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SOLUTIONS

# Chemically Speaking

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## Herbicide Resistance Studied

Responding to the first known report of waterhemp showing resistance to HPPD (4-hydroxyphenylpyruvate dioxygenase)-inhibiting herbicides (such as Callisto®, Impact®, and Laudis®), weed science researchers at the University of Illinois have identified two unique mechanisms in the plant that have allowed the weed to "get around" these herbicides. Dean Riechers, a U of I Professor of weed physiology, along with other collaborators at the U of I, recently published a paper describing the two distinct metabolic detoxification mechanisms that confer resistance to mesotrione and atrazine in an Illinois waterhemp population.

"Waterhemp is very diverse, which you can see in the field. There are red plants, green plants, tall, short, bushy-basically a germplasm pool. If you keep spraying the same herbicide over and over, eventually you're going to find that rare plant that can resist it," said Riechers. What the U of I researchers found of great concern in this population

was the way in which the waterhemp resisted the herbicide in much the same way that corn naturally resists HPPD-inhibiting herbicides. In the pharmaceutical industry, doctors know that you can't keep recommending the same antibiotic prescription. You might have a limited time you can use that, and then you have to use something different," Riechers said. "It mimics corn but also mimics the super bacteria that are resistant to all the antibiotics out there. Weeds are kind of like bacteria in that respect; at least this population is. Whatever active herbicide we throw on it, with the exception of glyphosate, it doesn't work anymore," he said.

The study was prompted in 2009 when a continuous seed corn grower from central Illinois realized the HPPD-inhibiting herbicides he was using were no longer killing waterhemp plants, which by then had grown into a literal mat of weeds across the field, said Riechers. "It became obvious to the grower that something was wrong, but it probably started years before that," Riechers said, adding that the grower had been planting continuous seed corn every year, using HPPD-inhibiting herbicides for at least eight years in a row. "Mesotrione and atrazine are normally two very good herbicides that are safe on corn but still kill waterhemp," Riechers said.

Working with Syngenta Crop Protection, the maker of the HPPD-inhibiting herbicide Callisto® (mestrione), the researchers first looked at herbicide target genes in the waterhemp plants, expecting to find signs of a mutation in the plant's HPPD gene sequence, expression, or in reduced herbicide absorption. They were able to establish that none of these measures were behind the resistance. Instead the researchers found that resistance was due to increased metabolism of mesotrione and atrazine-via P450 enzymes for mesotrione and GST enzymes for atrazine. The faster metabolism of the HPPD-inhibiting herbicides in waterhemp resembles the natural mechanism in corn, where the P450 enzymes confer tolerance to Callisto®.

The HPPD enzyme helps protect the plant's chlorophyll by producing protective compounds such as Vitamins A and E. The HPPD-inhibiting herbicides are systemic herbicides and will continue to move toward new tissue in the plant, eventually killing it. Older waterhemp growth in the study initially did show bleaching from Callisto®, however new emerging leaves recovered and turned green due to the increased metabolism of the herbicides. Although the 2009 report was the first to document this type of resistance, Riechers said four or five other locations in the Midwest have since reported similar occurrences. The concerning thing is that some of these fields actually did have corn and soybean rotations. "They weren't just growing corn, they were rotating, which is what you're supposed to do. But it still became HPPD resistant, and we're not sure how that happened."

The first thing growers should consider is not using the same herbicide mode of action repeatedly. For example, don't use HPPD-inhibiting herbicides alone for several years in a row because it is then easier for weeds to develop resistance. Growers could also use tillage because there's no resistance to tillage and growers have gotten away from this tool. Waterhemp has become a problem by not using tillage, using the same chemical over and over, and by not rotating crops. Riechers said that if they can find inhibitors of these herbicide metabolism pathways in waterhemp, this would be a possible way to get around resistance and still have it be safe for corn. "If it's metabolizing it, in theory we can block the metabolism and we should be able to use the herbicide again to control resistant waterhemp." (*AGprofessional.com*, 10/22/13).

