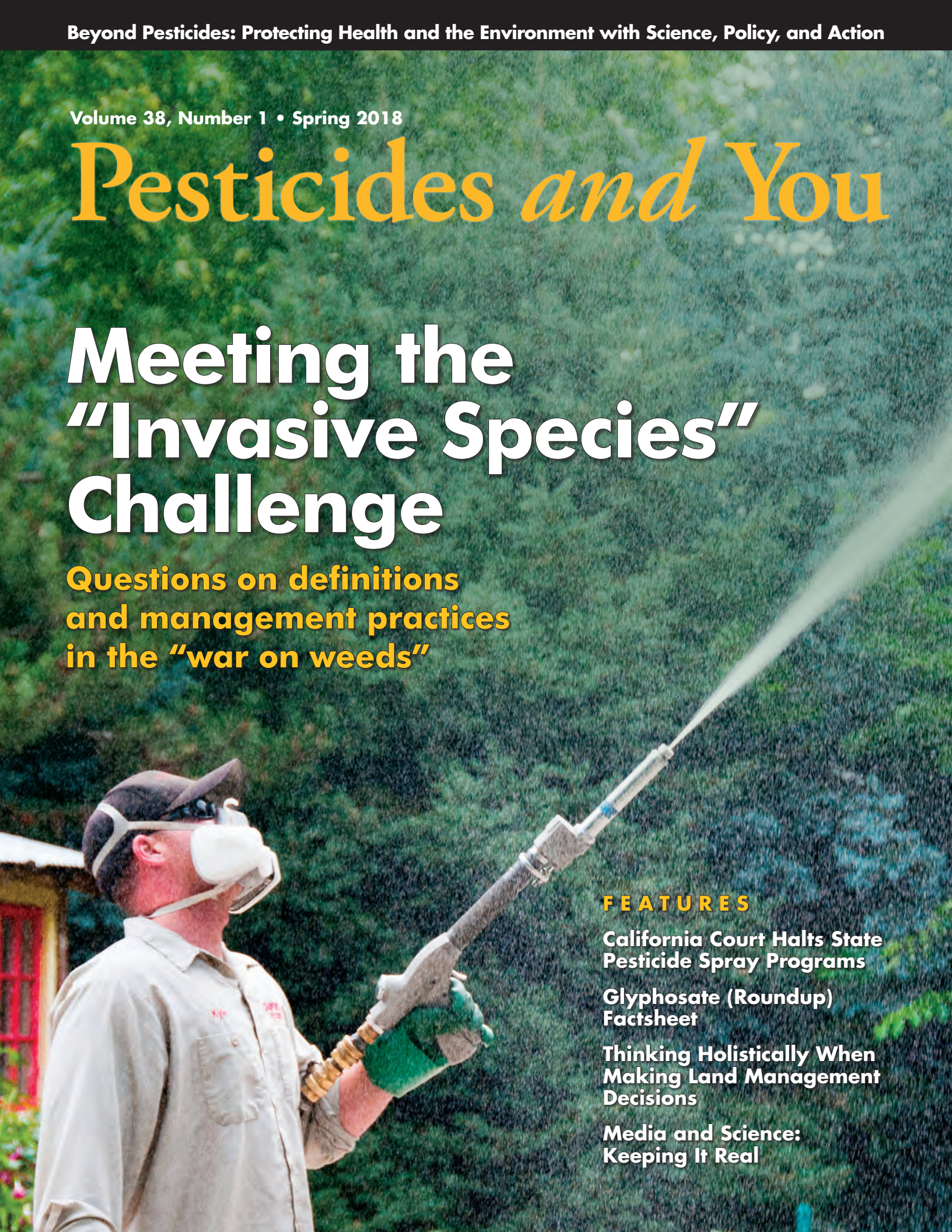
Beyond Pesticides: Protecting Health and the Environment with Science, Policy, and Action

Volume 38, Number 1 • Spring 2018

Pesticides *and* You

Meeting the "Invasive Species" Challenge

Questions on definitions and management practices in the "war on weeds"



FEATURES

Defining and Managing Invasives in an Ecological Context

This year's 36th National Pesticides Forum, *Organic Neighborhoods: For healthy children, families, and ecology*, reaffirms the value of bringing people together to share the latest science, policies, and practices to protect our communities from toxic pesticide use. We take a positive approach in showcasing the opportunities to adopt organic practices that eliminate the need for toxic chemicals. Change is emanating from communities and businesses across the country because federal and, too often, state governments are not functioning as they should for the common good.

Pesticide Use in the Name of Invasives

There are many factors that drive pesticide use and pesticide dependency. One that stands out is the stated need to kill, control, or manage invasive species. This issue of *Pesticides and You* explores an ecological approach to the management of unwanted species in the context of biological systems that are integral to sustaining life.

While the most common definition of invasive includes the term "non-native" accompanied by concepts of harm to the environment, natural habitat, human health, and the economy, the "invasives" are not typically defined in the context of intact or healthy ecosystems. So, a non-native species emerges on the landscape, is aggressive because it is filling a niche (an area that is stressed or vulnerable to infestation), and it begins to take over.

The scenario is common and viewed as justification for pesticide use that would otherwise be deemed unacceptable by public health and environmental standards. Therefore, we see the fever pitched response to invasives at the federal level with the issuance of Executive Order 13112 in February, 1999 —requiring executive departments and agencies "to take steps to prevent the introduction and spread of invasive species, and to support efforts to eradicate and control invasive species that are established" under the direction of the National Invasive Species Council. The Council was set up to oversee implementation of the order and encourage proactive planning and action to "improve the Federal response to invasive species." Under the federal *Plant Protection Act*, USDA's Animal and Plant Health Inspection Service (APHIS) is authorized to "take both emergency and extraordinary emergency actions to address incursions of noxious [invasive] weeds." This has translated to heavy pesticide use.

The list of invasive species is very long. It can be found on the USDA National Invasive Species Information Center's webpage. Species from these lists have been incorporated into state laws requiring landowners to take action to control them. Local governments often exempt invasives from ordinances restricting pesticides in parks and on playing fields. Government funds are available for weed management entities to carry out eradication efforts. In this issue, we discuss an approach to invasives, starting with a clear definition of the problem, evaluation of the conditions that give rise to the problem, and a strategy to address the underlying causes.

Court Stops CA Invasive Spray Program

We write about a landmark court decision in California, which recently found that the state has not performed adequate reviews of pesticides used to kill invasives under the *California Environmental Quality Act* (CEQA). The court shut down the aggressive spray program in the state until it conducts adequate reviews of the health impacts and possible alternative strategies. We include our factsheet on the most widely used herbicide, Monsanto's Roundup (glyphosate), in the campaign to kill invasives because of the danger it poses.

Real Organic

As the adverse effects of pesticides mount and organic alternatives take hold, USDA and members of Congress are attacking organic and the underlying standards that have supported exponential growth of organic agricultural production. The governing principles and values integral to the federal *Organic Foods Production Act* are in need of protection. It is critical that the farmer and consumer base that has driven organic vociferously protects the foundation of organic integrity. To that end, we have joined the standards board of The Real Organic Project, a collaboration that brings together the organic community to define those standards that are not being upheld by USDA, but are adopted by farmers who will display an add-on label on their certified organic products. This real organic label, which will roll out over the next year, will enable consumers to identify those products that truly meet the standards of the organic law, such as growing food in biologically active regenerative soil as opposed to a hydroponic water solution. Through this process, consumers and farmers together are embracing organic as it is intended to be by law, advancing organic market growth.

There is reason for optimism when groups of dedicated people join together to protect health and the environment. This is happening in communities nationwide and will continue in the marketplace, as people define the standards and practices that protect life.

Jay Feldman, executive director of Beyond Pesticides

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Pesticides and You © 2018 (ISSN 0896-7253) is published four times a year by Beyond Pesticides. Beyond Pesticides, founded in 1981, is a voice for health and the environment, promoting protection from pesticides and safe alternatives; donations are tax-deductible.

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Cover photo:
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Healthy Tree Care

Beyond Pesticides,

I see that there's been a lot of activity around eliminating pesticide use on lawns and landscapes, but, of course, landscapes are more than turf. And I do understand the ways that I can manage my lawn organically, but what do I do with the trees in my yard? Are there preventive practices I can do for them to make sure that I don't need to use pesticides on them? Thanks in advance.

George, Bend, OR

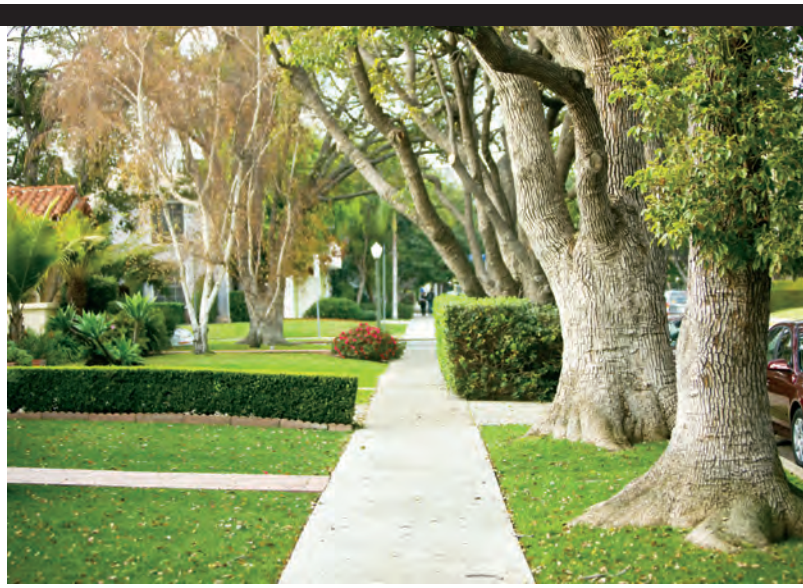
Hi George,

Fortunately, many of the same soil building practices important to a healthy lawn care program are equally applicable to tree care. We have put together some steps below that you can follow to maintain your trees with organic practices, including some options if you do experience pest outbreaks.

1. **Keep a healthy organic lawn.**
   Trees planted in a yard with a healthy organic lawn likely will not need much fertilization, as they will receive the nutrients they need from healthy soils developed with organic lawn care practices. Soil tests that evaluate soil chemistry and soil biology should guide whether your soil is deficient in any particular nutrients or organisms, which, when corrected, will improve the health of all plants in the landscape.

2. **Keep an eye on your trees' well-being.**
   Your trees likely need soil amendments if you observe any of the following: i) little growth despite rainfall; ii) yellowish leaves in midsummer; iii) gradually smaller leaves each year; or iv) leaves turn their fall colors and drop in late summer (August or early September). Also watch for any signs of pest infestation or disease, which can come in many forms. Typical signs include rapid and significant defoliation, widespread leaf browning, wilting, or dieback.

3. **If necessary, use natural organic fertilizers in the short-term.**
   The simplest way to fertilize is by broadcast spreading of an appropriate organic fertilizer (most organic tree fertilizers, such as Espoma Tree Tone or Down to Earth Tree & Shrub Mix, will provide application recommendations on the package) at the drip line of the tree (the outer circumference around the tree where the limbs end and water drips to the ground). Fertilizer can also be applied by digging or using an auger to create small, roughly 12– to18–inch deep holes every couple feet around the drip line, and adding fertilizer to those holes. A good time to apply fertilizer is in early spring just before trees begin their growth period. The goal, however, is to feed the soil, not the plant (or tree). So, building the soil biology with beneficial bacteria, fungi, and other organisms is key to long-term health.



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4. **Prune for health.**
   Pruning can be done for a variety of reasons – to manage health, improve safety, maintain a tree's form, or stimulate growth. Dead and damaged branches should be a chief priority, and pruning should be done from the bottom up. Generally, no more than 15% of a tree should be cut at any one time. That being said, if you are uncomfortable with the prospect of pruning your trees, reach out to local tree care experts to help.

