RECOGNIZING AND PROTECTING INSECT POLLINATORS IN THE AGRICULTURAL LANDSCAPE

PJ Liesch[1] and Bryan Jensen[1]

Basics of Pollinator Biology:

- Pollinators include bees, but also various other insects (wasps, beetles, moths, flies, etc.) and other animals (hummingbirds, bats, small mammals); *any creature that visits a flower could be a pollinator to some extent!*
  -Of these creatures, bees are amongst our best and most important pollinators.

- The US is home to ~4,000 bee species; Wisconsin is home to ~400 bee species
  - Honey Bee (1 sp.) social, live as colony year round
  - Bumble Bees (~20 sp.) social, seasonal colonies
  - Wild Bees (~400 sp. in several families) solitary, biology varies for each type

- Bees pollinate ~80% of flowering plants (~250,000 flowering plants known)
  -Roughly 1 out of every 3 bites of food due to pollinators

- Bees have two main needs: food sources (i.e., flowers) and shelter (i.e., nesting habitat)
  - Other than cuckoo bees, all bees collect pollen and nectar to feed their young
    - Solitary bees use provisioning to stockpile food for their developing young
  - Three main types of nesting sites:
    A) Ground nesters [~70 % of bees]
    B) Hole Nesters (use preexisting tunnels in most cases) [~30 % of bees]
    C) Cavity nesters (bumble bees, feral honeybees) [<1% of bees]

Identifying and Understanding Pollinators-Resources

1) *Pollinators* [USFS webpage: http://www.fs.fed.us/wildflowers/pollinators/]
2) *Wisconsin Bee Identification Guide* [UWEX Handout; http://labs.russell.wisc.edu/insectid/files/2016/06/WI-BEE-IDENTIFICATION-GUIDE.pdf]
3) *Wisconsin Spring Bee Guide* [Online ID Guide; http://energy.wisc.edu/bee-guide/]
4) *The Bees in Your Backyard* [Book; 2016; Wilson & Carrill]
5) *Bee Basics: An Introduction to our Wild Bees* [USDA Publication; http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5306468.pdf]
6) *Bumble Bees of the Eastern US* [USDA Booklet; http://www.fs.fed.us/wildflowers/pollinators/documents/BumbleBeeGuideEast2011.pdf]

[1]University of Wisconsin-Madison Entomology Department

Pollinator Conservation on and Around Farms

1) Use a wide variety of plants that bloom from early spring into late fall
   -Diversity of flowers = diversity of pollinators by providing food [pollen and nectar]
   - Include host plants for specific species (i.e., specific butterflies)

2) "Go wild" (i.e., use native plants & allow weeds to grow in appropriate situations)
   - Native plants suited for local conditions
   - Hybrid flowers (esp. with "doubled" flowers) may have little/no pollen or nectar!!!
   - In urban areas, consider leaving lawn weeds (dandelions, clover, etc.) – food for pollinators

3) Eliminate pesticides whenever possible
   * See *Wisconsin Pollinator Protection Plan* for additional information
   A) Eliminate pesticides entirely
   B) Choose products or formulations that are less toxic to bees
   C) Use pesticide appropriately and apply in ways that will eliminate/minimize exposure to bees
      - i.e. apply when bees not actively foraging
      - i.e. Don't apply to or allow to drift to flowering plants

4) Create and maintain pollinator nesting habitat
   A) "Bare" patches of soil for ground-nesting bees; minimize tilling
   B) Leave dead/dying trees (if appropriate) for nesting habitat (Hole nesters)
   C) Leave vegetation standing when appropriate (some hole nesters like pithy stems)
   D) Provide nesting habitat ("bee boxes" & "bee hotels")

Pollinator Conservation-Resources

7) *Wisconsin Pollinator Protection Plan* [DATCP Publication; https://datcp.wi.gov/Pages/Programs_Services/PollinatorProtection.aspx]
8) *How Farmers can Help Pollinators* [USDA-NRCS webpage; www.nrcs.usda.gov/wps/portal/nrcs/main/national/plantsanimals/pollinate/farmers/]
9) *Supporting Native Bees: Our Essential Pollinators* [UWEX Factsheet; https://learningstore.uwex.edu/Supporting-Native-Bees-Our-Essential-Pollinators-P1629.aspx]
10) *Selecting Plants for Pollinators: Eastern Broadleaf Forest* [Pollinator Partnership Publication; http://pollinator.org/PDFs/Guides/EBFContinentalrx13FINAL.pdf; see also: www.pollinator.org]
11) *Enhancing Nest Sites For Native Bee Crop Pollinators* [USDA Agroforestry Note; http://www.plants.usda.gov/pollinators/Enhancing_Nest_Sites_For_Native_Bee_Crop_Pollinators.pdf]
12) *Conservation of Native and Domestic Pollinators in Managed Turfgrass* [UWEX Factsheet; https://learningstore.uwex.edu/Conservation-of-Native-and-Domestic-Pollinators-in-Managed-Turfgrass-Landscapes-P1812.aspx]

Protecting Pollinators from Pesticides

There are several practices a crop advisor or applicator can implement in an agricultural landscape, however, these practices may require site-specific decisions.

[1]University of Wisconsin-Madison Entomology Department

IPM and Insecticide Use

The first practice to consider is to make sure the pesticide application is necessary. Eliminating prophylactic use is an important consideration when protecting pollinators. Use IPM practices, including scouting and economic thresholds to determine if the need is critical.