## DOJ Asks Court to Toss Suit

In late November, the U.S. Department of Justice filed a motion in federal court asking a judge to dismiss a lawsuit alleging the Environmental Protection Agency has failed to follow through on upholding an environmental justice pledge. In an August 23 lawsuit against the EPA, an Oxnard family argues that ongoing pesticide monitoring set up by the California Department of Pesticide Regulation (DPR) isn't enough to protect their children from excessive exposure to pesticides. The monitoring program is the result of a settlement agreement EPA reached with DPR in a 2011 settlement, which EPA celebrated as a crowning civil rights achievement.

That settlement came about after the EPA spent a decade investigating a claim by a Pajaro mom, identified in court papers only as Angelita C., that non-white public school students faced higher pesticide exposures based on pesticide applications near their schools. The EPA's findings marked the first time ever the agency found that one of its recipients (EPA provides funding to DPR) had discriminated based on race, color or nationality. The DPR voluntarily agreed to step up its game for pesticide monitoring, without ever acknowledging wrongdoing. The August lawsuit argues those steps weren't enough, and that the original plaintiff had been unjustly excluded from the EPA's investigation and the settlement agreement drawn up between EPA and DPR.

The motion for dismissal argues it's not the responsibility of the EPA to have included Angelita C. and her family in the agency's talks. "There is no statute or regulation that requires their inclusion," the motion states. They also argue that the broader allegation in the August lawsuit that the efforts taken to redress discrimination aren't effective is untrue. The EPA also argues that the new plaintiffs don't actually have standing to sue, because their children are ages one, three, five, and six - and therefore not currently enrolled in the schools with higher-than-average pesticide applications nearby. "Plaintiffs could move. The schools could be redistricted. Pesticide application practices could change. State regulations could change," the motion states. (*Monterey County Weekly*, 11/20/13).

## E.U. Process to Hurt U.S. Exports

A new report released in November finds that more than 40% of U.S. agricultural commodity exports, including soybeans, grains, tree nuts, fruits and peanuts could be blocked by upcoming changes in the European Union (EU) Plant Protection Regulation. If the EU regulation is implemented as proposed, it could block more than $4 billion of U.S. agricultural exports to the EU, in addition to exports of crop protection active ingredients. The report, *Potential Trade Effects on U.S. Agricultural Exports of European Union Regulations on Endocrine Disruptors*, was commissioned by CropLife America.

EU Regulation 1107/2009 diverges from the U.S. Environmental Protection Agency's (EPA) regulatory approach, which uses science-based risk assessment procedures for regulating crop protection products. While scientific risk assessment is the internationally accepted practice for regulating crop protection products, the EU increasingly regulates based on hazard identification, without taking into account exposure or risk. This runs counter to the

World Trade Organization (WTO) Sanitary and Phytosanitary (SPS) Agreement to which the EU is signatory.

U.S. agricultural exports containing trace amounts of approved crop protection products will be blocked because Maximum Residue Levels (MRLs) for food and feed treated with these crop protection products will default to a near-zero level of 0.01 parts per million (ppm). This arbitrary threshold is a result of the EU regulatory requirement to categorize compounds as endocrine disrupters, which then triggers a market cut-off, or ban. Exports from the U.S. to the EU have already fallen significantly relative to other exporting countries, in large part due to existing EU SPS barriers to trade. The report estimates, based on MRLs established in the U.S., that at least 24 active crop protection products and 25 different types of agricultural commodities could be impacted by the EU regulation. The largest effects would be felt in exports of tree nuts and fruit ($1.6 billion); soybeans and peanuts ($1.5 billion); and grains ($586 million).