5. **Manage pest and disease problems without toxic pesticides.**
   Pest and disease problems should not be a frequent issue when the other factors above are in place to promote tree health. While conventional solutions employ chemical insecticides or fungicides, there are organic and least-toxic alternatives available when problems do arise. Naturally derived neem oil and organic approved horticultural oils are all-purpose sprays that are effective against a range of insects and diseases, including scales, aphids, whiteflies, mildews, leaf spots, and rusts. Insecticidal soaps can kill a range of sucking and chewing insects by smothering and suffocating them, and biologicals, such as *Bacillus thuringiensis*, can help address caterpillars, hornworms, and loopers.

SHARE WITH US!

Beyond Pesticides welcomes your questions, comments, or concerns. Have something you'd like to share or ask us? We'd like to know! If we think something might be particularly useful for others, we will print your comments in this section. Mail will be edited for length and clarity, and we will not publish your contact information. There are many ways you can contact us: Send us an email at *info@beyondpesticides.org*, give us a call at 202-543-5450, or simply send questions and comments to: 701 E Street SE, Washington, DC 20003.

Insect Resistance to Pesticides

Beyond Pesticides,

There's a lot of information out there about weeds becoming resistant to herbicides with genetically engineered crops, but not much about resistance in the insecticide-incorporated plants. Isn't that also an issue?

Duane, Bloomington, IL

Hi Duane,

It is absolutely a growing concern. Insecticide-incorporated genetically engineered (GE) corn is infused with a toxin that is derived from the biological insecticide *Bacillus thuringiensis* (Bt). Bt is a naturally occurring soil microbe that the U.S. Environmental Protection Agency (EPA) has generally considered to be among the safer biological pesticides. When used in its naturally occurring form, it can play an important part in responsible pest management practices, including an organic systems approach. However, when incorporated into crops and used prophylactically and indiscriminately, it creates a host of issues that lead to insect resistance, undermining the responsible use of this least-toxic pesticide in the field, particularly for organic farmers. Though reports of insect resistance in Bt corn have been observed since the late 2000s, in 2013, EPA officially announced that "corn rootworm may not be completely controlled by Cry3Bb1 [an incorporated Bt insecticide] in certain parts of the Corn Belt."

Many in the GE industry tout increased refuges (i.e. certain sections planted without GE crops) as the solution to corn rootworm resistance. However the industry's own reporting shows that nearly 41% of their farmers are not employing this "best management practice." While industry places the blame on farmers and attempts to impose control and tight restrictions for "non-compliance," the point remains that the idea of refuges runs contrary to agricultural practices in GE crops. As opposed to organic farming, which requires that growers foster soil fertility, in practice, GE growers ignore these ecological concerns, instead focusing on maintaining sterile landscapes free from any life but the intended crop. Any refuge area will be highly susceptible to crop loss, jeopardizing the yields of GE farmers.

The GE industry claims that "stacking" different forms of the Bt toxin within the same plant will fix the issue. However, researchers have recently called this practice into question. A 2013 study published in *Proceedings of the National Academy of Sciences* shined light on the industry's inaccurate assumption that, if a pest is resistant to one Bt toxin, then another slightly different Bt toxin will kill it. Researchers find that things are a bit more complicated in the field. Yves Carrière, PhD, lead author of the study explains, "[O]n the two-toxin plants, the caterpillars selected for resistance to one toxin survived significantly better than caterpillars from a susceptible strain." As indicated by the study, once an insect has developed a resistance to one form of Bt, the likelihood increases that it will rapidly develop a cross-resistance to new forms of the toxin.

The issue of resistance is one of common sense. Whether in herbicide-tolerant or insecticide incorporated GE crops, broadscale and repeated use of a pesticide sets in motion the factors that drive the evolution of resistance in the target pest. Those that are not killed by the pesticide pass down the genes that allowed them to survive, perpetuating a toxic cycle. First, attempts are made to use more of a pesticide, but eventually, when that tactic predictably fails, newer, more toxic pesticides are employed. With insecticide-incorporated crops, this is represented by Bt "stacking," though other hazardous technologies, such as RNA interference (RNAi), which attempts to target and turn off specific genes in a pest, are on the horizon. In herbicide-tolerant crops, given the failure of glyphosate, the pesticide industry is incorporating older, more toxic herbicides like dicamba and 2,4-D.

Given ongoing and ever-expanding resistance in target pests, it is little wonder that studies raise questions about farmers' economic benefit from planting Bt corn and herbicide-tolerant crops.

FROM THE WEB

Beyond Pesticides' Daily News Blog features a post each weekday on the health and environmental hazards of pesticides, pesticide regulation and policy, pesticide alternatives and cutting-edge science, www.beyondpesticides.org/dailynewsblog. Want to get in on the conversation? "Like" us on Facebook, www.facebook.com/beyondpesticides, or send us a "tweet" on Twitter, @bpncamp!

Excerpt from Beyond Pesticides Action of the Week (2/12/2018): Take Action! Tell EPA to Ban Paraquat. The most recent findings on the development of Parkinson's disease after exposure to highly toxic paraquat add to the well-established body of scientific literature linking the herbicide to Parkinson's—which should lead to finally eliminating the use of the herbicide in the U.S.

Nan Willetts comments via Facebook: My father, a farmer, died from the complications of Parkinson's disease. Prior to that, no one in our long ancestry of farmers had ever had the disease. I recall watching him mixing chemicals into the sprayers before heading out to the fields. If he had known then how toxic they were, I'm sure he would never have used them. In my opinion, independent long-term studies need to be conducted before any chemical (or drug) is approved by USDA, FDA, or EPA. Instead, they seem to be kowtowing to big chem/ag and pharma corporations without consideration of the welfare of workers, consumers, and the environment.

Amazon and Syngenta Break Pesticide Law, Get Slap on the Wrist

Violations of pesticide law result in a slap on the wrist for giant corporations Amazon and Syngenta. As part of an agreement with EPA, Amazon will pay $1.2 million in administrative penalties for nearly 4,000 violations of the *Federal Insecticide, Fungicide and Rodenticide Act* (FIFRA), including allowing third-party distributors to sell imported pesticide products on Amazon even though the products were not registered in the U.S. Meanwhile, Syngenta will pay a civil penalty of $150,000 after dozens of workers in Kauai, Hawaii were exposed to the neurotoxic pesticide chlorpyrifos in 2016 and 2017. EPA backed away from a $4.8 million settlement that it was initially seeking from the pesticide giant, which is merging with China's state-owned ChemChina to become one of the world's largest pesticide manufacturers.

Farmworkers in Hawaii.

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Amazon Sells Illegal Pesticides

Of greatest concern, among Amazon's sale of illegal pesticide products, are insecticide chalk products imported from Chinese manufacturers. These products contain false and misleading statements of safety on their labels and contain active ingredients, such as pyrethroids, propoxur, and azamethiphos. Azamethiphos is not registered in the U.S. and propoxur has limited uses. The chalk, used by drawing a pesticide-laden barrier on a surface, is often packaged in bright colors that make the product look like sidewalk chalk, toys, or even candy.

According to EPA officials, because of the enormous shift from brick-and-mortar retailers to online commerce, "This is a very difficult avenue of pesticide sales to get our hands around," said Chad Schulze, EPA Region 10 Pesticide Enforcement Team Lead. Amazon said it will develop an online training course about pesticide regulations and policies in an effort to reduce the number of illegal pesticides available through the online marketplace. The training, which will be mandatory for all entities planning to sell pesticides on Amazon, will be available to the public and online marketers in English, Spanish, and Chinese.

Last year, EPA's Office of the Inspector General (OIG) released a report finding low rates of inspection and sampling across the U.S. to stop the importation of pesticide products that violate federal laws. With inspection guidelines being voluntary and set at only two percent of shipments—which is still not being met—advocates say that pesticide products will continue to be sold illegally to unsuspecting U.S. customers. These pesticides may

Saving America's Pollinators Act

On February 14, 2018, U.S. Representatives Earl Blumenauer (D-OR) and Jim McGovern (D-MA) re-introduced the *Saving America's Pollinators Act* (H.R. 5015), which suspends the registration of certain neonicotinoid insecticides until the U.S. Environmental Protection Agency (EPA) conducts a full scientific review that ensures these chemicals do not harm pollinators. As of this writing, 42 members have joined as cosponsors.

Numerous scientific studies implicate neonicotinoid pesticides as key contributors to the global decline of pollinator populations. In addition, EPA's own scientists have found that neonicotinoids pose far-reaching risks to birds and aquatic invertebrates.

"The health of our food system depends on the health of our pollinators. The status quo is like flying blind—we shouldn't be using these pesticides when we don't know their full impact," said Rep. Blumenauer. "The EPA has a responsibility to get to the bottom of this issue and protect pollinators," he said. Europe has instituted a temporary ban on neonicotinoids based on their harm to pollinators, and the European Commission has proposed extending the ban indefinitely and eliminating all agricultural uses of the chemicals. Canada's pesticide regulatory agency has recommended banning the most widely used neonicotinoid, imidacloprid, based on harm to aquatic ecosystems.

contain ingredients banned in the U.S. or be applied in ways that can pose risks to human health.

In March 2017, over 30 environmental and public health groups, joined by several environmentally responsible businesses, sent a letter to Amazon CEO Jeff Bezos, urging him to remove from the retailer's website products linked to pollinator decline. The letter to Amazon was accompanied by a product list identifying over 100 products sold on Amazon's website that contain bee-toxic neonicotinoid pesticides.

Syngenta Poisons Workers

Nineteen workers were exposed to chlorpyrifos after Syngenta sprayed the insecticide on a field of genetically engineered (GE) corn at its Kekaha farm. According to the complaint, the workers were allowed to reenter the field before the reentry period expired and without protective equipment. Ten workers were taken to the hospital and three were held overnight. This incident occurred in 2016, however a second incident occurred in 2017 when Syngenta, after applying chlorpyrifos, failed to post warnings for worker crews containing 42 employees. At the time of the incident, an inspector from the Hawaii Department of Agriculture (HDOA) was present on the Syngenta farm, which triggered an immediate investigation from the state. Consequently, a civil administrative enforcement action was brought against Syngenta seeking $4.8 million for violating multiple federal statutes, including worker protection standards affecting as many as 77 workers and leading to the 388-count complaint—with maximum penalties as high as $19,000 per violation.

Alexis Strauss, acting regional administrator for EPA region 9, acknowledged that the settlement was far less than the maximum allowed under the *Federal Insecticide, Fungicide, and Rodenticide Act* (FIFRA) and its regulations designed to protect workers. In addition, EPA found that Syngenta failed to provide both adequate decontamination supplies on-site and prompt transportation to a medical facility for exposed workers.

EPA Administrator Scott Pruitt has made it clear he intends to severely limit the agency's regulation and enforcement. One of his first acts in office was to rescind the proposal to ban the insecticide chlorpyrifos in agriculture.

Trump Administration Set to Slash EPA Staff in Half

EPA scientists, public health managers, and others charged with protecting the health of the public and the environment are being encouraged to exit the agency. This, as EPA Administrator Scott Pruitt plans to meet his goal of cutting agency staff and programs by 50 percent. According to the *Washington Examiner*, by early 2021, Mr. Pruitt and his team are aiming to reduce the staff of what was nearly 15,000 to below 8,000. Among the people who are being encouraged to "retire" are more than 200 scientists and nearly 100 environmental protection specialists.

