dr. bugs

BY RAYMOND A. CLOYD

Are XXpire and Altus Neonicotinoids?

***Question:** I have heard that XXpire is returning to the marketplace for use in greenhouse production systems. However, I am curious; are XXpire and Altus considered neonicotinoids?*

Raymond A. Cloyd is professor and Extension specialist in horticultural entomology/ plant protection at Kansas State University. He can be reached at rcloyd@ksu.edu.

Answer: You ask a very good question. Nonetheless, I think we need to first step back and understand some background information associated with XXpire and Altus before answering your question. XXpire (Corteva Agriscience) contains the active ingredients spinetoram and sulfoxaflor. Sulfoxaflor is a sulfoximine-based insecticide active on sucking insect pests of greenhouse production systems, including aphids, mealybugs and whiteflies. Altus (Bayer Environmental Science) contains the active ingredient flupyradifurone. Flupyradifurone is a butenolide-based insecticide active on the same sucking insect pests as sulfoxaflor.

Now let's discuss mode of action. The Insecticide Resistance Action Committee (IRAC) designates insecticides (and miticides) into specific classifications and sub-groupings based on mode of action. The current general mode of action for all IRAC 4 insecticides is as ***nicotinic acetylcholine receptor (nAChR) competitive modulators***. However, within the IRAC 4 classification there are five sub-groups: 4A, 4B, 4C, 4D and 4E. Sub-groups are different classes of insecticides that have similar modes of action but differ based on structure or interactions with proteins or receptors on the target site. The neonicotinoids (imidacloprid, dinotefuran, thiamethoxam, clothiandin and acetamiprid) are in sub-group 4A, sulfoxaflor is in sub-group 4C, and flupyradifurone is in sub-group 4D.

Therefore, XXpire and Altus are not technically considered neonicotinoids. However, the question should not be whether XXpire and Altus are neonicotinoids, but rather what are the modes of action of XXpire and Altus, and are these insecticides harmful to bees — honey bees and bumble bees?

MODE OF ACTION

Sulfoxaflor and flupyradifurone have the same mode of action as the neonicotionids by functioning as an agonist (a substance that acts like another substance in stimulating an action) on the insect nicotinic acetylcholine receptors (nAChRs) by mimicking the natural neurotransmitter. However, there may be chemical or molecular structural differences, and/or metabolic differences among the insecticides regarding biological interactions in insect pests. For instance, the chemical structural differences between sulfoxaflor and the neonicotinoids may result in distinct interactions associated with binding on the target site (nAChRs). Flupyradifurone supposedly acts differently than the neonicotinoids on the target site (nAChR), and there may be differences in the chemical structure between flupyradifurone and the neonicotinoids. However, it is interesting to note that the metabolites (products of chemical reactions that occur naturally within cells during metabolism) of flupyradifurone include 6-chloronicotinic acid, which is also a metabolic byproduct of many neonicotinoids. In general, sulfoxaflor, flupyradifurone and the neonicotinoids are active on the same target site (nAChR) in the insect central nervous system. Therefore, these insecticides should not be used successively in rotation programs to avoid cross-resistance (resistance based on a single resistance mechanism conferring resistance to pesticides in the same chemical class and/or having similar modes of action) developing in insect pest populations.

BEE TOXICITY

First of all, let's consider the label information associated with XXpire and Altus:

XXpire: this product is highly toxic to bees exposed through contact during spraying and while spray droplets are still wet. Toxicity is reduced when spray droplets are dry. This product is toxic to bees exposed to treated foliage for up to three hours following application. Do not apply this pesticide to blooming, pollen-shedding or nectar-producing parts of plants if bees are foraging on the plants during this time period. Risk to managed bees and native pollinators from contact with pesticide sprays or residues can be minimized by limiting applications to times when managed bees and native pollinators are least active — two hours prior to sunset or when the temperature is below 50° F at the site of application.

Altus: this pesticide is toxic to adult bees in laboratory studies via oral exposure; however, it is not toxic to bees through contact exposure, and field studies conducted with this product have shown no effects on honey bee colony development.

The results of studies vary regarding the direct and/or indirect (sublethal) harmful effects of sulfoxaflor on bees (honey bees and bumble bees) with some studies indicating harmful effects, such as: negatively impacting reproduction of bumble bees, whereas others suggest no harmful effects. However, in general, any harmful effects are similar to those of the neonicotionids. There are also conflicting results affiliated with studies on the direct and sublethal toxic effects of flupyradifurone on bees. Nonetheless, studies show that flupyradifurone displays similar effects on honey bees as the neonicotinoids with sublethal effects on survival and behavior.

The bottom line is that neonicotinoids, sulfoxaflor and flupyradifurone have very similar modes of action and bee toxicity. Therefore, insecticides in the IRAC sub-groups 4A, 4C and 4D should not be used successively in rotation programs and should not be applied to plants that produce flowers attractive to bees. gpn