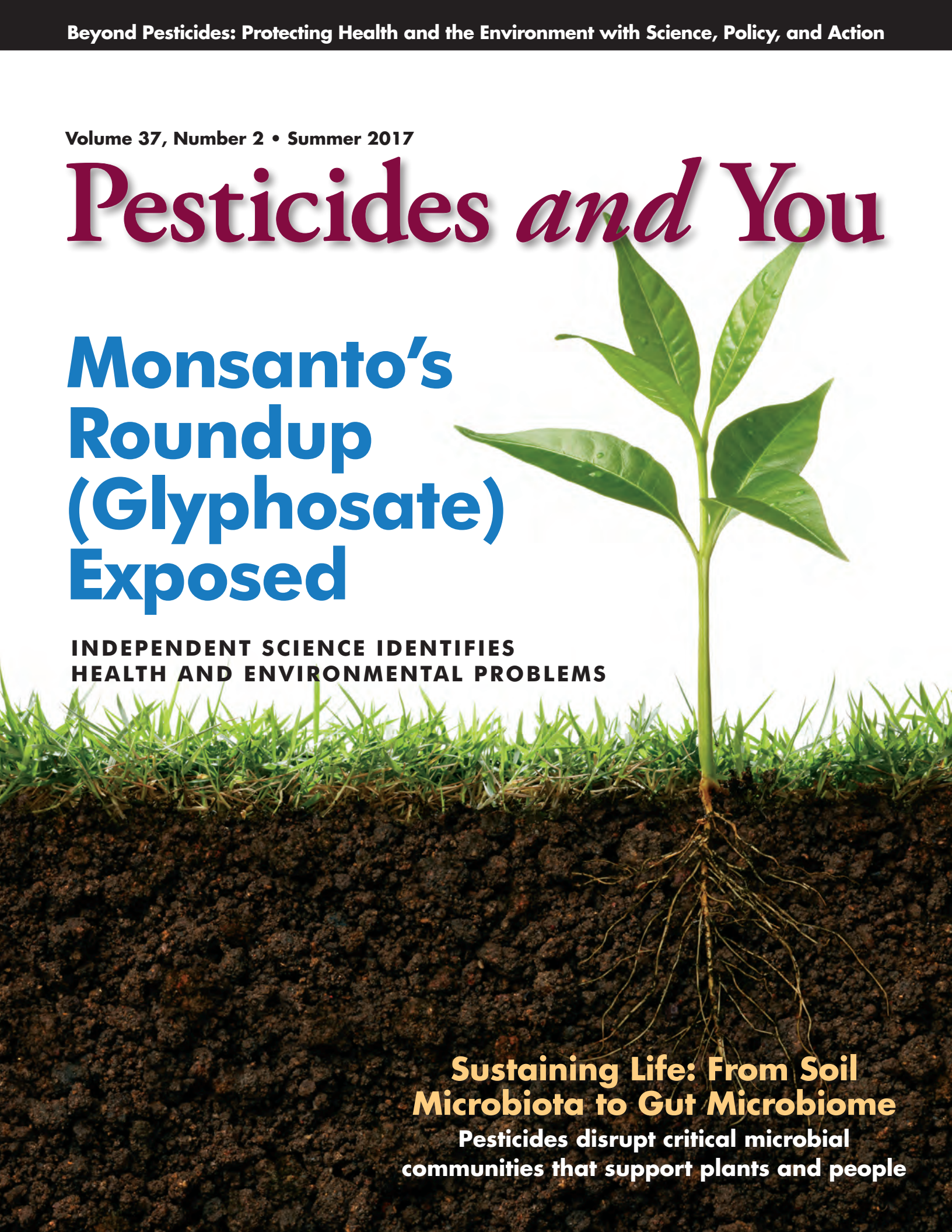
Beyond Pesticides: Protecting Health and the Environment with Science, Policy, and Action

Volume 37, Number 2 • Summer 2017

Pesticides *and* You

Monsanto's Roundup (Glyphosate) Exposed

INDEPENDENT SCIENCE IDENTIFIES HEALTH AND ENVIRONMENTAL PROBLEMS



Sustaining Life: From Soil Microbiota to Gut Microbiome

Pesticides disrupt critical microbial communities that support plants and people

Respecting the Underground Ecosystem and Gut Microbiome

In his talk at Beyond Pesticides' 35th National Pesticide Forum in April, David Montgomery, PhD captures the essence of the conversations that are critically needed in all our communities and action that must be taken for a sustainable future. In many ways, the talk, published in this issue, is a personal story of revelation, rethinking of scholastic thinking, understanding relationships in nature, and an appreciation of the power and fragility of the natural world. (View the presentation at *Healthy Hives, Healthy Lives, Healthy Land: Ecological and Organic Strategies for Regeneration* on Beyond Pesticides' YouTube channel.)