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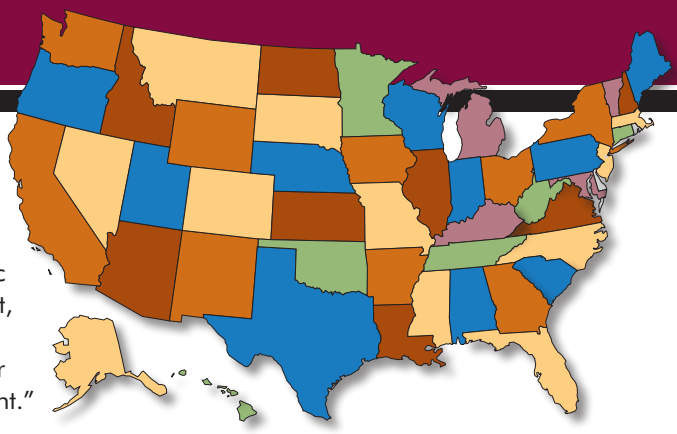
Younger Farmworker Children To Apply Toxic Pesticides

In two related actions, EPA is proposing to remove age requirements for application of pesticides by farmworkers. The actions involve changes to the Agricultural Worker Protection Standard (WPS) which went into effect this January and covers farmworkers hired to apply pesticides, and the Certification of Applicators (CA) rule, which will go into effect May 22 and covers those allowed to apply restricted use pesticides (RUPs), the most acutely toxic pesticides. The proposals to remove the age requirements present hazards to teenagers, who "are still developing in critical physical and emotional areas, with particular regard to their brains and reproductive systems," according to the American Academy of Pediatrics (AAP).

The removal of the age requirement is opposed by farmworker and children's health advocates. AAP points out that dangers of pesticide exposures to teens include long-term damage to nervous and reproductive systems. It also points out that 16- to17-year-old workers in other industries are prohibited from working with hazardous chemicals.

At a U.S. Senate oversight hearing in January, U.S. Senator Cory Booker (D-NJ) blasted EPA Administrator Scott Pruitt for his lack of concern for environmental justice issues. In particular, Sen. Booker noted the proposal to drop the minimum age requirement for agricultural workers who can use pesticides. Many of these workers, Sen. Booker noted, come from "communities of color, indigenous communities, and low income communities." When Sen. Booker asked, "Do you think that children handling dangerous pesticides is a good idea?," Mr. Pruitt did not respond.



Dover, NH Passes Organic Land Care Ordinance Unanimously

The City of Dover, NH in February unanimously adopted an ordinance that requires that its property is managed with organic practices. Spearheaded by the grassroots organization Non Toxic Dover, NH, the resolution requires the management of city land with "sound land management practices, and the use of least toxic compounds only when necessary, . . . thereby eliminating exposure to toxic pesticides on the part of our citizens and the environment." The ordinance also instructs the city manager to "develop and execute a plan to transition the City to eliminate the use of synthetic fertilizers on City property."

The resolution states: "There are numerous resources that tabulate lists of least toxic products, (e.g., the United States Environmental Protection Agency's minimum risk products list or materials listed as organic by non-profit organizations such as the Organic Materials Review Institute) to facilitate the choice of materials. Organic land management is an effective and environmentally sensitive approach to pest and turf management that relies on a combination of common-sense best management practices without the use of toxic pesticides. Organic land management uses current, comprehensive information on the life cycles of pests and their interaction with the environment."

Assessment Finds Alternatives Negate Any Need to Use Bee-Toxic Neonicotinoids

A comprehensive review of notorious, bee-killing neonicotinoid insecticides finds that crop yields and on-farm profit can be maintained and improved by replacing these toxic chemicals with alternative pest management strategies. The new study is part of an ongoing update to the 2014 Worldwide Integrated Assessment undertaken by an international team of scientists called the Task Force on Systemic Pesticides. The results of this review point to the need for strong action against these chemicals by all levels of government.

"Regulators need to realize that if we want sustainable agricultural practices, we need a more restrictive regulatory framework and programs to support farmers making the switch," said Jean-Marc Bonmatin, PhD, Task Force co-chair and scientist at France's National Scientific Research Centre. "Our findings on the availability of alternatives will be particularly relevant where new restrictions on neonics are being considered," he said.

The Task Force reviewed 200 studies on systemic insecticides, looking at their use and pest resistance in annual and perennial crops, the viability of alternative pest management techniques, and the potential to implement alternative forms of crop insurance to cover risks.

Soybean plants damaged by herbicide.

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Monsanto Loses Lawsuit to Stop Dicamba Ban in Arkansas

Monsanto has lost its bid to halt a statewide ban on the use of its specialty herbicide dicamba in Arkansas. Arkansas' Plant Board conducted a lengthy process of evaluation and public comment that led to a prohibition on the use of drift-prone dicamba herbicide during the upcoming growing season on Arkansas farms. The state is on track to implement the toughest U.S. restrictions of dicamba, redeveloped to be used in genetically engineered herbicide-tolerant crops that have become resistant to glyphosate.

Monsanto's lawsuit argued against the makeup of the state's Plant Board, which voted to prohibit the company's product last November. Monsanto also made claims that the state did not consider the economic damage that a ban of the herbicide would cause.

Beyond Pesticides led a nationwide campaign supporting the ban. Dicamba

was originally registered for use in 1967 to control broadleaf weeds. Monsanto (with its XTEND herbicide), as well as the companies BASF (Engenia herbicide) and DowDupont (FeXapan herbicide) claim that their new formulations do not volatilize or drift.

Herbicide Paraquat Again Linked to Parkinson's Symptoms in Brain

Scientists at the European Institute for the Biology of Aging have found new information on the development of Parkinson's disease resulting from exposure to the herbicide paraquat, as they seek to find ways to prevent the progression of the disease. Despite a well-established body of scientific literature linking paraquat to Parkinson's, and a ban on the use of the chemical in the European Union that dates back to 2007, its use is still permitted in the U.S. Many health groups, including Beyond Pesticides and organizations like the Michael J Fox Foundation, are calling on EPA to stop the use of paraquat by denying its upcoming reregistration.

Published in the journal *Cell Reports*, this new research on Parkinson's investigates the impact of "senescent" cells in the body. Senescent cells are those which, despite being able to divide, stop doing so in response to stress. This is an anti-cancer mechanism, as stress would otherwise cause the cells to multiply unchecked and create malignancies. Researchers suspect that despite the benefit of stopping cancer, senescent cells may be causing other problems in the body. Rather than dying, these cells can cause inflammation in the area around where the cell became senescent. While paraquat has long been associated with the direct death of these neurons, this new research shows that additional neurological impacts may be at play.

This complex study provides a route to potentially treat not only Parkinson's but other diseases where senescent cells may play a role, such as ALS (amyotrophic lateral sclerosis) and Alzheimer's. Future research will need to uncover how to isolate and remove specific senescent cells while not disturbing others, which may be valuable in other areas, such as healing wounds. "We know the cells we want to target, but at the moment we don't have the therapeutics to do that," said. Demaria, PhD to *The Guardian*. "We cannot yet only target the bad cells."

Whistling Straits Golf Course in Kohler, WI features two miles of Lake Michigan shoreline vulnerable to pesticide runoff.

© Alamy Stock Photo/Donna Tabbert Long

States Join Monsanto Challenge of California's Cancer Warning for Glyphosate

Attorneys General in Idaho, Indiana, Iowa, Kansas, Louisiana, Michigan, Missouri, North Dakota, Oklahoma, South Dakota and Wisconsin joined Monsanto and the National Wheat Growers Association in January to challenge California's listing of glyphosate as a carcinogen under the state's Proposition 65 law. California added glyphosate to the list of cancer-causing chemicals in July 2017, but has since been attacked by Monsanto and its allies for carrying out state law that requires carcinogens to be labeled and monitored. The case, seeking a stay of the listing, was filed in Federal Court in the Eastern District of California in November, 2017. Earlier last year, Monsanto lost its case before a state Superior Court in which it sought to stay the Prop 65 listing.

Neonicotinoid Insecticides Threaten Aquatic Life in Great Lakes

New U.S. Geological Survey (USGS) data reveals the year-round presence of neonicotinoids (neonics) in the Great Lakes—the world's largest freshwater ecosystem. Neonics, which are highly toxic to aquatic organisms and pollinators, are prevalent in the tributaries of the Great Lakes, with concentrations and detections increasing during planting season. This data adds to the science supporting a federal ban of these insecticides in order to safeguard vulnerable aquatic ecosystems and pollinators.

The study, *Year-round presence of neonicotinoid insecticides in tributaries to the Great Lakes, USA*, sampled ten major tributaries to the Great Lakes from October 2015 to September 2016. Neonicotinoids were detected in every month sampled. Imidacloprid detections significantly increase as the percent of urbanization increases, where home gardeners and golf courses use neonicotinoid turf and garden products.

Flower strips attract insects that prey on pests.

Matthias Tschumi/Agroscope

Prior to the study, little was known about the chemicals' presence in the Great Lakes region. Michelle Hladik, PhD, lead author of the new study and a research chemist at the USGS, said the major risk of these chemicals is to aquatic insects—an effect that could ripple up the food chain. "If these pesticides are affecting aquatic insects, causing lower populations, it could affect the food chain by removing a food source" for fish, Dr. Hladik said.

Neonicotinoids are the most widely used insecticides in the U.S. and have been linked to neurological and immune system impairment in honey bees and other pollinator declines. In December, EPA released preliminary ecological (non-pollinator) assessments for the neonicotinoids clothianidin, thiamethoxam, dinotefuran and the terrestrial ecological assessment for imidacloprid, finding that these pesticides pose both acute and chronic risks to aquatic life and birds. The aquatic assessment for imidacloprid, released last year, finds that it threatens the health of U.S. waterways with significant risks to aquatic insects and cascading effects on aquatic food webs.

Pesticide Exposure and Poor Nutrition: A One-Two Knockout Punch for Pollinators

Poor nutrition coupled with exposure to neonicotinoids act synergistically to significantly reduce the survival of honey bees and their colonies, according to research published by scientists at the University of California, San Diego (UCSD). This is the first study to delve into the real-world effects that pesticide exposure has on honey bees also subject to nutritional stress, a common occurrence in the wild. The outcome of this research highlights the weaknesses of EPA's testing regime for registering pesticides, which does not account for the complex ecology surrounding catastrophic declines in honey bee and other wild pollinator populations.

UCSD scientists looked at two of the most popular neonicotinoids, chlothianidin and thiamethoxam, to investigate how realistic levels of exposure to the chemicals interacted with varying levels of available food. High and low levels of both chemicals, 1/5 and 1/25 of the LD50 (amount at which 50% of honey bees exposed would die), were added to sugar syrup solution containing a range of different nutrition levels. Sugar syrup, which mimics nectar and honey, is a critical source of carbohydrates for honey bees.

Lead author of the study, Simone Tosi, PhD, notes, "Our results provide the first demonstration that these stressors can synergistically interact and cause significant harm to animal survival."

"These findings should cause us to rethink our current pesticide risk assessment procedures, which, based upon our findings, may underestimate the toxic effects of pesticides on bees," said Dr. Tosi. Co-author James Nieh, PhD, indicates that this research "may have even broader implications beyond honey bees because prior studies have not demonstrated a negative synergistic effect of pesticides and poor nutrition in animals."

Intermediary Strips of Wildflowers Across Fields Reduce Pesticide Use

New trials are being launched in the United Kingdom (UK) to monitor fields that have long strips of wildflowers planted through croplands to boost natural predators and potentially reduce pesticide applications. The field trials, carried out by the Centre for Ecology and Hydrology (CEH), are being conducted on 15 large arable farms in central and eastern England and will be monitored for five years to determine whether in-field strips are feasible tools for practitioners wishing to enhance biological pest control in the field.

Resources provided by in-field strips and normal field margins benefit the greatest diversity of important predators. According to Ben Woodcock, PhD, ecological entomologist at CEH, sowing specific grasses and wildflowers in the field can support predators in the crop canopy or those that target internal pests living in stems or seed pods. Many parasitic wasps, for instance, need access to open flowers so that they can feed on pollen and nectar. Without this resource, the number of eggs they can lay is dramatically reduced.

Similar field trials are underway in other parts of Europe where flowers, such as cornflowers, coriander, buckwheat, poppy and dill, are planted in strips. According to reports, densities of leaf beetle pests in fields of winter wheat were 40 to 53% lower than when no flower strips were sowed. This low pest pressure resulted in a 61% reduction in damage to the wheat plants.

Flower strips are also designed to provide early season pollen and nectar resources for important crop pollinators, such as bumblebees and solitary bees. In this respect, they provide dual benefits—enhanced natural pest control and crop pollination.

Meeting the "Invasive Species" Challenge

Questions on definitions and management practices in the "war on weeds"

Spraying in Cowlitz County, Washington.