Drift Control

Controlling pesticide drift onto honey bee colonies is crucial. Drift is often a reason for acute, if not catastrophic poisoning of honey bees. Although hives can be easy to spot, some may not be visible. Furthermore, knowing if hives are present prior to application can be useful information to have which may allow for alternative application timings. To help determine if hives may be present consult the Wisconsin **Driftwatch** map https://driftwatch.org/map . **Driftwatch** is an interactive mapping program which is operated by a non-profit company created by Purdue University. It allows commercial beekeepers (and specialty crop producers) to voluntarily register sensitive sites on a map. Applicators can use this information to determine if potential concerns exist prior to application. Registering is voluntary and not all beekeepers have uploaded bee yard locations, however, several hundred apiaries were register during 2016. **Driftwatch** allows applicators to zoom in on application sites using Google Imagery which allows for precise positioning of bee yards. Beekeepers who do upload bee yard locations are required to do so each year so map data stays current. Data Stewards, employed by the cooperating state's Department of Agriculture, approve or deny request for beekeepers and specialty crop producers who want to upload sensitive sites. This process helps verify the requests are from commercial bee keepers and producers, not homeowners. **Driftwatch** is free and viewable by the public. Membership is voluntary but provides operating funds for sustained operation and development of updates.

Other practices applicators can use to minimize drift are typical best drift management practices which include monitoring weather condition including wind speed and direction prior to spraying sensitive areas. Use appropriate nozzles and pressure settings that are designed to minimize drift yet are still appropriate for the target pest. Specific pollinator protection practices include avoid spraying near water sources. Pollinators often use various water sources (ditches, ponds, dew, etc.) for a source of drinking water. Avoid drift onto blooming plants which serve as nectar or pollen sources.

Insecticide Selection

Choosing the appropriate insecticide is not always an easy decision when pollinator protection is a goal. To help with the decision process, The Environmental Protection Agency has implemented a Bee Advisory Box on labels. This icon was developed to draw attention to the potential harmful effects that certain pesticide will have on pollinators. It makes it clear that the labeled pesticide can kill bees as well as other pollinators. It also warns that drift, direct contact, etc. are issues and if there are specific restrictions applicators must follow.

According Wisconsin statues, beekeepers can request a 24 hr. advanced notice if pesticides labeled as "Highly Toxic to Bees", are to be applied 1½ miles of their bee yards. The person who owns or control the land where the applications is to be made is legally responsible for this notification. However, communication between the applicator and landowner is important.

Choosing a pesticide or pesticide formulation that is least toxic to bees is an important consideration. There are too many pesticides available today to list. Always check labels prior to application. A few hints are important. Insecticides are certainly the most toxic group of pesticides to pollinators, however, some fungicides may possibly be toxic to pollinators. Consult labels for more information.

[1]University of Wisconsin-Madison Entomology Department

Pesticide formulations can have some effect on relative toxicity to pollinators, however, the active ingredient probably plays a bigger role in prevention. In general, wettable powders, dusts and microencapsulated insecticides have a greater potential for toxicity than the same active ingredient with a different formulation. The speed in which an insecticide kills also can play a role in pollinator toxicity. The worst possible combination might be a slow killing insecticide used in a formulation that is a wettable powder, microencapsulated or is a dust. The bees exposed to these compounds may live long enough to return to the hive and expose other adults and/or brood.

The science associated with pollinator health and with seeds treated with neonicotinoid insecticides is not completely understood. What is known, however, is that dusts from planting operations that drifted onto hives or nectar/pollen sources is an acute source of mortality. Sub-lethal effects from pollen and nectar is unclear at this point and certainly these results will be dependent on detection, landscape and foraging behavior.

Applications timing can have some influence on honey bee exposure to pesticides. Typically, honey bees are actively foraging until approximately 4-5 in the afternoon. Applying a short residual pesticide after bees are done foraging for the day may help. However, this serves as a useful guideline for honey bees but foraging may occur much later in the day. Also, it does not consider foraging behavior of other native pollinators.

Attractiveness of the crop can also have an impact on pesticide exposure to honey bees and other pollinators. Alfalfa and soybean can be considered a source of both pollen and nectar for honey bees. Corn only a pollen source and wheat is not a source of pollen or nectar. However, that only tell part of the story. Alfalfa is only a source of pollen and nectar when it is flowering. Most of the alfalfa in Wisconsin is cut well before flowering. Also, weeds in non-attractive crop must be considered. A list of weeds that serve as pollen and/or nectar sources common to Wisconsin cropping systems include: dandelion, milkweed, white clovers, asters, bindweed, mustards, ragweed, sow thistle and wild buckwheat. Also, important in attractiveness to crops and or weeds is nectar and pollen competition from other plants. Although a crop may be listed as an attractive nectar source another non-crop plant may be more attractive to pollinators and they may not visit that crop plant.

References

Krupke, C. H., G. j. Hunt, B.D. Eitzer, G. Andino, and K. Given, 2012. Multiple routes of pesticides exposure for honey bees living near agricultural fields. PLoS ONE 7(1):e29268. Doi:10.1371/juournal.pone.0029268.

[1]University of Wisconsin-Madison Entomology Department