Underground ecosystem

Dr. Montgomery, a professor of geology at University of Washington, MacArthur Fellow, and author of three books on soil health, human health, and taking action, explains the steps that his co-author, biologist, and wife, Anne Biklé, took to convert their garden soil, which contained a mere one percent organic matter, to a healthy ecosystem. He said, "We were cycling organic matter into this underground ecosystem in ways that led us to learn things that frankly quite surprised us and started us on this view of a completely different relationship of the natural world to human societies."

He clearly explains the contribution that soil microbes bring to soil and plant health and the effect that the management of the land has on our bodies and particularly our gut biome. In this issue, we also hear from Don Huber, PhD, professor emeritus of plant pathology at Purdue University, who gives us a complete picture of the adverse impact that pesticides have on the ecosystem and our health. (See Dr. Huber's talk on our YouTube channel.)

We hold our national conference every year to keep ourselves updated on the underlying science that must drive change, to share strategies from around the country on transitioning to organic practices that respond to our increasing scientific understanding, and to bring back to the policy debate in our communities appropriate land and building management practices that protect and nurture life. Bring Drs. Montgomery's and Huber's words to your campaign to align community practices with sustained health. As Dr. Montgomery says, "[W]e need to think about our microbial crew, or the microbiomes of plants and people, in terms of protecting, restoring, and cultivating the beneficial microorganisms that are key elements of those communities."

Respecting complexity

Rachel Carson warned us in her book *Silent Spring* in 1962 that when we use pesticides we are adversely affecting complex biological communities. And people understood the value of the microbial community (sometimes referred to as ecosystem services) when Sir Albert Howard constructed the definition of organic in *The Soil and Health: The Study of Organic Agriculture* (1940), and *An Agricultural Testament* (1947).

After building the case for nurturing the underground ecosystem, Dr. Montgomery concludes, "[I]f we use a broad spectrum biocide [pesticide], we are taking out all the beneficial organisms. . . ."

Holistic solutions

There is a tendency to try to simplify problems and then look for simple solutions. In truth the problems of environmental degradation and health threats induced by toxic chemical exposure require holistic solutions with changes in systems that establish our much-ignored relationship with nature.

Indiscriminate effects to microbiota

We must remember that when the U.S. Environmental Protection Agency (EPA) registered the neonicotinoid insecticides, which are clearly tied to elevated rates of decline in bee and pollinator populations, it did not have a field study to evaluate the chemicals' overall impact on ecosystem health, let alone impacts on individual species. Whether we are talking about the soil or aquatic food web, the agency did not do the analysis. But, it really is not difficult to see that systemic pesticides that enter the vascular system of a plant and express themselves through pollen, nectar, and guttation droplets are going to have a wide range of non-target effects.

Same is true for plants that are genetically engineered to contain a pesticide gene. What is the overall impact on the soil microbiota when growing a plant in the ground that exudes pesticides indiscriminately? And, with an eye to economic impact, indiscriminate pesticide use is causing insect and weed resistance, which adversely affects productivity and keeps those on the pesticide treadmill looking for the next best chemistry to throw at the ecosystem.

We celebrate the victories in communities across the country that have adopted and are working to adopt organic land management, with practices that build soil health. It is critical that we enrich our understanding and effectiveness to meet the challenges ahead in our communities and states. This issue and Beyond Pesticides' program is intended to do just that. Let us know how we can support your efforts.

Jay Feldman, executive director of Beyond Pesticides

CONTENTS

© Thinkstockphoto/photokostic

FEATURES

DEPARTMENTS

Pesticides and You © 2017 (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.

NATIONAL HEADQUARTERS
701 E Street, SE Washington DC 20003
ph: 202-543-5450 fx: 202-543-4791
email: *info@beyondpesticides.org*
website: *www.beyondpesticides.org*

Cover photo:
© Thinkstockphoto/Okea

Printed on 100% post consumer waste with soy inks.

© From Walmart Website

New Roundup, Same Danger

Beyond Pesticides,

Although I never use herbicides on my property, I recently saw a new Roundup brand, "Roundup for Lawns," advertised while shopping at the supermarket. It doesn't look like it has glyphosate in it, and there are two versions—one for northern lawns, and one of southern lawns. I assume they're the same or worse than original Roundup in terms of toxicity. Can you tell me more about these products, and alternatives to their use?