TERRY SHISTAR, PhD AND JAY FELDMAN

"Invasive species" are frequently given as the reason for dispersing toxic pesticides in the environment. This claim to virtue—the assertion of an environmental benefit to justify the use of toxic pesticides—typically comes with a sense of urgency and indisputable benefit. While an "invasive" species problem may not be fully defined or understood, the short-term pesticide solution too often creates greater ecological imbalance and impedes the adoption of a plan that offers sustained benefits, and protects human health and the environment.

DEFINITIONS—WHY THEY ARE IMPORTANT

Pesticide-intensive programs to control "invasive" species are typically based on a disconnect between the ecological and regulatory meanings of "invasive." Species that are truly invasive in an ecological sense are capable of invading and persisting in healthy intact ecosystems. In this context, the introduction and spread of species that are truly invasive threaten biodiversity and native ecological communities. The regulatory definition is focused on the plant or insect as a super pest without attention to the context in which it has emerged or exists.

The 2016 Executive Order 13751, entitled *Safeguarding the Nation from the Impacts of Invasive Species*, provides the following definition: "'Invasive species' means, with regard to a particular ecosystem, a non-native organism whose introduction causes or is likely to cause economic or environmental harm, or harm to human, animal, or plant health." This definition is essentially the same as—and is actually broader than in a literal sense—the definition of "pest" (an organism that is "injurious to health or the environment") in the federal pesticide law, the *Federal Insecticide, Fungicide, and Rodenticide Act* (FIFRA), and does not define the underlying ecology of the unwanted species.

AUTHORITY TO FIGHT THE INVASIVE WAR

In the context of other federal, state, and local laws, the regulatory definition of "invasive species" gives broad authority to agencies to use all means at their disposal to rid the jurisdiction of non-native organisms causing economic harm, or harm to health and the environment. Many local ordinances that ban or restrict pesticide use make an exception for "invasive species" with the assumption that pesticides are needed to protect the environment, thus creating an allowance for pesticides that are understood to be unacceptably toxic. In other contexts, these exceptions are incorporating requirements of specific laws.

UNDERSTANDING THE CAUSE

The use of the term "invasive species" to justify hazardous pesticide use results in otherwise unacceptable means in an attempt to exterminate an unwanted organism that is defined as an economic, environmental, or human health threat. In this sense, the definition of "invasive" is reactive to the presence of a species without requiring an understanding of its ecological context—including the underlying issues or conditions that support or invite that species.

In fact, there are few, if any, species that are truly ecologically invasive—that is, capable of invading and persisting in intact ecosystems. Instead, such situations usually involve species that can take advantage of disturbed habitats ("weeds" or "weedy species"). A plan for a sustained solution, therefore, requires an emphasis on healing the disturbance (to which end, so-called "invasives" may sometimes be helpful), rather than killing the opportunist colonizer.

Removal of such opportunist colonizers may be necessary based on an ecological assessment and an evaluation of the options to ensure a long-term solution compatible with environmental health, but the use of toxic chemicals are rarely, if ever, justified in the process.

REDEFINING INVASIVES

If the definition of "invasive species" is limited to those species that can invade and damage intact ecological communities, then resources will only be directed at those species that legitimately present an ecological threat and prevent chemical strategies that are ecologically destructive.

WHY DISTINGUISH "INVASIVE SPECIES" FROM WEEDS?

Although other organisms, such as insects, are labeled "invasive," by far the largest attention is devoted to "invasive" plants. "Invasive plants" are sometimes called "non-native plants," "weeds," or "noxious weeds. "If invasive plants are labeled simply "non-native plants," they become confused with the many crop, turf, and horticultural plants that people value—and, in fact, often seek to protect from "invasive plants."

If "invasives" are labeled "weeds" or even "noxious weeds," then it will be necessary to treat them like other plants with that label. Land managers employ a number of strategies and tactics to prevent "weeds" from interfering with their land use goals. If they are environmentally conscious, they cultivate, graze, mulch, mow, or harvest the "weeds." They may plant or encourage competitors or specialist herbivores. Some land managers may use herbicides, and even in these cases, there are situations—as around sensitive areas or in jurisdictions where pesticide bans are in place—where herbicides may not be used.

This is the context, then, in which the label "invasive species" becomes a claim to virtue—because the solution is held as protecting the common good, when, in fact, it causes unnecessary harm. It is a situation in which there is independent scientific consensus that the use of toxic chemicals, including pesticides, is not appropriate or effective. However, land managers facing a challenging problem, are comfortable with the methods they know—spraying herbicides. By definition, herbicides kill plants, so the assumption is that any law restricting the use of pesticides must allow for their use in these difficult situations. However, in practice this challenge is confronted where effective alternatives to chemicals are available. It is not often accompanied by an analysis that evaluates the perceived problem, and, if accepted as a problem, its underlying causes.

If analysis identifies the weed or pest as exceptional—that it can invade intact native ecological communities—then pesticide use is potentially justifiable as protecting the environment. In fact, however, it is almost never the case that such "invasive species" can invade intact ecological communities because those communities do not have available niches for the "invader" to occupy. In those cases in which the analysis does not identify the weed or pest as exceptional, the "invasive" label has been used as a claim to virtue to allow otherwise unacceptable methods.

IF THE WEED IS NOT AN "INVASIVE SPECIES," THEN WHAT?

There are plants and other organisms that invade managed systems. Managed systems include cropland, rangeland, roadsides, turf, gardens, parks, forests, and even "wilderness" areas. Such systems may provide habitat for other species. Appropriate management strategies for unwanted additions to the biota differ according to the setting. Some of these species may be difficult to manage, and it is always appropriate to ask whether their presence indicates a need in the community that the new species could fill. Management strategies for these difficult non-native species are the same as for others, but because of their adaptation to the disturbance, may take more effort to implement. Strategies include cultivation, grazing, mulching, mowing, harvesting the "weeds," and planting or encouraging competitors. Herbicides, which only reinforce the vacancy in the community, are counterproductive, creating an opening to be filled.

DO YOU HAVE AN "INVASIVE SPECIES" PROBLEM?

When faced with a difficult problem involving an unwanted plant, there are several questions, the land manager should ask:

Is this plant really a problem, or can it fit into my managed landscape?

A "weed" plant may be performing an important function in the landscape—it may be fixing nitrogen or relieving soil compaction, for example—and it may be managed by existing land use or maintenance. A "weed" in one place—even one labeled an "invasive species"—may not be a nuisance in another place.

Is the presence of this plant an indicator that restoration efforts are needed to relieve stresses on the plant community?

If a non-native plant seems especially difficult to remove from your landscape, it may be filling an ecological niche that a native plant once filled. Its presence may reflect stresses on the plant community that can be relieved. For example, dandelions and some other deep-rooted plants in turf are an indicator of soil compaction—and they also help to relieve soil compaction. By addressing soil compaction by other means, the landscape manager can relieve the stress that led to the dandelion problem.

What strategies and tactics have been used by others to control this plant? Do they work? What are possible unintended consequences?

There are many approaches that can be used in the many different situations where vegetation is managed. Mowing

controls most broadleaf plants in managed grass simply because the growing point of broadleaf plants is at the tip, while grasses grow from the base. Grazing can be both a cause of a problem and a solution. Overgrazing by a single species (e.g., cows) reduces the cover by favored plants (grasses), allowing other plants (broadleaved plants) to multiply. Reducing overgrazing by the cows and introducing grazers who prefer broadleaved plants (e.g., sheep or goats) can address the problem.

Why Not Herbicides?

While herbicides are a popular choice, there are several reasons why they are not the most effective approach. Herbicides address the symptom, not the problem. They create a hole in the plant community that must be filled, and if the underlying problems are not addressed, it will likely be filled by some opportunistic species—i.e., a "weed." Since herbicides are not species-specific, they are likely to kill other plants as well, compounding the problem. Finally, many weeds have become resistant to herbicides through years of selection.

While the likelihood of unintended consequences should be examined for all methods—will those goats eat my oak saplings along with the poison ivy?—the possible consequences of herbicides may extend far from the managed landscape and may have serious effects on the health of humans and ecological systems.

Is this a crisis, or can I take the time to research restoration methods?

Poor decisions arise out of crisis. Crisis encourages herbicide use because it addresses the symptoms and does not involve analysis of underlying causes. However, as described above, herbicide use rarely produces a permanent solution. It is always better to take the time to research the appropriate strategies for your situation.

CONCLUSION

Communities and land managers confront species that are defined by law or in the common parlance as "invasive." While the solution has been to identify those species and then allow the toxic pesticide use exemption under community land management policies and state law, a sustained solution protective of health and the environment requires a more analytical approach that evaluates the species, the problem it poses, and the underlying causes that has invited and supports the unwanted organism. In this context, the threshold for action, the type of action, and the health of the ecosystem in which the organism lives are factors that require consideration. When confronted with an unwanted plant, consideration must be given to both the short- and long-term solution, ensuring that the immediate action does not create a greater problem in the future. The tools exist to effect a strategy for managing unwanted plants that is protective of health and the environment. It starts with asking the right questions.

Invasive Species Law

The concept of "invasive species" is embodied in federal and state statutes, regulations, and executive orders. Although dating back to the *Lacey Act of 1900*, which was designed to prevent the importation of "injurious wildlife," the body of regulation has focused largely on "noxious weeds." Many "noxious weed" laws were, and are, designed to promote chemical control of difficult agricultural weeds.

Plant Protection Act of 2000. This law replaced the *Federal Noxious Weed Act of 1974*, consolidating and updating major statutes pertaining to plant protection and quarantine *(Federal Noxious Weed Act, Plant Quarantine Act)* and permits USDA's Animal and Plant Health Inspection Service (APHIS) to address all types of weed issues through measures that may include emergency and extraordinary emergency actions to address infestations of noxious weeds.

Other federal laws governing invasive species. These include: *Nonindigenous Aquatic Nuisance Prevention and Control Act Of 1990*, *Brown Tree Snake Control and Eradication Act of 2004,* Nutria Eradication and Control Act of 2003, and *Alien Species Prevention and Enforcement Act of 1992*. In addition, Executive Order 13112, signed by President Bill Clinton on February 3, 1999, creates a National Invasive Species Council (NISC), and Executive Order 13751 of 2016, entitled *Safeguarding the Nation from the Impacts of Invasive Species,* continues and clarifies actions of E.O. 13112 and "incorporates considerations of human and environmental health, climate change, technological innovation, and other emerging priorities into Federal efforts to address invasive species."

Federal Pesticide Law Definitions

Federal Insecticide, Fungicide and Rodenticide Act (FIFRA)

2 (t) PEST.—The term ''pest'' means (1) any insect, rodent, nematode, fungus, weed, or (2) any other form of terrestrial or aquatic plant or animal life or virus, bacteria, or other micro-organism (except viruses, bacteria, or other micro-organisms on or in living man or other living animals) which the Administrator declares to be a pest under section 25(c)(1).

25(c) OTHER AUTHORITY.—The Administrator, after notice and opportunity for hearing, is authorized—(1) to declare a pest any form of plant or animal life (other than man and other than bacteria, virus, and other micro-organisms on or in living man or other living animals) which is injurious to health or the environment.

2 (j) ENVIRONMENT.—The term ''environment'' includes water, air, land, and all plants and man and other animals living therein, and the interrelationships which exist among these.

California Court Halts State Pesticide Spray Programs

STATE FAILS TO CONDUCT ENVIRONMENTAL IMPACT ANALYSES

Juan Carlo/The Star

An agriculture aide for the state of California sprays citrus trees to fight Asian citrus psyllids.

LISA BUNIN, PhD

A California court in January halted a state program that mandated pesticide spraying and other applications for invasive species at schools, organic farms, and backyards across the state. The court found that the state had inadequate environmental assessments and public disclosure of adverse effects for the pesticides used. The California Department of Food and Agriculture's (CDFA) Statewide Plant Pest Prevention and Management Program required no site-specific analysis of hazards before the application of 79 pesticides, including some known to cause cancer and birth defects and highly toxic to bees, butterflies, fish and birds.

