Protecting Honey Bees from Chemical Pesticides

Maryann Frazier
Senior Extension Associate
Penn State

Honey bees are vulnerable to many of the insecticides used to control damaging pest species by fruit, vegetable, nut, and seed growers. Growers dependent on honey bees for the pollination of their crop(s) must constantly maintain a delicate balance between protecting their crops from pests and pathogens, and protecting the insects that are necessary to pollinate these crops.

The recent dramatic die-off of tens-of-thousands of honey bee colonies has left many beekeepers devastated and possibly many growers without the quantity and quality of bees needed to pollinate crops this spring and summer. A research group, the Colony Collapse Disorder Working group (see MAAREC.org) is trying to determine what factors are responsible for these unprecedented colony losses. Chemical contamination is one of several possible contributing factors that are being investigated. These include chemicals being used within the hive for mite and disease control as well as chemicals pesticides used on crops that may inadvertently find their way into hives. Until we have more documented information, it is advisable to use pesticides with care, erring on the precautionary side.

The neonicotinoids are a relatively new class of insecticides that impact the central nervous system of insects. They act either as contact insecticides or applied to plants, they are translocated throughout the plant tissue, making all parts of the plant toxic to pests that feed on the plants. While imidacloprid registered in 1992, is the best-known insecticide in this class, there have been a number of new neonicotinoids introduced since then (clothianidin, acetamiprid, thiamethoxam, etc.). Their use has increased dramatically over the past few years and they are now the most widely used group of insecticides in the US. Their uses include: seed treatments for corn, cotton, canola and sunflowers; foliar sprays of fruit, nut and coffee crops; granular, and liquid drench applications in turf, ornamentals, fruit crops and in forests; and in California the number one use of imidacloprid is for the control of structural pests.

There is conflicting information about the affects of neonicotinoids on honey bees, and different chemicals in this class are known to vary in their toxicity to bees, however the EPA identifies both imidacloprid and colthianidin as highly toxic to honey bees. For example: "Clothianidin is highly toxic to honey bees on an acute basis (LD50>0.0439 mg/bee). It has the potential for toxic chronic exposure to honey bees, as well as other non-target pollinators through the translocation of clothianidin resides in nectar and pollen. In honey bees, the affects of this toxic chronic exposure may include lethal and/or sub-lethal effects in the larvae and reproductive effects on the queen". [EPA Fact Sheet on Clothianidin]. Documented sub-lethal affects of neonicotinoids include physiological affects that impact enzyme activity leading to impairment of olfaction memory. Behavioral affects are reported on motor activity that impact navigation and orientation and feeding behavior. Additional research has found that imidacloprid impairs the memory and brain metabolism of bees, particularly the area of the brain that is used for making new memories. Decourtye et al. (2004). Recent research done on imidacloprid looked at crops where imidacloprid was used as a seed treatment. The chemical was present, by systemic uptake, in corn and sunflowers in levels high enough to pose a threat to honey bees. Bonmatin et al. (2003 and 2005). In 2002 a broad survey for pesticide residues in pollen was conducted across France.

Imidacloprid was the most frequently found insecticide and was found in 49% of the 81 samples. Chauzat et al. (2006).

In addition, there is concern about the practice of combining certain insecticides and fungicides. A North Carolina University study found that some neonicotinoids in combination with certain fungicides, synergized to increase the toxicity of the neonicotinoid to honey bees over 1,000 fold in lab studies. Iwasa et al. (2004). Both the neonicotinoids and the fungicides (Terraguard and Procure) are widely used. This synergistic effect needs to be looked at more carefully.

Below is a summary of the chemical and brand names of the commonly used neonicotinoids and their toxicities to honey bees. ***We are asking growers who are using these materials and who are dependent on honey bees for pollination, to use caution when selecting and applying these materials.*** Below are more specific recommendations for growers.

Neonicotinoids' Toxicity to honey bees

Chemical	**Brand name**	**Acute Contact**	**Acute Oral**
thiamethoxam	Actara, Platinum, Helix, Cruiser, Adage, Meridian, Centric, Flagship	Highly toxic	Highly toxic
clothianidin	Poncho, Titan, Clutch, Belay, Arena	Highly toxic	Highly toxic
imidacloprid	Confidor, Merit, Admire, Ledgend, Pravado, Encore, Goucho, Premise	Highly Toxic	Highly toxic
acetamiprid	Assail, Intruder, Adjust	Toxic	Toxic
thiacloprid	Calypso	Toxic	Toxic

Recommendations for Growers

• Know the pesticides you are using and their toxicity to bees (do not depend on third party to provide this information).

• READ the LABEL AND FOLLOW THE LABEL DIRECTIONS

• **Never** use a neonicotinoid pesticide on a blooming crop or on blooming weeds if honey bees are present.

• The use of a neonicotinoid pesticide pre-bloom, just before bees are brought onto a crop **is not recommended**. If one of these materials MUST be used pre-bloom (for example at pink in apples), select a material that has a lower toxicity to bees (acetamiprid or thiacloprid) and apply only when bees are not foraging, preferably late evening.

• Do not apply these materials post bloom (example petal fall) until after the bees have been removed from the crop.

• Blooming time varies depending on varieties. Bees pollinating one variety or crop may be at risk while another post-bloom crop or variety is being treated with insecticides. Also while crops may have completed blooming, bees may be visiting blooming weeds in and around crops. Be aware of these situations and avoid the application of pesticides on a non-blooming crop if there is risk of drift onto blooming crops and weeds if bees are present. If a spray must be applied, use the least toxic material and apply only when bees are not foraging.

• Protect water sources from contamination by pesticides. If necessary, provide a clean source of water close to colony locations prior to their arrival in the orchard or crop.

For more information on CCD visit the MAAREC website; MAAREC.org

References

EPA Fact Sheet on Clothianidin

Decourtye, A., C. Armengaud, M. Renou, J. Devillers, S. Cluzeau et al.(2004). Imidacloprid impairs memory and brain metabolism in the honeybee *(Apis mellifera L.) Pestic. Biochem. Phys* 78:83-92

Bonmatin, J. M., P. A. Marchand, R. Charvet, I. Moineau, E. R. Bengsch and M. E. Colin. 2005. Quantification of Imidacloprid Uptake in Maize Crops. *J. Agric. Food Chem*. 53, 5336-5341.

Bonmatin, J. M., I. Moineau, R. Charvet, M. E. Colin, C. Fleche, E. R. Bengsch. 2003. Fate of imidacloprid in fields and toxicity for honeybees. *Environmental Chemistry*.

Chauzat, M. P., J. P. Faucon, A. C. Martel, J. Lachaize, N. Cougoule and M. Aubert. (2006). Survey of Pesticide Residues in Pollen Loads Collected by Honey Bees in France. *J. Econ. Entomol*. 99 (2): 253-262

Iwasa, T. N. Motoyama, J. T. Ambrose and R. M. Roe. (2004). Mechanism for the differential toxicity of neonicotinoid insecticides in the honey bee, *Apis mellifera. Crop Protection* 23, 371-378