In the U.S., the EPA requires extensive testing on all new pesticide active ingredients in order to determine their potential impacts on human health and the environment. These tests include acute and chronic health effects, as well as reproductive and generational effects that are important to consider for endocrine disruption. The testing also addresses sensitive sub-populations including children and pregnant women. In addition, the EPA has developed a two-tiered screening program for all chemicals to identify adverse effects specific to endocrine-disrupting activity - the Endocrine Disruptor Screening Program (EDSP). Research demonstrates that there are thresholds of exposure that do not adversely impact the human endocrine system, which is complex and interacts with both natural and manmade compounds, such as soy, sunlight and stress. It is important that regulators have the ability to discern between substances that do and do not pose concern. Understanding potency and exposure enables regulators to minimize risk while still benefitting from technology. (*4-Traders.com*, 11/21/13).

## *Pesticide Registrations and Actions*

## *Food Related Actions*

- On November 19, the Florida Department of Agriculture and Consumer Services (FDACS) registered the biological nematicide *Pasteuria nishizawae* Pn1 (Clariva®) to control soybean cyst nematode in soybean. The EPA registration number for the Syngenta product is 100-1524. (FDACS PREC Agenda, 12/5/13).

- On November 12, the FDACS registered the fungicide fenpyrazamine (Protexio®) to control disease on lettuce, strawberry and other crops. The EPA registration number for the Valent U.S.A. Corp. product is 59639-179. (FDACS PREC Agenda, 12/5/13).

- Based on a request by IR-4, tolerances have been granted for residues of the herbicide fomesafen (Reflex®) in lima bean, cantaloupe, cucumber, succulent pea, soybean vegetable, summer/winter squash, and watermelon. (*Federal Register*, 11/1/13).

- Tolerances have been granted for residues of the insecticide spirotetramat (Movento®) in sweet corn kernel plus cob and persimmon. (*Federal Register*, 11/6/13).

- Based on a request by IR-4, tolerances have been granted for residues of the molluscicide metaldehyde (Meta®). Tolerances of interest to the region include blueberry, strawberry, field/sweet corn, citrus, grass forage/hay, leafy petiole vegetables (subgroup 4B), lettuce, tomato, leafy brassica vegetables (subgroup 5), and watercress. (*Federal Register*, 11/27/13).

- Based on a request by IR-4, tolerances have been granted for residues of the mosquito control insecticide etofenprox (Vectron®). Tolerances on all food/feed commodities allows the products containing etofenprox to be applied over agricultural lands when conducting vector control. (*Federal Register*, 11/27/13).

## *Other Actions*

- The Oregon Department of Agriculture (ODA) has restricted the use of two insecticides to theoretically help protect pollinators, including honeybees. The action comes after thousands of bumblebees were killed this summer with a misapplication of insecticides on European linden trees. Shortly after, the state restricted the use of 18 pesticides that contained dinotefuran while it continued investigating the bumblebee deaths in Wilsonville and Hillsboro. Beginning in 2014, Oregon will require a state-specific label on dinotefuran and imidacloprid products sold in the state that prohibits their application on linden, basswood or Tilia species. Apparently, the trees' natural toxicity combined with the pesticide contributed to the bumblebee deaths. Applicators testing for their license or seeking re-certification will receive additional education on pollinator protection. The ODA director Katy Coba also has sent a letter to the Environmental Protection Agency requesting additional evaluations of these active ingredients as well as other neonicotinoids. She also questioned whether use limitations on a national basis should be considered. (*AGprofessional.com*, 11/25/13).

- BASF has said it filed legal action with the General Court of the European Union challenging the EU Commission's decision to restrict major seed treatment uses of the insecticide fipronil in the EU. The company said it remains convinced that the decline of the bee population is caused by multiple and complex factors and that the ban of fipronil uses will not contribute to protecting bees. BASF said it believes the EU Commission's decision to restrict specific fipronil uses is the result of a disproportionate application of the precautionary principle. The Commission voted to restrict European farmers from using fipronil on maize and sunflower from Dec. 31, 2013, while treated seeds can be sown up until Feb. 28, 2014. The ban follows a scientific risk assessment carried out by the EU's Food Safety Authority published in May. It concluded that fipronil "poses a high acute risk" to Europe's honey bee population when used as a seed treatment for maize. (*Farm Chemicals International*, 11/7/13).