This action came in response to a lawsuit filed by the City of Berkeley and 11 public health, environmental, conservation, citizen and food safety groups, including Beyond Pesticides, which argued that CDFA has failed in its duty to protect human health, the environment, and the state's organic agriculture. CDFA's lack of compliance with California's Environmental Quality Act (CEQA) resulted in the court's suspension of "all chemical activities undertaken . . . to control or eradicate pests," "unless and until" the agency corrects violations.

The court injunction follows an earlier court ruling in January annulling CDFA's Program Environmental Impact Report (PEIR), due to numerous state environmental law violations. Under CEQA, agencies must produce an Environmental Impact Report (EIR –the California state equivalent of a federal Environmental Impact Statement) for any project with potentially significant environmental impacts. Unlike the National Environmental Policy Act (NEPA), it also requires the state to prevent or mitigate negative impacts. Agencies may avoid conducting an EIR for each action by conducting a programmatic EIR (PEIR) for their programs.

COURT FINDINGS

In its implementation outline for the program, the PEIR gave CDFA carte blanche to use more pesticides in a state already over-burdened with pesticides in the environment. The court labeled as "woefully deficient" CDFA's analysis of the cumulative impacts of adding pesticides to the state's already hefty environmental burden of over 150 million pounds released annually. It cited "unsupported assumptions and speculations" contained in the PEIR as a basis for concluding that pesticides would not contaminate waterbodies. Potentially significant pollinator impacts were also "improperly ignored." The court further concluded that in the PEIR document CDFA had granted itself authority "to implement a broad range of practices without evaluating the site-specific conditions" as a basis for determining their impacts.

FUTURE OF STATE PROGRAM IN QUESTION

This nearly unprecedented court decision has put the future of the statewide "invasive" pest control and management program in indefinite limbo. Despite years of contestations from public and environmental organizations, CDFA has continued a pattern of managing pests by invoking emergency provisions in California's Food and Agriculture Code. The emergency declarations exempt CDFA from requirements to analyze the health and environmental impacts of its pesticide applications

and to provide notice and comment opportunities for public input into decisions that could threaten the welfare of their communities. This cloak of secrecy has angered local residents who have been exposed to an array of toxic and carcinogenic pesticides without advanced knowledge or consent in the name of "emergency pest eradication."

ASSESSMENT OF ENVIRONMENTAL IMPACT REQUIRED

CDFA describes its Statewide Plant Pest Prevention and Management Program as an "effort by CDFA to protect California's agriculture from damage caused by invasive plant pests." Not too long ago, CDFA instituted an aerial spray program to attempt to eradicate the light brown apple moth (LBAM). Communities were bombarded by synthetic pheromones of an undisclosed composition sprayed from airplanes flying in grid patterns over houses, schools, workplaces, and parks. Intensive public outcry in northern California forced the agency to abruptly cancel its aerial strategy, an action that had little impact on the overall spread of the moth. In fact, to this day, CDFA has not documented any damage whatsoever that it can attribute to the LBAM.

The PEIR was produced in part as response to the LBAM debacle under a 2008 bill, AB 2763, introduced by then Assembly Member John Laird of Santa Cruz County. The law's primary purpose was to require the state to compile a comprehensive list of potential future invasive species and outline a range of approaches for dealing with them. While the bill did not require a PEIR to be written, CDFA seized the opportunity to draft the PEIR and include in it a large number of possible pesticide programs that would not require any further CEQA review. In this way, the PEIR allowed CDFA to avoid writing additional EIRs, which are intended to examine site-specific impacts of pesticide applications and the unique conditions inherent in individual communities and ecosystems around the state. The PIER also eliminated the mandate to solicit public input on individual pest programs.

NON-PESTICIDE APPROACHES MUST BE CONSIDERED

The ruling does not completely paralyze CDFA. It still allows the agency to perform a full range of non-pesticide related activities, including pest identification, site inspections, and the imposition of quarantines, among others. The agency can still use pesticides associated with its other programs, although such uses are likely limited to just two that were identified in the PEIR as having prior CEQA approval, according to Nan Wishner of California Environmental Health Initiative, a lead plaintiff organization in the lawsuit. The decision also does not limit the individual choice of farmers, other institutions, companies, or residents from spraying pesticides on their land. Even with these exceptions, this court ruling still represents a big victory for those working to curtail pesticide use in California and for those advocating for a more ecologically based approach to managing pests and invasive species.

Importantly, the court decision does not prevent CDFA from producing specific EIRs relating to individual projects. The use of individual EIRs allows for better public comment opportunities that can suggest effective non-pesticidal remedies. It remains to be seen whether CDFA will produce specific EIRs and public input opportunities.

Since the onset of CDFA's 2014 pest program, more than 1,000 pesticide treatments were carried out. The program allowed fumigation, ground and aerial spray, and other application methods on public lands, schools, parks, and in residential neighborhoods. The 79 chemicals approved in the PEIR include: bee-toxic neonicotinoids; the chemical warfare gas chloropicrin, which is banned in Europe; methyl bromide, an ozone depleter with five times the global warming potential of carbon dioxide; and, chloropyrifos, which threatens 97 percent of endangered wildlife.

This latest court decision falls on the heels of new California regulations that restrict the use of certain pesticides near schools and daycare centers. As of January 2018, farmers are prohibited from spraying certain pesticides during school days, between 6am and 6pm, and within a quarter of a mile from K-12 public schools and licensed daycare centers. The first of their kind, the new statewide regulations require farmers to annually report the pesticides they plan to use near schools to their county agricultural commissioner. After more than 50 people on school campuses became ill due to pesticide drift, these regulations are designed to better protect the health of children, teachers, and school staff.

CONCLUSION AND ACTION

CDFA's culture of emergency spraying needs to change in order for the agency to fully embrace its responsibility to protect human health, the environment, and the economic welfare of the people it serves. With a heightened public awareness and concern about the threats posed by rampant pesticide use, it is incumbent upon CDFA to change not only its pest management strategies and practices, but also its mindset going forward. Instead of spraying first and asking questions later, as was the case with LBAM, CDFA must initiate pest programs that advance sound ecosystem management, in transparent consultation with the constituents it represents.

In California and across the nation, it is critically important that agencies deliberately seek out advisors and hire staff with knowledge and hands-on expertise in sustainable and organic agriculture and land management to assist in moving the state away from pesticide-intensive methods. State agencies authorized to use or require the use of pesticides must actively engage the public as partners and work closely with them to devise robust programs that respond to the public's desire to expand ecologically sustainable and organic agricultural policies and practices that protect human health and the environment.

BEYOND PESTICIDES
INFORMATION FOR ACTION

Glyphosate (Roundup)

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SUMMARY

Despite the prevalent myth that this widely-used herbicide is harmless, glyphosate (N-phosphono-methyl glycine) is associated with a wide range of illnesses, including non-Hodgkin's lymphoma (NHL), genetic damage, liver and kidney damage, endocrine disruption, as well as environmental damage, including water contamination and harm to amphibians. Researchers have also determined that the "inert" ingredients in glyphosate products, especially polyethoxylated tallow amine or POEA —a surfactant commonly used in glyphosate and other herbicidal products—are even more toxic than glyphosate itself. Monsanto, manufacturer of glyphosate, formulates many products such as Roundup™ and Rodeo™ and markets formulations exclusively used on genetically engineered (GE) crops. Glyphosate, one of the most widely used herbicides in the world, due in large part to the increased cultivation of GE crops that are tolerant of the herbicide.

GENERAL

First registered for use in 1974, glyphosate is used to kill a variety of broadleaf weeds and grasses. Labeled uses of glyphosate account for approximately 276 million pounds applied in 2014 on over 100 terrestrial food crops, as well as other non-food sites, including forestry, greenhouses, rights-of-way, turf, garden beds, and hardscapes.

The greatest overall glyphosate use by acreage is in the Mississippi River basin where most applications are for weed control on GE corn, soybeans, and cotton, as well as other crops. Contrary to industry claims that GE crops would result in lower pesticide use rates, glyphosate use in agriculture rose 300-fold from 1974 to 2014, with non-agricultural uses increasing by 43-fold during the same time.

Plants treated with glyphosate translocate the systemic herbicide to their roots, growing points, and fruit, where it blocks the activity of the enzyme 5-enolpyruvylshikimate-3-phosphate synthase (EPSPS), a key enzyme in the shikimate pathway of aromatic amino acid production, ultimately leading to the plant's death by starvation. Because plants absorb glyphosate, it cannot be completely removed by washing or other food preparation. It persists in food products for up to two years.

GLYPHOSATE FORMULATED PRODUCTS AND OTHER INGREDIENTS

Glyphosate products (Roundup) are more toxic than glyphosate alone, resulting in a number of chronic, developmental, and endocrine-disrupting impacts.The "inert" ingredients in Roundup formulations kill human cells at very low concentrations. At least some glyphosate-based products are genotoxic. One "inert," polyethoxylated tallow amine (POEA), is extremely toxic to aquatic organisms. It accounts for more than 86% of Roundup toxicity observed in microalgae and crustaceans.

ACUTE EXPOSURE TO GLYPHOSATE

Although EPA considers glyphosate to be "of relatively low oral and dermal acute toxicity," symptoms following exposure to glyphosate formulations include: swollen eyes, face and joints; facial numbness; burning and/or itching skin; blisters; rapid heart rate; elevated blood pressure; chest pains, congestion; coughing; headache; and nausea. In developmental toxicity studies using pregnant rats and rabbits, effects of glyphosate in high dose groups include diarrhea, decreased body weight gain, nasal discharge and death.

CHRONIC EXPOSURE TO GLYPHOSATE

Since EPA's classification of glyphosate as a Group E carcinogen—or "evidence of non-carcinogenicity for humans,"

ChemicalWATCH Summary Stats

CAS Registry Number: 1071-83-6

Trade Name: Roundup, Rodeo

Use: Nonselective herbicide for broadleaf weed and grass control on food and non-food field crop sites.

Toxicity rating: Toxic

Signal Words: Caution

Health Effects: Eye and skin irritation, associated with non-Hodgkin's Lymphoma, and spontaneous abortions. Other ingredients in formulated products are linked to developmental abnormalities, decreased sperm count, abnormal sperm, and cell death of embryonic, placental and umbilical cord cells. Functions as an antibiotic.

Environmental Effects: Weed resistance due to use in genetically engineered crop production, water contamination, soil quality degradation, toxic to soil microorganisms and aquatic organisms. A source of phosphate pollution in water.

the International Agency for Research on Cancer (IARC) in 2015 classified glyphosate as a Group 2A "probable" carcinogen, which means that the chemical is probably carcinogenic to humans based on sufficient evidence of carcinogenicity in experimental animals. As of July 7, 2017, glyphosate is listed as a cancer-causing chemical under California's Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65). This requires cancer warning labels be placed on end-use glyphosate products in California. It has been specifically linked to non-Hodgkin's Lymphoma (NHL).and multiple myeloma.

Glyphosate causes DNA and chromosomal damage in human cells. Glyphosate and its formulated products adversely affect embryonic, placental and umbilical cord cells, affect fetal development, and increase the risk for spontaneous abortions. Detectable concentrations of glyphosate have been found in the urine of farm children. Chronic, ultra-low dose exposure to glyphosate in drinking water results in adverse impacts on the health of liver and kidneys. Glyphosate is considered to be an endocrine disruptor. It can cause changes to DNA function resulting in the onset of chronic disease.

GLYPHOSATE IS AN ANTIBIOTIC

Glyphosate works by disrupting a crucial pathway for manufacturing aromatic amino acids in plants—but not animals—and, therefore, many have assumed that it does not harm humans. However, many bacteria use the shikimate pathway, and glyphosate has been patented as an antibiotic. The destruction of bacteria in the human gut is a major contributor to disease, and the destruction of soil microbiota leads to unhealthy agricultural systems with an increasing dependence on agricultural chemicals. Disturbing the microbiota can contribute to a whole host of "21st century diseases," including diabetes, obesity, food allergies, heart disease, antibiotic-resistant infections, cancer, asthma, autism, irritable bowel syndrome, multiple sclerosis, rheumatoid arthritis, celiac disease, inflammatory bowel disease, and more. The rise in these same diseases is tightly correlated with the use of the herbicide glyphosate, and glyphosate exposure can result in the inflammation that is at the root of these diseases. Glyphosate appears to have more negative impacts on beneficial bacteria, allowing pathogens to flourish.

