applications to control black cherry aphids or thrips in cherry orchards. • Drift from applications to nearby crops, such as pre-bloom applications in pear orchards to control pear rust mites or pear psylla.
TIMING OF DETECTIONS: AFTER PETAL FALL		
Bifenthrin (e.g., Brigade, Sniper)	Mustard cover crop, wildflowers	Bifenthrin has no labeled uses in production cherry orchards, suggesting that the likely source of these residues was drift from applications in other nearby crops.
Chlorantraniliprole (e.g., Altacor, Dauntless)	Wildflowers	• Drift from petal fall applications aimed at controlling aphids, leafrollers, or thrips in cherry orchards. • Drift from pre-bloom or bloom applications in other nearby crops.
Imidacloprid (e.g., Admire Pro, Macho)	Mustard cover crop, wildflowers	• Drift from petal or shuck fall applications in cherry orchards to control aphids or leafhoppers. • Drift from spring applications targeting cherry fruit fly. • Drift from applications to nearby crops, such as petal fall applications in pear orchards for pear psylla control.
Tolfenpyrad (e.g., Bexar)	Mustard cover crop	• Drift from applications for cherry fruit fly in cherry orchards. • Drift from applications targeting a variety of pest species in nearby apple, pear, berry, or grape crops.

***TREE FRUIT POLLEN COULD NOT BE IDENTIFIED TO CROP SPECIES. HOWEVER, TREE FRUIT POLLEN WAS ONLY IDENTIFIED IN SAMPLES TAKEN DURING CHERRY BLOOM THROUGH PETAL FALL, SO WHILE MOST OF THESE SAMPLES WERE LIKELY COLLECTED BY HONEY BEES FORAGING ON CHERRY FLOWERS, SOME OF THE POLLEN MAY HAVE COME FROM EARLY BLOOMING PEAR TREES IN THESE REGIONS.**

How to Protect Pollinators During and Beyond Bloom

Use integrated pest and pollinator management (IPPM).

Integrated pest and pollinator management (IPPM) is a strategy that focuses on the long-term prevention of crop pests and diseases through a combination of techniques such as biological control, habitat manipulation, cultural practices, and use of resistant varieties. Pesticides are reserved as a final line of defense, only to be applied when established guidelines justify their necessity to prevent economic damage. Following an IPPM approach can help to reduce pesticide costs and inputs, which in turn will help pollinators and other beneficial insects in and around your orchard to thrive.

Pesticide Detections in Hood River

While most pollen samples in this project were taken from cherry orchards during and after bloom in The Dalles, samples were collected at three sites during bloom in Hood River in 2020. All Hood River samples had high levels of pyridaben (e.g., Nexter). Notably, pyridaben (Nexter® SC) is labeled for use for control of pear psylla nymphs during pear bloom with a 24(c) Special Local Needs label in Oregon, at a rate of up to 0.73 lb ai/acre, if applied between late evening and early morning. While honey bees are often more frequent visitors to apple and cherry orchards, they will visit pear flowers to collect pollen (Diaz et al. 2013). Pear orchards are the most likely source of this pesticide in bee-collected pollen in Hood River.

- Always use appropriate scouting, monitoring, and/or degree day models to confirm that economic thresholds have been met before making a pesticide application.
- Be proactive to identify and use prevention-based management strategies for pests and diseases of concern.
- For more detailed guidance on pest monitoring, economic thresholds, and prevention-based strategies, refer to the Pacific Northwest Pest Management Handbook for Cherry.

Avoid bloom applications wherever possible, especially of combinations of pesticides that jointly increase toxicity to bees.

- Insecticide applications during bloom can result in high exposure for pollinators in pollen and nectar. Some insecticides are allowed to be applied during crop bloom if beekeepers are notified and spraying occurs when bees are less active (i.e., after dark). While this will avoid the maximum exposure to bees from direct knockdown of actively flying insects, even relatively short residual pesticide products are likely to be picked up on open flowers in the days following the nighttime application.
- Fungicides can have subtle harmful effects on pollinators, including making bees more vulnerable to other stressors like pathogens and diseases. Fungicides can also increase the bee toxicity of some other pesticides that may be present in or around the orchard at the same time. Bloomtime fungicide applications are often unavoidable in tree fruit management, so care should be taken to avoid tank mixtures of insecticides, miticides, and fungicides with synergistic toxicity, as bees exposed to common fungicides become more vulnerable to these other pesticide exposures. Synergistic interactions are not exclusively caused by pesticide tank mixtures. Multiple pesticide applications, leading to overlapping exposures to co-synergistic pesticides, can also increase bee toxicity. Consider the residual toxicity times of the products you are using and avoid applying a potentially synergistic pesticide when residues of co-synergists may still be present in the orchard. For more information on pesticide residual toxicities for bees, refer to the EPA webpage on Residual Time to 25% Bee Mortality (RT25) Data. For examples of combinations of pesticides used in cherry orchards that may result in synergistic interactions, see Table 2 (page 9).