## Pesticide Potpourri

- Research carried out at Victoria University of Wellington (NZ) shows that exposure to some commonly used pesticides makes an invasive ant species more aggressive and more likely to survive conflict with a native ant species. At the same time, the native species becomes less aggressive after being exposed to the pesticide. Led by PhD student Rafael Barbieri, Professor Phil Lester and Associate Professor Ken Ryan from Victoria University's School of Biological Science, the research is the first in the world to demonstrate the impact that neonicotinoid pesticides can have on dynamics in insect communities and invasion success. Neonicotinoids are the world's most widely deployed insecticides. The compounds are often applied to seeds and spreads throughout the plant as it grows, affecting insects that eat it. The study examined the invasive Argentine ant, which is widely established in New Zealand, and the native Southern ant. The two species have similar habitat and food preferences. "The Argentine ant is already known as an extremely aggressive invader, all around the world," says Professor Lester. "Here you have the Ghengis Khan of the ant world becoming even more aggressive after exposure to these pesticides." The success of such invasive species is often linked to their highly aggressive behavior and to their ability to displace native communities and manipulate food sources. The level of increased aggression displayed by the Argentine ants as they faced off over food supply with their native competitors was significant. The native ant was clearly less able to hold its own when the area was treated with sub-lethal amounts of the pesticide. (*VOXY.co.nz*, 10/23/13).

- Researchers have found a common aquatic bioindicator, *Hyalella azteca*, used to test the toxicity of water or sediments has become resistant to pyrethroid insecticides used in agricultural areas of central California. The *Hyalella* amphipods are aquatic crustaceans commonly used by scientists and agencies as an indicator species of a healthy, unpolluted environment. The study documented the specific genetic changes that allow the amphipods to survive at 500-times the normal lethal dose of the pesticide. The results have far-reaching implications for biomonitoring programs that rely on H. *azteca* as a bioindicator. The species may prove to be an unreliable indicator in agricultural states where biomonitoring programs use it as a principal species for monitoring and environmental policy decisions. The evolution of H. *azteca* in the study occurred when the species mutated and adapted to the widely used pyrethroid insecticides - a principle known as adaptive evolution. (*EurekAlert*, 10/29/13).

- The California Department of Pesticide Regulation released its 2012 pesticide residue report that shows the bulk of items tested had no detectable pesticide residues. Of the 3,501 samples collected at farmers markets, wholesale and retail outlets, and distribution centers, 58% had no residues, according to the report. The samples included both domestically grown and imported produce. An additional 39% of samples were within the legal tolerance

levels, and 3% had illegal residues of pesticides not approved for use on that commodity. Less than 1% of samples had pesticide residues that exceeded established tolerances. Overall, 98% of all California-grown produce sampled by the department had pesticide residues within the legal limits. Most of the samples with illegal residues were from other countries and contained very low levels. In 2012, scientists most frequently found illegal residues on yardlong beans, limes, tomatillos and chili peppers from Mexico; snow peas from Guatemala; ginger from China and the United States; and spinach from the United States, according to the report. (*The Grower*, 11/13/13).

- In France, a biodynamic winemaker in Beaune has been threatened with a €30,000 fine and six months in prison for not treating his vines against the flavesence dorée disease. The DRAAF-SRAL (an arm of the Agricultural Ministry that has enforcing powers) is prosecuting the farmer for not following the Cote d'Or-wide directive to systematically treat vines against the leaf hopping insect known as *Scaphoideus titanus*. The insect is thought to be behind the infectious disease flavesence dorée that has affected vineyards across France, and has been present in Burgundy since 2011. The grower was served with a notification to appear before the Dijon Tribunal on November 10, for 'failure to apply an insecticide treatment to his vineyard between July 5-10 2013, and for an unspecified time since, to prevent the installation of flavesence dorée vine disease. (*Decanter.com*, 11/25/13).

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