ANTIBIOTIC RESISTANCE

Bacteria resistant to the most commonly prescribed antibiotics result in longer-lasting infections, higher medical expenses, the need for more expensive or hazardous medications, and the inability to treat life-threatening infections. The development and spread of antibiotic resistance is the inevitable effect of the use of antibiotics. Use of antibiotics like glyphosate in agriculture allows residues of antibiotics and antibiotic-resistant bacteria on agricultural lands to move through the environment, contaminate waterways, and ultimately reach consumers in food. Both the human gut and contaminated waterways provide incubators for antibiotic resistance.

ENVIRONMENTAL FATE

Glyphosate has the potential to contaminate surface waters and is not broken down readily by water or sunlight in surface water, with a half-life of 70 to 84 days. U.S. Geological Survey (USGS) surveys detect glyphosate and its degradate aminomethylphosphonic acid (AMPA) in the majority of samples, persisting from spring through to fall. Glyphosate and/or AMPA have also been detected in significant levels in rain in agricultural areas across the Mississippi River watershed, in more than 50 percent of soil and sediment samples, in water samples from ditches and drains, and in more than 80 percent of wastewater treatment plant samples. Glyphosate also contributes to phosphorous pollution of waterbodies.

Residues of glyphosate may persist for months in anaerobic soils deficient in microorganisms. Heavy use of Roundup on GE crops appears to cause harmful changes in soil, potentially hindering yields of crops. Concerns for soil health from long-term glyphosate use include reduction of nutrient availability for plants and organisms; disruption of organism diversity, especially in the areas around plant roots; reductions of beneficial soil bacteria; increases in plant root pathogens; disturbed earthworm activity; reduced bacterial nitrogen fixation; and compromised growth and reproduction in some soil and aquatic organisms.

EFFECTS ON NONTARGET ANIMALS

Glyphosate use directly impacts a variety of nontarget animals, including insects, earthworms, and fish, and indirectly impacts birds and small mammals. Roundup kills beneficial insects, including parasitoid wasps, lacewings and ladybugs. Repeated applications of glyphosate significantly affect the growth and survival of earthworms. Enviromental factors, such as high sedimentation, increases in temperature and pH levels increase the toxicity of Roundup, especially to young fish.

Roundup, in sublethal and environmentally relevant concentrations, causes morphological changes in two species of amphibians by interfering with hormones. It is "extremely lethal" to amphibians in concentrations found in the environment.

FOOD RESIDUES

Sampling by the U.S. Food and Drug Administration), under pressure after the release of the IARC report, found residues of glyphosate in honey and oats. Residues, which have no established legal allowance in honey, were found in all samples and in some cases at double the allowable limit set in the European Union. FDA also found residues in oat products, including cereals for babies. These tests follow European findings of glyphosate residues in German beer and British bread, in addition to private testing in the U.S. in Cheerios, cookies, crackers, and wine.

Thinking Holistically When Making Land Management Decisions

Regulatory analyses that support pesticide use ignore complex ecological impacts

TERRY SHISTAR, PhD

This article focuses on ecological impacts of chemical-intensive practices when they are adopted on a wide scale as the dominant land management system. These impacts are not easily captured in an ecological risk assessment because they may result from interactions among stressors and cumulative impacts of single or multiple stressors. In order to get a better idea of the impacts of chemical-intensive agriculture and land management, it is necessary to see the entire system in contrast with organic management systems. Organic agriculture and land management demand not just the avoidance of toxic chemicals, but also the promotion of healthy soil and biodiversity in crop and non-crop areas.

Ecological changes occur on a broad scale—such as shifts in plant and animal populations—in response to widespread low or high levels of chemicals in the environment, as well as physical and biological impacts of practices such as monoculture, short rotations, and intensive tillage. Examples include the impacts of glyphosate on milkweed and monarch butterflies, effects of nitrogen deposited from the atmosphere on forests, poisoning caused by low levels of phenoxy herbicides vaporizing and moving to natural areas, and the dead zone in the Gulf of Mexico.

MICROBIAL AND SOIL INVERTEBRATE COMMUNITIES

Microbial communities in the soil and on plants contribute to plant growth and health. Soil communities include bacteria, fungi, earthworms, and other invertebrates that break down organic matter and make nutrients available to plants. Bacteria and fungi engage in reciprocal exchanges of nutrients with plants—providing soluble forms of plant nutrients in return for sugars produced through photosynthesis. Some—perhaps most—of the minerals needed by plants and soil organisms are abundant in the soil and are available under favorable conditions. Synthetic nitrogen can be replaced by legumes and their symbiotic microbes. Phosphorus, though plentiful, can be locked up in the soil unless freed by bacteria or mycorrhizal fungi. Iron and other micronutrients are made more available by microbial action. The task of the organic farmer, landscaper, or gardener, then, is to feed and create a favorable environment for the soil organisms who make nutrients available to plants.

Chemical-intensive farming and land management, on the other hand, destroys these essential communities. Soil fumigants are highly toxic gases—including methyl bromide, chloropicrin, dazomet, 1,3-dichloropropene, metam sodium (methyl isothiocyanate), and dimethyl disulfide—that are injected into the soil to sterilize it. They are used on a wide

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range of high-value crops to control nematodes, fungi, bacteria, insects, and weeds. Soil fumigants wipe out entire soil communities, thus necessitating the use of other chemicals to provide the fertility and pest control services that soil organisms provide.

In addition to fumigating soil, which intentionally kills all living things in the soil, other practices also threaten soil life. Glyphosate, the most widely used herbicide, is also an antibiotic. Glyphosate varies in its impacts on microbes—some species are inhibited by glyphosate, some tolerate it, and still others may use glyphosate or its metabolite aminomethylphosphonic acid (AMPA) as a food source. The impacts of glyphosate's interactions with the microbiota of the root zone are various. For example, soybeans are legumes and hence harbor nitrogen-fixing bacteria in root nodules. Glyphosate interferes with nitrogen fixation in glyphosate-tolerant soybeans. Glyphosate-tolerant plants release glyphosate into the soil, where it has a continued impact. Glyphosate is also released to the soil by dead treated plants. "Once in soil, glyphosate may be adsorbed [adhere to the surface] onto soil particles, degraded by microbes, or transferred to deeper soil horizons, migrating via soil pores or root canals. However, some agricultural practices, such as adding a phosphorous amendment, may re-solubilize glyphosate in soils, making it available for leaching and to the rhizosphere of non-target plants." Other herbicides, diminish or shift microbial populations.

Seeds of corn, soybeans, canola and others are widely coated with pesticides, such as neonicotinoid insecticides, before they are planted—in an effort to poison soil pests, including insects and fungus, before and after germination. The pesticides are also applied to vegetable and flower seedlings and plants, including turf, as a soil drench, spray, granules, or dust. Whether applied as a seed coating or to the plant, these systemic pesticides translocate throughout the plant, essentially making the entire plant a pesticidal agent. Pesticides applied to seeds and seedlings also seep into the soil and kill insect and other invertebrate decomposers, such as earthworms. Since neonicotinoids have long half-lives and are mobile, these impacts affect invertebrates in surrounding soil, as well as the crop site. The biological insecticide *Bacillus thuringiensis* (Bt), when genetically engineered into crops, lets loose its toxin in exudates or in decomposition. Other insecticides and fungicides sprayed on crops affect the life of the soil as well. And while these impacts occur mostly on cultivated fields, the chemicals and genes drift to surrounding areas. Intensive tillage, with soil left bare over the winter, allows all of these threats to be carried away in dust and runoff.

PLANT COMMUNITIES

Plant communities are also affected by chemical drift and volatilization, dust, and runoff. Diminished populations of milkweed and their impact on monarch butterflies have been documented, both within fields and in all breeding areas. The U.S. Geological Survey estimates that 1.8 billion more milkweed stems are necessary for a sustainable monarch population.

Phenoxy herbicides, like 2,4-D, and similar herbicides in the benzoic acid family, like dicamba, are notorious for vaporizing and settling on susceptible plants, sometimes far from the application site. Although the reduced use of 2,4-D had allowed crops like grapes to be grown in grain-producing states where their production was previously impossible, recent drift incidents with dicamba and 2,4-D, reintroduced with new genetically engineered herbicide-tolerant plants, have brought back old problems.

Hedgerows of plants and shrubs along fields that were widely planted in response to the Dust Bowl were torn out in the 1970s, with the official U.S. Department of Agriculture policy being to plant "fencerow to fencerow." Organic farmers are required to devote space to conserving biodiversity, and benefit from the habitat provided by hedgerows for pollinators, insect predators and parasitoids, and predators of rodents, as well as their value in protecting soil from erosion. Hedgerows and woodlots adjoining fields that are managed in a chemical-intensive manner contain more grassy and weedy plants than those managed with fewer chemicals. Because of the inclusion of those habitats and cropping systems with a complex structure (with intercropping, cover crops, diverse rotations, etc.), organic farms have greater plant diversity than chemical-intensive farms.

ADVERSE EFFECTS FROM SYNTHETIC FERTILIZATION

Threats to forests and severe ecosystem changes are linked to the nitrogen from chemical fertilizers. Nitrogen (as ammonia and oxides of nitrogen) moves in the air, and is deposited in forest soils. Of the 54 million tons of ammonia emitted to the air, 75 percent is of anthropogenic origin. The impacts of the ammonia emitted by agriculture and deposited in forests has been summarized by Steingröver and Boxman: "Long-term increased atmospheric input of N may dramatically change forest ecosystems by acidification and/or eutrophication. Prominent changes to the non-tree part of the ecosystem are the increasing number of nitrophilous [i.e., early successional, "weedy"] species in forest undergrowth and the decline in the number of fruiting bodies of ectomycorrhizal fungi. In trees, nutritional imbalances may result from the loss of base cations from the soil, from preferential uptake of NH_4^+; by roots and from competition between NH_4^+ and the uptake of cations like K^+, Mg^{+2}, and Ca^{+2}. Next to these soil mediated effects, N may be taken up directly by the foliage, resulting in increased N concentrations and disturbing the N allocation in the tree." Other impacts of excess nitrogen in forests include decline of mycorrhizae, changes in species composition and diversity, and overall decline resulting from increased susceptibility to insects, disease, freezing, and drought.

Agricultural emissions of nitrogen fertilizers account for 80% of the growth in global air concentrations of nitrous oxide (NO_2), a greenhouse gas with global warming potential of 265–298 times that of carbon dioxide. Synthetic nitrogen fertilizers applied to California cropland contribute 20 to 51% of the nitrous oxides emitted in the state, resulting air pollution, acid rain, and respiratory illness. In addition to promoting the emission of greenhouse gases, chemical-intensive agriculture promotes climate change by reducing (in comparison to undisturbed land or organic production) the sequestration of carbon in the soil.

Climate change causes wide-ranging shifts in plant communities. It causes changes in plant flowering times. Those shifts in flowering times can lead to disruption of plant-pollinator interactions, with a predicted extinction of both pollinator and plant species. Climate change and associated factors (such as increased nitrogen deposition and carbon dioxide (CO_2) concentrations) have been linked to "invasive species" problems, which are also connected to disturbances that cause openings in plant communities and provide opportunities for invaders. While it is difficult to predict the impact of plant diseases in global climate change, it will at least add another layer of complexity and uncertainty to plant populations.

ANIMAL COMMUNITIES

Frightening global reductions in biodiversity are occurring, and at least some of the reductions are due to pesticide use. European scientists document a decrease of over 75% in flying insect biomass in natural areas over a 27-year period.