Use care with pre-bloom and petal fall applications.

- Pollinators begin exploring orchards in search of open flowers well before peak bloom, and continue seeking nectar and pollen through petal fall, until the last open flowers are gone. To minimize pollinator exposure, apply pesticides as early as possible for pre-bloom spraying and as late as possible for petal fall spraying. Always ensure that pesticide applications and timing are justified based on scouting and monitoring.

Maintain good communication with beekeepers and neighbors.

- Building and maintaining a strong relationship with your beekeeper is essential for a successful tree fruit operation, and the cornerstone of that relationship is open and effective communication.
- Several fungicides commonly used during orchard bloom can interact with miticides, like amitraz and tau-fluvalinate, frequently applied by beekeepers to manage *Varroa* mites in their hives. These synergistic interactions can significantly increase the toxicity of these chemicals for honey bees. Both growers and beekeepers should be made aware of this risk and, whenever feasible, take measures to avoid exposing bees to residues of both chemicals simultaneously. Achieving this goal will require comprehensive education and effective communication between both parties.
- Remember that farms exist within larger ecosystems, where everything is connected. Therefore, building good relationships with your neighbors is crucial, as actions on your neighbor's property can impact your bees, and vice versa. Even when your orchards are not in bloom, take extra precautions when applying pesticides to avoid them drifting onto your neighbor's land and harming their bees. Talk to your neighbors about doing the same. Working together, we can all help support healthy bee populations and keep our farm landscapes thriving.

Provide flowering habitat for pollinators outside of orchards.

- Providing pollinators with a variety of flowering resources can help improve their health and nutrition. Healthy pollinators are often more resilient to stressors, including exposure to parasites, diseases, and low levels of pesticide residues. These habitats can also provide other essential resources such as nesting sites and materials that help support native pollinator populations. By establishing pollinator-friendly habitats around your orchard and taking precautions to protect them from pesticide drift and contamination, you can provide significant benefits to your local pollinator community.
- For specific guidance on how to create and maintain pollinator habitat around your orchard, see the Xerces Society Enhancing Pollinator Habitat in Remnant Oak Plant Communities Factsheet.

Reduce Pesticide Drift and Off-Site Movement

Many of the pesticide residues detected in pollen collected by honey bees in and around cherry orchards in The Dalles and Hood River likely originated as drift from nearby applications to other crops. When applying pesticides, take steps to minimize pesticide drift. The amount of drift is determined by numerous factors, including spray droplet size, application rate, environmental conditions such as wind speed/direction and relative humidity, equipment type and settings, and operator care and experience. Deliberate attention should be given to each of these factors before making a pesticide application.

Avoid applying pesticides to or allowing drift onto flowering plants, including weeds.

- Take precautionary measures to prevent pesticides from drifting onto noncrop flowers within and surrounding the orchard, including flowering weeds in the understory or margins, and any flowering resources in adjacent pollinator or remnant habitats.
- If flowering weeds are present in orchard rows or margins, mow them down before applying pesticides to the crop.
- When making a pesticide application, turn off your spray equipment when you reach the end of a row.
- Establish an unsprayed buffer around any sensitive areas surrounding your orchard, such as designated pollinator habitat or remnant natural/seminatural habitats. The wider the buffer you are able to provide, the greater the benefits that habitat will yield for pollinators, beneficial insects, and other wildlife.

Only apply pesticides in optimal environmental conditions.

- Wind speed and direction are two of the primary factors that determine how much pesticide moves away as drift, and where it is deposited. Only apply when wind speeds are between 2–10 mph. Do not apply during temperature inversions, when pesticides are more likely to move off-site.
- Note: Temperature inversions are most common between late afternoon and early morning. If you are planning to make a nighttime application, always check if an inversion exists before applying. More information on how to recognize temperature inversions can be found in this BASF Technical Information Bulletin.

Consider using drift-reduction techniques, products, and equipment.