Penny, Indianapolis, IN

Hi Penny,

It appears Monsanto is making an effort to rebrand Roundup in light of mounting evidence that glyphosate, the long-standing active ingredient in Roundup brand products until now, is a carcinogen. Your assumptions about its toxicity are correct, as the chemicals in these products present significant health and environmental concerns. Northern Roundup for Lawns contains four different active ingredients: MCPA, quinclorac, dicamba, and sulfentrazone. Southern Roundup for Lawns contains a different combination of chemicals, including penoxsulam, dicamba, 2,4-D, and sulfentrazone. Each of these chemicals present toxicity concerns by themselves. For example, auxin class herbicides MCPA, dicamba, and 2,4-D have each been linked to neurotoxicity, kidney and liver damage, and reproductive effects. Penoxsulam was labeled as having "suggestive evidence of carcinogenicity" by the U.S. Environmental Protecting Agency (EPA). Quinclorac has been associated more significantly with environmental concerns, particularly in fish and aquatic wildlife. And sulfentrazone has been linked to reproductive and birth and developmental impacts in humans.

Broader health concerns beyond the toxicity of individual chemicals are also apparent in these new products. There is a disturbing trend for pesticide manufacturers like Monsanto to take advantage of a loophole in federal law that allows companies to formulate pesticide products with multiple active ingredients without conducting new toxicity testing. Despite the fact that research has consistently demonstrated changes in overall toxicity based upon differing chemical combinations or mixtures, EPA only considers active ingredients individually. In addition, and even more concerning are the inert (undisclosed) ingredients in these products. These chemicals may be more or less toxic than any of the active ingredients, but are not required to be listed on the label as they are considered proprietary business information by Monsanto and other pesticide manufacturers. Perhaps unsurprisingly, the most famous instance of a highly toxic inert, polyethoxylated tallowamine, is in a Roundup product. This inert was shown to cause necrosis (death) in human umbilical, embryonic, and placental cells. Many point to the inert ingredients in Roundup to explain studies that show formulated Roundup displaying a

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.

higher toxicity than the technical grade or active ingredient of glyphosate.

The bottom line is that Roundup in all its current formulations is toxic and dangerous. To control common weeds on lawns without Roundup or any toxic synthetic chemicals, there are a wide range of alternative practices you can employ, and least-toxic products available as a last resort. You can get an idea of the range of least-toxic and organic products available through Beyond Pesticides' new List of Products Compatible with Organic Production, available at *bp-dc.org/OrganicCompatible*. For example, a good selective herbicide that does the same job as the new "Roundup for Lawns" product is the EPA minimum risk product HALO. To find out more about the toxicity of the individual chemicals in this new Roundup, see Beyond Pesticides' Gateway on Pesticide Hazards and Safe Pest Management at *bp-dc.org/PesticideGateway*.

Preventing the Rash of New Tick-Borne Diseases

Beyond Pesticides,

I'm hearing a lot of news about a rise in ticks and tick-borne diseases throughout the country. It seems like every year there's a newly discovered disease spread by ticks. First lyme, then the one that makes you allergic to red meat (!?), and now Powassan, which they say could be worse than lyme. How do I protect myself and my family from these scary new diseases without spraying pesticides and putting them at risk for other health effects?

Lynn, Bedford, MA

Hi Lynn,

We certainly understand your concerns. Although Powassan virus was discovered as far back as 1959, there were very few reports until recently. During the last decade, official reports detail 75 cases in 12 states, a majority in the Northeast. Powassan, lyme, rocky mountain spotted fever, and yes, even that odd disease that causes an allergic reaction to alpha-galactose (a sugar molecule in red meat) appear to be on the rise. However, despite these new and spreading tick-borne diseases, the same prevention methods still apply. While there is no way to completely rid an outdoor area of ticks, you can prevent them from getting to your skin by wearing bright-colored, long sleeve clothing, and conducting a full-body tick check after returning from an outdoor or wooded area. Add an extra layer of protection by employing a least-toxic tick repellent, containing an active ingredient like Oil of Lemon Eucalyptus, 2-undecanone, IR3535 or Picaridin. Avoid neurotoxic DEET in favor of these products. You can use EPA's database to identify the efficacy of tick repellents [*bp-dc.org/EPArepellents*].