In addition to loss of species and numbers of animals, chemical-intensive agriculture shifts animal populations in ways that are detrimental to agriculture as well as the survival of natural communities. When the landscape is so dominated by crop fields without other habitat, native herbivore populations must shift to those species who feed on crop plants. Without the hedgerows, cover crops, and diverse cropping systems provided by organic farms, chemical-intensive farms lack overwintering sites and food sources for insect predators and parasites outside of the time when their "pest" prey and hosts are available. As a result, natural controls are absent, leading to greater reliance on toxic chemicals.

The impacts of pesticides on bees have been recognized as a problem since the 1870s, but intensification of insecticide and herbicide use after World War II, along with increasing monoculture and removal of hedgerows and other non-cropped areas, led to decreased populations of native pollinators and increased reliance on domesticated bees for pollination. Meanwhile, beekeepers were forced to pasture

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their bees on fields treated with insecticides. In the time since pesticides were first recognized as a problem for bees and other pollinators, pest control technology has undergone several generations of change. With shifts from organochlorines to organophosphates to synthetic pyrethroids and neonicotinoids, the toxicological mechanisms may have changed, but there is abundant research demonstrating that insecticides, herbicides, and fungicides have significant lethal and non-lethal impacts on bees and other pollinators, which threaten pollinator-dependent crops.

Organic farm management, on the other hand, nurtures pollinators and other insects considered beneficial to agriculture. Organic farms are required to support biodiversity, and providing nectar sources that have not been poisoned is one way that they meet that requirement. Research shows that "ecological intensification," natural and semi-natural habitat surrounding fields, and weedy areas support populations of pollinators and other "beneficial" insects. The loss of these benefits due to the use of chemical-intensive approaches are necessary factors to consider in a valid assessment of pesticide risks.

All taxonomic groups benefit from organic, as opposed to chemical-intensive, production. In chemical-intensive agriculture, birds lose nesting sites and perches from which to hunt. Larger mammals are affected by the loss of migration corridors, effectively reducing their available habitat. Deer foraging in pesticide-treated fields are subjected to pesticide residues that would not be allowed in domestic livestock feed, which ultimately affects the human consumers who may believe they are eating a less contaminated product.

AQUATIC/MARINE COMMUNITIES

Aquatic and marine communities are also affected by drift, runoff, and fallout from chemical-intensive agriculture. The most notorious example is the Dead Zone in the Gulf of Mexico, caused mostly by runoff of fertilizer, which contributes 80% of the nitrogen and 60% of the phosphorous to the Gulf. Dead zones are areas of low oxygen (hypoxia) that have severe impacts on the biodiversity and functioning of marine ecosystems and the services they provide, including production of fisheries, nutrient cycling, and water column filtration. On the way to the Gulf, the contaminants diminish the water quality of streams, compromising drinking water, posing risks from algal blooms, and threatening commercial fisheries.

Herbicides from runoff, drift, or fallout cause shifts in populations of algae and aquatic plants. The loss of keystone species has been documented, and these impacts cascade up aquatic food chains. Indirect effects of pesticides on aquatic and marine systems include changes in behavior, physiology, competitive or predator-prey interactions, which are generally not identified in toxicity testing.

Higher rates of atmospheric carbon dioxide, which could be prevented or ameliorated by organic agriculture, contribute to acidification of oceans, reducing availability of carbonate ions that are needed by marine organisms, such as corals, marine plankton, and shellfish for formation of skeletons and shells.

In addition to these broad impacts, residues of many individual pesticides in streams, lakes, and oceans have been documented, as well as their impacts on aquatic and marine species. In all samples taken year-round, the U.S. Geological Survey (USGS) detected neonicotinoids in the Great Lakes and its tributaries, with increased detections during planting season. Michelle Hladik, PhD, lead author of the study and a research chemist at USGS, said the major risk of these chemicals is to aquatic insects—an effect that could ripple up the food chain. "If these pesticides are affecting aquatic insects, causing lower populations, it could affect the food chain by removing a food source" for fish, she said.

GLOBAL EFFECTS

Globally, the climate is affected by the loss of carbon sequestration in fields that lay bare half the year and contain minimal plant and microbial diversity during the growing season.

Nitrate and ammonia from chemical fertilizers are deposited in aquatic and terrestrial ecosystems, shifting the balance of plants, algae, and seaweeds. Chemical-intensive agriculture, with its lack of soil cover during most of the year, results in soil loss from wind and water erosion. The siltation from erosion damages aquatic and marine ecosystems.

For example, siltation affected the Willapa Bay and Grays Harbor, throwing the ecosystem out of balance, leading to the loss of some native predators, an increase in invasive species, and slumping oyster productivity. Over time, as impacts on

streams impaired water quality and contributed to the decline of fish populations like salmon and sturgeon, the native Washington oyster, *Ostrea lurida*, began to decline due to over-harvesting and declining environmental quality, and oystermen began importing the Pacific oyster from Japan and creating artificial oyster beds to help boost productivity.

By the early 1920s, numbers of the native burrowing shrimp grew, as the sediment layer increased and predatory fish populations in the bay declined. Early efforts to prevent shrimp from burrowing—graveling, shelling—were not effective, and soon gave way to chemical control options. Several efforts are underway to restore salmon species in the Pacific Northwest, including Willapa Bay. Stream enhancement and restoration improves habitat for fish, amphibians, and invertebrates—species that help control bountiful populations of burrowing shrimp and aquatic plants. The use of pesticides only serves to further threaten the long-term health of the sensitive ecosystem by adversely affecting other non-target species, and potentially throwing other communities out of balance.

Although efforts have been made to estimate the economic costs to the environment associated with pesticide use, these efforts have not focused on environmental services and do not include the costs of industrial agriculture as a system.

ECOSYSTEM SERVICES—THE ECONOMIC VALUE OF ENVIRONMENTAL PROTECTION

The term "ecosystem services" refers to benefits that people receive from functioning ecosystems. The hydrological cycle provides clean water for agriculture and human consumption. The carbon cycle removes carbon from the atmosphere and incorporates it into plants. Microorganisms decompose waste and turn it into nutrients. Insects provide pollination and pest control services to agriculture.

A decrease in soil microbial diversity reduces the services that soil provides, from decomposition of organic matter to nutrient cycling and carbon fixing. Chemical-intensive agriculture contributes to the loss of ecosystem services. When soil diversity is high, the soil functions more efficiently and provides a multitude of ecosystem services. The application of pesticides in industrialized agriculture reduces soil diversity and therefore reduces soil functionality. As mentioned above, glyphosate, the active ingredient in Roundup, is an antibiotic affecting soil organisms and interfering with nitrogen fixation. Along with other pesticides, glyphosate also harms earthworms, important for the decomposition of organic matter and aeration of soil.

Other ecosystem services are affected as well. Chemical-intensive agriculture reduces insect diversity that provides pollination and pest control services. By reducing vegetative cover during much of the year, it diminishes the ability of the land to mitigate flood events.

Although efforts have been made to estimate the economic costs to the environment associated with pesticide use, these efforts have not focused on environmental services and do not include the costs of industrial agriculture as a system.

PESTICIDE RISK-BENEFIT ANALYSES MUST INCLUDE COMMUNITY AND ECOSYSTEM IMPACTS

The *Federal Insecticide, Fungicide and Rodenticide Act* (FIFRA), the nation's pesticide review law, requires that in registering a pesticide, the U.S. Environmental Protection Agency (EPA) consider risks "to man or the environment, taking into account the economic, social, and environmental costs and benefits of the use of any pesticide." This requirement should not allow EPA to consider a single pesticide or single use of a pesticide in isolation from the system in which it is used. However, risk assessments of pesticides generally examine direct toxicological effects of acute or chronic exposures to single pesticide ingredients, but the impacts of chemical-intensive monoculture and non-target adverse effects are typically less direct and more serious than those considered in pesticide registration. Similarly, in considering whether to cancel the use of a pesticide, EPA compares its risks to those of the pesticide that it believes to be the most likely to be adopted by users. This practice not only gives an inaccurate picture of the risk of the pesticide, but it also creates a context for decision making that excludes options that are protective of human health and the environment.

The widespread availability of toxic pesticides makes possible the chemical-intensive system whose effects are broad and complex. The alternative is not the use of another product, but the implementation of another system—such as organic agriculture—that does not have these impacts. Organic agriculture and land management provide a standard against which pesticide impacts should be measured, both individually and in the aggregate. A broader assessment provides a more complete picture of the threats that pesticides pose and the importance of shifting to organic management systems.

A fully cited version of this article is available at bp-dc.org/ecosystemimpacts.

COMMENTARY

Media and Science: Keeping it Real

DEBRA SIMES

In a national political and cultural climate of challenges to the notion that information can be trusted as "real," and news reporting as reliable rather than "fake," the dynamics of the science information landscape are worthy of attention. There are several elements in this portrait: industry that will purchase academic or scientific reports to serve its interests; academicians, scientists, and others who are willing to sell; careless or under-resourced news outlets; increasing complexity of information coupled with poor science literacy; and impacts of the digital revolution—which, for all the "democratization" of information, has also led to widespread confusion and skepticism in the public square.

A January 19, 2017 *Newsweek* article titled, "The Campaign for Organic Food Is a Deceitful, Expensive Scam," by Henry I. Miller, MD, made the titular argument. Further, it posited a concerted and well-funded "black marketing" campaign "to discredit and diminish genetically engineered foods and to attack their defenders in the scientific community. The chief perpetrators of this . . . campaign are lobbyists for the organic agriculture and 'natural products' industries and their enablers."

Organizations, such as Beyond Pesticides, that work to advocate for organic food and agriculture as the safest for human and environmental health, no doubt found that claim rich. Stacy Malkan, co-director of the consumer watchdog and transparency group Right to Know, in her piece, "Monsanto's Fingerprints All Over *Newsweek*'s Hit on Organic Food," writes, "Miller's *Newsweek* hit on organic food has Monsanto's fingerprints in plain sight all over it." The piece was first written for and published on the Hoover Institution website; the Hoover Institution is a think tank and public policy organization, sited at Stanford University, that is influential in conservative and libertarian circles.

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INDUSTRY PURCHASING SCIENCE

Among the spurious claims made in the *Newsweek* article are these: organic agriculture is more harmful to the environment than conventional agriculture, and North American supporters of organic spent $2.5 *billion* in 2011 on anti-GE (genetically engineered) food campaigns. The latter claim was made by Jay Byrne, formerly a corporate communications director for Monsanto, and current director of a public relations firm that specializes in "reputation management."

As an exemplar of the "industry purchasing science" phenomenon: Monsanto works with people such as Dr. Miller and Jay Byrne to launch disinformation attacks on issues, scientists, and advocates. According to Ms. Malkin, Dr. Byrne was instrumental in helping Monsanto establish a corporate front, called Academics Review, that generated a report critiquing the organic "industry" as a marketing ploy—the theme of Dr. Miller's *Newsweek* article. The front group was designed, says Ms. Malkan, to seem legitimate yet function as a "platform from which academics could attack critics of the agrichemical industry, while secretly receiving funds from industry groups, and also claiming to be independent. Wink, wink, ha, ha." "'The key will be keeping Monsanto in the

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background so as not to harm the credibility of the information,' wrote a Monsanto executive involved in the plan.**"** (Beyond Pesticides wrote about Monsanto's tactics in the fall 2017 issue of *Pesticides and You*.)

On the "academicians ready to be compensated" front: Dr. Miller has a history of working with corporations looking to reassure the public that their not-so-safe products are safe and do not need regulation. Not long ago, he was exposed as having published an article in *Forbes* magazine, under his name, that was ghostwritten by Monsanto. *The New York Times* broke that story, which was based on an email exchange between Dr. Miller and Monsanto; that exchange surfaced as evidence in a lawsuit against the company. The *Times*'s Danny Hakim wrote, "Monsanto asked Mr. Miller if he would be interested in writing an article on the topic, and he said, 'I would be if I could start from a high-quality draft.' The article appeared under Mr. Miller's name, and with the assertion that 'opinions expressed by *Forbes* Contributors are their own.' The magazine did not mention any involvement by Monsanto in preparing the article."