- Your equipment settings can substantially impact the drift risk of your application. Always adjust spray nozzles to the largest droplet size recommended on the product label. Additionally, when using an air-assisted sprayer, carefully adjust fan settings such as speed, blade pitch, air outlet width, and gearbox position to minimize drift beyond the tree canopy.
- There are also various products and technologies that have been developed to enhance pesticide deposition rates and reduce pesticide drift. For orchard production, these include drift-reduction nozzles, electrostatic sprayers, sensor-based spray equipment, and drift-control adjuvants.
- Drift-reduction nozzles, such as air-induction (aka Venturi) and turbulence chamber (aka pre-orifice) nozzles, can help minimize pesticide drift and off-target deposition by enlarging spray droplet size without increasing product volumes. These nozzles have been reported to reduce pesticide drift by up to 50% (Torrent et al. 2020).
- Electrostatic spray systems use static electricity to electrically charge spray droplets, which then become attracted to oppositely charged leaves. This attraction enables the droplets to overcome gravity, enhancing pesticide deposition and minimizing drift. However, the specific design and settings of the sprayer significantly influence the drift reduction benefits of these systems (Salcedo et al. 2023). Additionally, because many electrostatic sprayers produce very fine spray droplets, it’s advisable to exercise extra caution when operating them, especially in windy conditions.
- Sensor-controlled spray equipment has been around since the 1980s. However, recent technological advancements have significantly improved their sophistication, reliability, and drift-reduction potential. Modern models of ‘variable spray rate’ applicators, including ultrasonic, LiDAR, and image-responsive sensor sprayers, can adjust spray outputs for each nozzle, based on the detected crop canopy characteristics. These advanced applicators can not only lower spray volumes, but also substantially reduce pesticide drift with ground drift reductions of 60–85% and airborne drift reductions of 80–90% (Salcedo et al. 2021; Xun et al. 2023).
- Drift control adjuvants can be extremely effective at reducing pesticide drift, with some formulations showing up to a 60% decrease in ground drift potential and an 85% reduction in airborne drift potential (Itmec et al. 2022). However, the absence of federal regulation for these adjuvants raises concerns about their potential toxicity to pollinators. Several spray adjuvants have been found to increase the toxicity of tank-mixed insecticides to bees (Mullin 2015; Mesnage & Antoniou 2017). Additionally, some adjuvants can negatively impact bees by impairing their learning ability and increasing their susceptibility to viral diseases (Ciarlo et al. 2012; Mullin et al. 2016; Fine et al. 2017).
- Note - Hooded or shielded spray equipment, such as full boom shields, nozzle shields, tunnel sprayers, and recycling tunnel sprayers, can also be used to substantially reduce drift from pesticide applications in other cropping systems, including row crops and vineyards.

Regularly maintain and calibrate spray equipment.

- Regular maintenance and calibration of spray equipment is crucial for ensuring accurate and effective distribution of pesticides onto their intended targets. This not only enhances pest control efficacy and cost-effectiveness, it also helps minimize pollinator exposure to pesticides by reducing over-application, off-target deposition, and drift.

Use windbreaks and other vegetative barriers to reduce drift and protect habitat outside of orchards.

- Wind breaks and other vegetative barriers can be used to reduce pesticide drift in your orchard. Planting windbreaks upwind of your orchard can decrease wind speeds within the orchard, thus reducing the amount of drift generated by any pesticide applications. Conversely, planting vegetative barriers downwind of your orchard can capture excess airborne spray particulate from applications, preventing pesticide droplets from drifting beyond your orchard area.
- Vegetative barriers can also be planted in between your orchard and any nearby pollinator or remnant natural/seminatural habitats to help protect these areas from pesticide drift by intercepting pesticide particulate.

Table 2. Examples of pesticide combinations that may result in synergistic interactions based on their mode of action groups.

This table is not meant to serve as a comprehensive list of all known and potential synergisms that may occur in tree fruit crops in Oregon. Only pesticides that were detected in the pollen residue analysis or are labeled for use in cherry production were included. There are other combinations of pesticides, including insecticide–insecticide, insecticide–miticide, and fungicide–fungicide interactions, that may also result in synergism.