In his *Newsweek* article, Dr. Miller also sought to discredit the reporting of Mr. Hakim, without mention of the fact that it was Mr. Hakim who exposed Dr. Miller's Monsanto ghostwriting scandal. Ms. Malkan noted that Dr. Miller has gone on, in spite of the *Forbes* scandal, to produce promotional content published in *The Wall Street Journal* (in addition to the cited *Newsweek* piece), without disclosing his compromising relationship with Monsanto.

MANUFACTURING COUNTERFEIT SCIENCE

These ethically dubious realities are neither new nor confined to Monsanto, or to the food or GE sectors. The pharmaceutical industry is famous for hiring ghostwriters to write about science in ways that resemble marketing as much as science reporting. As have the tobacco and sugar industries, the fossil fuel industry has engaged for decades in a pervasive disinformation campaign, hiring scientists and academics prepared to shill for them. As the Union of Concerned Scientists has written, "Some companies choose to manufacture counterfeit science—planting ghostwritten articles in legitimate scientific journals, selectively publishing positive results while underreporting negative results, or commissioning scientific studies with flawed methodologies biased toward predetermined results. These methods undermine the scientific process . . . [and] can have serious public health and safety consequences."

In 2015, Greenpeace conducted a "sting" operation in which it approached, in the guise of consultants to fossil fuel companies, seven professors at leading U.S. universities to commission reports touting the benefits of rising carbon dioxide levels and the benefits of coal. Five declined, but William Happer, PhD, the Cyrus Fogg Brackett professor emeritus of physics at Princeton University, expressed interest in the fake commission. Dr. Happer asked to donate his fee to the CO_2 Coalition, whose mission is . . . to "shift the debate from the unjustified criticism of CO_2 and fossil fuels." The group also asked Frank Clemente, PhD, a retired sociologist, formerly at Pennsylvania State University, to do a report countering damaging studies on Indonesian coal deaths and promoting the benefits of coal.

Both professors proffered methods for hiding the source of funding for the reports, at the request of the fake companies. As *The Guardian* reported, "In Happer's case, the CO_2 Coalition, which was to receive the fee, suggested he reach out to a secretive funding channel called Donors Trust, in response to a request from the fake Greenpeace entity to keep the source of funds secret." Further, Dr. Happer acknowledged that his report would likely not survive the peer-review process typical of legitimate scientific journals. "'I could submit the article to a peer-reviewed journal, but that might greatly delay publication and might require such major changes in response to referees and to the journal editor that the article would no longer make the case that CO_2 is a benefit, not a pollutant, as strongly as I would like, and presumably as strongly as your client would also like,' he wrote."

THE CASTING OF DOUBT ON INDEPENDENT SCIENCE

Greenpeace notes that this investigation showed what the public rarely sees: the practice of clandestine industry commission and funding of reports that cast doubt on critics of industry, or promote industry positions on controversial issues in the public and political realms. Industry will trot out such research or reports in a way that hides or obfuscates its role in shaping the information—sometimes through complex machinations, as with Monsanto's "Academics Review" organization, that appear on the surface to have no relationship with the corporation.

The obscuring of that information dupes the public into believing that such reports come from "independent" scientists or academics. This "independent academic" ruse contravenes what has long been a tenet of science communication, and is a great disservice to members of the public who are trying to figure out what is real and true. What makes science useful in informing public policy is that it, per se, has no "skin" in the commercial or political game—i.e., it is useful when it is genuinely independent. It is supposed to operate, and to be communicated, on its own merits. Ms. Malkin predicts that, "As more documents tumble into the public realm—via the Monsanto Papers and public records investigations—the 'independent academic' ruse will become harder to maintain for industry PR writers such as Henry I. Miller, and for editors, journalists and policy makers to ignore."

THE CHOCOLATE SCAM

In 2015, a science journalist mounted a deliberate hoax to demonstrate the point, as he had done previously in collaboration with the journal *Science* in 2013. As reported by National Public Radio's *The Salt*, in a piece titled, "Why a Journalist Scammed the Media into Spreading Junk Science," John Bohannon, PhD, a science journalist with a PhD in molecular biology, conducted an actual research study on the potential role of chocolate consumption in weight loss. The research intentionally featured multiple design flaws, including too few subjects and too many variables. Dr. Bohannon then got it published in the *International Archives of Medicine,* which failed to carry out peer reviews of the findings—and which charges researchers and authors for the privilege of being published, aka, a so-called "pay for play" publication. Media outlets subsequently fell all over themselves to shout the news that eating chocolate could help people lose weight.

The science–media entropy is described by Robert Gebelhoff, writing in 2016 for *The Washington Post*: "Science and health media writers are constantly in need of new, sexy studies. . . . Meanwhile, scholars and academic journals face pressure to produce work that gets attention from media outlets—doing so can elevate the stature of their research, which in turn promotes their funding. At the same time, researchers have become very good at playing with data—such as shifting the length of their experiments or picking and choosing which variables to control for—in order to come out with the results they want."

The Achilles' Heel for media is exactly what happened in the "chocolate" case: those covering and pushing the story failed to ask independent experts to evaluate the research, which should be standard operating procedure if the media entity cannot do it on its own. Dr. Bohannon wrote, "'You have to know how to read a scientific paper—and actually bother to do it. For far too long, the people who cover this [nutrition science] beat have treated it like gossip, echoing whatever they find in press releases. Hopefully our little experiment will make reporters and readers alike more skeptical."

VETTING SOURCES

Reporting accurately and responsibly on scientific research or information can be challenging, and news venues certainly sometimes fail. Media entities—particularly non-journalistic enterprises—can be careless about vetting the sourcing of their information. Even established media outlets contend with issues of adequate resources to evaluate the legitimacy of the science or research they are covering. Most reporters, editors, bloggers, and, for lack of a better term, "reposters," are *not* scientists and may not be personally equipped to vet research, reports, or sources.

Yet media outlets—newspapers, broadcast media, wire services, and the zillions of digital outlets—must do better in screening for the validity of the scientific or academic reports or research they consider covering. With so many independent information venues, the "echo chamber" effect is real. Blogs or nonprofit venues may pick up information and repeat it—sometimes with vetting, sometimes with none. And as in the traditional game of "telephone," accuracy can be lost in the serial translations, and the information, understanding, and opinion that inform public policy are compromised, with potentially serious consequences.

Both the public and members of the media would do well to become more savvy and more conscientious, given the perils of the current information landscape. The American Press Institute offers a useful guide for determining the trustworthiness of media sources. Wendy Koziol, who works, ironically, for Public Communications, Inc. a private communications strategy and public relations company, nevertheless has sensible tips for journalists in her article, "Science or Scam: Vetting Credible Sources for Journalists."

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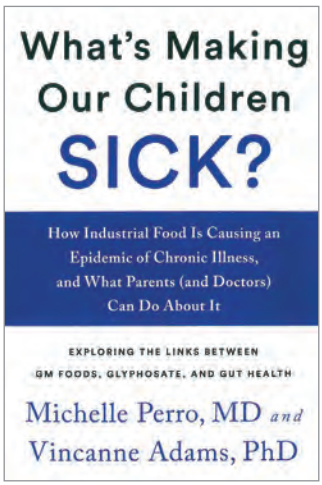
Reviewed by Terry Shistar, PhD

What's Making Our Children Sick?

HOW INDUSTRIAL FOOD IS CAUSING AN EPIDEMIC OF CHRONIC ILLNESS, AND WHAT PARENTS (AND DOCTORS) CAN DO ABOUT IT



By Michelle Perro, MD and Vincanne Adams, PhD, Chelsea Green Publishing, White River Junction, Vermont, 2017, 257 pages

This is a book I would like to put in the hands of every parent (or parent-to-be) of young children. Michele Perro, MD is a pediatrician practicing integrative medicine, which means that she uses methods from a variety of medical traditions. Her major focus is on food—both as a source of illness and a remedy for it. This book contains several case studies of her young patients who suffered from serious chronic illnesses, including autism, celiac disease, asthma, developmental delays, and eczema. Her treatments generally start with removal of foods that often cause sensitivities, homeopathic medicines for detoxification, and an organic diet. However, she also includes conventional pharmaceutical medicines in her practice.

The first subtitle of the book is "How Industrial Food Is Causing an Epidemic of Chronic Illness, and What Parents (and Doctors) Can Do About It." The case studies in the book are interspersed with an analysis of chronic illnesses arising from foods and the chemical-intensive food production system. *What's Making Our Children Sick?* complements *The Hidden Half of Nature* by David Montgomery, PhD, and Anne Bicklé (reviewed in the Spring 2017 issue of *Pesticides and You*). That book looked at the microbiome in the gut and in the soil from an ecological perspective. Drs. Perro and Adams take a medical approach to the same subject. The microbiome in the human gut is medically important because of its central immune system function and its relationship to mental health.

This book identifies as a central important part of the microbiome story, "Whatever disrupts a healthy gut environment probably has significant impacts on the ways in which genes are turned off or on that, in turn, play a key role in regulating all of the body's physiology," which brings us to the second subtitle of the book: "Exploring the Links Between GM Foods, Glyphosate, and Gut Health."

Although the authors investigate impacts of many pesticides through foods and other exposures, they find that genetically modified (GM) foods are "*the key ingredient* in the larger pesticide problem." [Emphasis in original.] They present evidence that GM foods themselves are harmful because of changes in nutritional value and other qualities of the food. However, the larger impacts come from the system in which the GM foods are used. Indeed, although it is often difficult to distinguish the impacts of the GM food itself from the effects of the glyphosate that is sprayed on most of it, evidence does support claims that the herbicide also changes nutritional value of the food and disrupts the gut microbiome.

In spite of the difficulty for a clinician to sort out the science of causality, the authors repeatedly state the importance of switching to an organic diet in treating chronic disease—"Without changing to organic, even the best of treatments and successes aren't, in Dr. Perro's experience, able to be sustained."

And the importance of organic goes beyond the individual. As they explain, "What we are saying is that we need a type of medicine that understands how patients are part of a medico-environmental ecosystem, what we call *ecomedicine*. Considering food-related causes of ill health means thinking beyond the normal list of diseases that students are currently taught in medical school and also beyond the normal list of drug therapies that are available for these diseases.... In this ecosystem, health can be sought and achieved only if the food ecosystem itself is healthy."

The book concludes with a call to action and explanation of why the authors wrote the book—to support those parents driven to ensure that their children are healthy. It is a great tool to put in the hands of those parents.

Although it is often difficult to distinguish the impacts of the genetically modified food itself from the effects of the glyphosate that is sprayed on most of it, evidence does support claims that the herbicide also changes nutritional value of the food and disrupts the gut microbiome.

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Spring 2018 ■ Vol. 38, No. 1

MAKE YOUR YARD, LOCAL PARK, AND SCHOOL A "PESTICIDE FREE ZONE"

Display a Honey Bee or Ladybug yard sign

Show your neighbors that pesticide-free lawns are important for the health of your family the environment and the community. At eight inches in diameter, these painted metal signs will not rust and will retain their bright colors for years. The sign comes with valuable information on organic lawn and garden management, pollinators, and how to talk to your neighbors about pesticides. Signs are available for $13 each ($10 plus shipping for ten or more) at **bit.ly/BeyondPesticidesStore**.

Distribute doorknob hangers

The Safe Lawn Door Knob Hanger is a tool to help spread the word about the dangers of lawn pesticides and the ever-increasing availability of alternatives. It's an easy, non-confrontational way to approach neighbors that may be using pesticides. You can request a free pack of 25 doorknob hangers by emailing your name and address to **info@beyondpesticides.org**. You can order more from our online store. Learn more at **bit.ly/lawnsandlandscapes**.

Adopt organic land management in your town

Help your town, city or county adopt organic land management practices and a policy –protect and nurture soil biology, save the pollinators by preserving and improving biodiversity, use less water, and sequester carbon to reverse global climate change. Work with Beyond Pesticides at **bit.ly/ToolsForChange**.

Learn more at *www.beyondpesticides.org/lawns*.