FUNGICIDE MODE OF ACTION GROUP	FUNGICIDE ACTIVE INGREDIENTS (EXAMPLES)		*INSECTICIDE/ MITICIDE MODE OF ACTION GROUP*	*INSECTICIDE/MITICIDE ACTIVE INGREDIENTS (EXAMPLES)*
1 (MBC Fungicides)	• Thiophanate-methyl (e.g., Incognito, Talaris, Topsin)	+	3A (Pyrethroids)	• Bifenthrin (e.g., Brigade, Sniper)
			4A (Neonicotinoids)	• Acetamiprid (e.g., Assail, Intruder) • Clothianidin (e.g., Arena, Belay) • Imidacloprid (e.g., Admire Pro, Macho)
3 (DMI Fungicides)	• Difenoconazole (e.g., Inspire, Miravis Duo, Quadris Top) • Fenbuconazole (e.g., Indar) • Myclobutanil (e.g., Eagle, Rally) • Propiconazole (e.g., Concert II, Quilt Xcel, Tilt) • Tebuconazole (e.g., Luna Experience, TebuStar) • Triflumizole (e.g., Procure, Trionic)	+	3A (Pyrethroids)	• Bifenthrin (e.g., Brigade, Sniper)
			4A (Neonicotinoids)	• Acetamiprid (e.g., Assail, Intruder) • Clothianidin (e.g., Arena, Belay) • Imidacloprid (e.g., Admire Pro, Macho)
			4D (Butenolides)	• Flupyradifurone (e.g., Sivanto)*
			15 (Benzoylureas)	• Dimethenamid (e.g.,FreeHand, Tower, Verdict)
			28 (Diamides)	• Chlorantraniliprole (e.g., Altacor, Dauntless)
7 (SDHI Fungicides)	• Boscalid (e.g., Pageant, Pristine)	+	4A (Neonicotinoids)	• Acetamiprid (e.g., Assail, Intruder) • Clothianidin (e.g., Arena, Belay) • Imidacloprid (e.g., Admire Pro, Macho)
11 (QoI Fungicides)	• Azoxystrobin (e.g., Abound, Quadris, Quilt Xcel) • Pyraclostrobin (e.g., Cabrio, Pristine) • Trifloxystrobin (e.g., Flint, Gem, Luna Sensation)	+	3A (Pyrethroids)	• Bifenthrin (e.g., Brigade, Sniper)
		+	21A (METI Acaricides)	• Fenpyroximate (e.g., FujiMite) • Pyridaben (e.g., Nexter) • Tolfenpyrad (e.g., Bexar)
***PESTICIDE WAS NOT DETECTED IN THE POLLEN SAMPLES, BUT IS LABELED FOR USE IN CHERRIES.**				

Synergistic Interactions: How Combinations of Pesticides Can Increase Toxicity to Bees

Several fungicides commonly applied during tree fruit bloom are known to interact with various insecticides and miticides, creating a combined toxicity greater than the sum of their individual toxicities. This phenomenon, known as synergistic interaction, substantially increases the risk these pesticides pose to bees.

Pesticide residues were detected in 79% of pollen trap samples collected between cherry bloom and mid-May. Among samples with detectable residues, nearly half contained combinations of residues that could result in synergistic interactions, substantially increasing their risks to bees. About a quarter of these samples were collected during cherry bloom and three-quarters post-bloom. In the most extreme case, a single sample contained residues from nine different pesticide co-synergists, forming four distinct combinations of synergistic modes of action and raising concerns about unpredictable increases in toxicity.

Conclusions

Hazardous levels of several individual pesticides and pesticide combinations were detected in pollen collected by honey bees during and after cherry bloom in Hood River and The Dalles. These high pesticide loads are associated with colony losses and other individual and colony health impacts, such as honey bee queen death or replacement in managed colonies (Traynor et al. 2016).

The findings from this project indicate that current mitigations and label language may not be enough to provide sufficient protections to bees for some applications. For example, high levels of pyridaben (e.g., Nexter) and tolfenpyrad (e.g., Bexar) were detected in tree fruit pollen. Current label guidelines permit the application of these pesticides during crop bloom, so long as certain conditions are met, such as ensuring that the product is applied at least 8 hours prior to bee foraging and sending notice of the application to your bee broker. However, the residues can remain toxic to honey bees for longer than 8 hours. Growers should reconsider their use of these and similar extended residual insecticides during crop bloom, and outside of this period, applicators should take additional precautions to prevent drift onto flowering resources in the surrounding landscape.

While managed honey bees are often relocated from orchards after the bloom period, native pollinators and other beneficial insects that offer essential pollination and pest control services remain present throughout the entire season. Therefore, it is important to take precautions to safeguard these insects and reduce pesticide drift, even when the orchard is not in bloom.

In many cases, treatments for economically damaging diseases, such as brown rot blossom blight, during cherry bloom may be unavoidable. Therefore, whenever possible, producers should take care to refrain from applying insecticides and miticides in the orchard when residues of these fungicide synergists are likely to be present. Likewise, it is advisable to avoid applying pesticide tank mixtures, especially of known synergistic combinations.

Many of the pesticide residues found at highly hazardous levels in pollen collected by honey bees likely originated as drift from nearby or neighboring applications, which underscores the value in forming and maintaining good relationships and open lines of communication with your neighbors, as their activities can significantly impact your operations, just as yours can affect theirs.

Additional Resources

- *Oregon Bee Guide*. (2017; S. Kincaid.) Oregon Department of Agriculture. oregon.gov/oda/shared/Documents/Publications/IPPM/ODABeeGuide.pdf
- *How to Prevent Bee Poisoning from Pesticides*. (2016; L. Hooven, R. Sagili, and E. Johansen.) Oregon State University Extension. extension.oregonstate.edu/catalog/pub/pnw-591-how-reduce-bee-poisoning-pesticides
- *Preventing Water Contamination and Pesticide Drift: A Checklist for Pesticide Applicators*. (2023; T. Stock and S. Castagnoli.) Oregon State University Extension. extension.oregonstate.edu/catalog/pub/em8964-s
- *Minimizing Pesticide Risk to Bees in Fruit Crops*. (2015; E. May, J. Wilson, and R. Issacs.) Michigan State University Extension. canr.msu.edu/resources/minimizing_pesticide_risk_to_bees_in_fruit_crops
- *USDA Agronomy Technical Note 9: Preventing or Mitigating Potential Negative Impacts of Pesticides on Pollinators Using Integrated Pest Management and Other Conservation Practices*. (2014; M. Vaughan, G. Ferruzzi, J. Bagdon, E. Hesketh, and D. Biddinger.) United States Department of Agriculture, Natural Resource Conservation Service. xerces.org/publications/scientific-reports/preventing-or-mitigating-potential-negative-impacts-of-pesticides
- *Sprayers for effective pesticide application in orchards and vineyards (FABE-533)*. (2022; E. Ozkan and E. Gil.) Ohio State University Extension. ohioline.osu.edu/factsheet/fabe-533
- *Bee Precaution Pesticide Ratings*. (S. Dreistadt, E. L. Niño, L.G. Varela, E.C. Mussen, L. Hooven, B. Phillips, E. Johansen, T. Lawrence, and R. Sagili.) University of California Extension. Retrieved April 2024. ipm.ucanr.edu/bee-precaution-pesticide-ratings/
- *A Guide to Reducing Pesticide Risk to Bees in Tree Fruit Orchards*. (2023; M. Van Dyke, E. Mullen, D. Wixted, M. Centrella, and S. McArt.) Pollinator Network at Cornell University. cornell.app.box.com/v/ProtectionGuide-Orchard2023
- Residual Time to 25% Bee Mortality (RT25) Data. United States Environmental Protection Agency. www.epa.gov/pollinator-protection/residual-time-25-bee-mortality-rt25-data
- *Pacific Northwest Pest Management Handbook: Cherry*. (2023; A. Thompson, H. Stoven, and C. Adams.) Oregon State University, Washington State University, and University of Idaho Extension. pnwhandbooks.org/insect/tree-fruit/cherry
- Recognizing Temperature Inversions. (2017; BASF technical bulletin.) agriculture.mo.gov/plants/pdf/BASF_TechBulletin_TemperatureInversion_highres.pdf
- *Sensor Sprayers for Specialty Crop Production*. (2019; B. W. Warneke, J. W. Pscheidt, R. R. Rosetta, and L. L. Nackley.) Oregon State University Extension. extension.oregonstate.edu/catalog/pub/pnw-727-sensor-sprayers-specialty-crop-production
- *Selecting Spray Nozzles to Reduce Particle Drift*. (2017; T. Peters, A. Thostenson, J. Nowatzki, V. Hofman, and J. Wilson.) North Dakota State University Extension. www.ag.ndsu.edu/AgCMS/agmachinery/documents/pdf/selecting-drift-reducing-nozzles

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Acknowledgments

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This material is based upon work supported by a U.S. Department of Agriculture (USDA), Natural Resources Conservation Service Conservation Innovation Grant, under agreement number NR203A750008G004. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the views of the U.S. Department of Agriculture.