Note that ticks can also be brought into homes on pets that roam outside—especially if pets wander in areas that provide a good mouse habitat. Common mice habitats include woods, bushes, leaf piles, burrows and other areas that provide cover to protect them from predators. By discouraging mice, which are often the primary vector where ticks will pick up diseases that can be passed to humans, you can reduce tick populations and diseases fairly effectively. To do this, remove piles of leaves or other debris that may provide shelter for the mice, clean around bushes and under trees, store wood piles away from your home and elevate them, and keep tightly closed lids on metal trash containers.

If you get a tick bite, tweezers should be able to successfully remove the tick. Wash and clean the area, and dispose of the tick by submerging it in rubbing alcohol. Watch the area and be mindful of any symptoms of tick-borne disease, including fever or chills, muscle ache, headache, or joint pain, a bulls-eye rash around the site of the bite, and swollen lymph nodes. These spreading and novel tick-borne illnesses are concerning, but by practicing prevention and regular tick-checks, you can stop the bite that leads to these diseases. See Beyond Pesticides ManageSafe database, *bp-dc.org/ticks*.

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 original blog post (05/12/2017): Exposure to Heavy Pesticide Use Can Impact Neurobehavioral Performance in Children. Researchers from the University of California San Diego, School of Medicine, in collaboration with scientists from Ecuador and Minnesota, have found that exposure to heavy pesticide use during peak periods impacts neurobehavioral performance in children.

Steven Zien comments via Facebook: These toxic agricultural pesticides are available at your local nursery and garden center and are being used by unsuspecting urban gardeners. If you have any organophosphate pesticides (e.g., malathion) stop using them, there are many safer and effective alternatives. Then take these toxic products to your local household hazardous waste collection site for proper disposal.

Nan St. Michael comments via Facebook: We are all being exposed to toxic pesticides every day—they're in the air, the water, the soil and our food. We all need to stand up and demand that they stop being produced and used.

Endangered Species Act Violated with EPA Bee-Toxic Pesticide Registrations

In early May, U.S. District Judge Maxine Chesney ruled that the U.S. Environmental Protection Agency (EPA) violated the Endangered Species Act (ESA) when it issued 59 neonicotinoid insecticide registrations between 2007 and 2012 for pesticide products containing clothianidin and thiamethoxam. The original lawsuit against EPA, Ellis v. Housenger, was filed in March 2013, by beekeeper Steve Ellis and a coalition of other beekeepers and environmental groups, including Beyond Pesticides. The 2013 lawsuit focused on EPA's failure to protect pollinators from dangerous pesticides and challenged EPA's oversight of the bee-killing pesticides, clothianidin and thiamethoxam, as well as the agency's practice of "conditional registration" and labeling deficiencies.

Judge Chesney rejected claims by pesticide producers and their supporters that the plaintiffs failed to establish a causal link between the pesticides and the plaintiffs' injury. The judge did not order EPA to consult with the U.S. Fish and Wildlife Service (FWS) and National Marine Fisheries Service (NMFS), which is required when registering a pesticide in order to mitigate risks to endangered species. Instead, she directed the parties, including the plaintiffs, defendant EPA, and intervenor Bayer CropScience, to move forward with a settlement conference to resolve the disputes. Thus, additional proceedings will follow the decision to assess the proper solution for EPA's violations, which may lead to cancellations of the 59 pesticide registrations, including agricultural products such as seed-coating insecticides.

This ruling comes at a time when neonicotinoids are pervasive and widely used across the agricultural landscape, home gardens, and public spaces. Of the two most widely planted crops in the U.S., between 79 to 100 percent of corn seed and 34 to 44 percent of soybean seed were coated with neonics in 2011. A conservative estimate of the area planted with neonic coated corn, soybean, and cotton seed totals just over 100 million acres, or 57 percent of the entire area for these crops.

EPA Sued for Delaying Updated Pesticide Applicator Standards

© Alamy/J.R. Bale

On June 14, farmworker and health organizations sued the U.S. Environmental Protection Agency (EPA) following the agency's announcement in May that it will delay for one year the implementation of a final rule that revised and updated protections for certified pesticide applicators. The Certification of Pesticide Applicators (CPA) rule includes much needed requirements like mandatory age minimums, as well as better training for pesticide applicators to protect workers and the public from poisoning by toxic pesticides.

The CPA rule was revised and made final on January 4, 2017, and was scheduled to go into effect March 6, 2017. It outlines regulations regarding the certification of applicators of restricted use pesticides (RUPs)—some of the most hazardous pesticides. The rule ensures that applicators of RUPs get adequate training and establishes a minimum age of 18 for pesticide applicators. It also requires that applicators be able to read and write; increases the frequency of applicator safety training to every year; and improves the quality of information that workers receive about the pesticides that they apply. EPA has issued an extension "until May 22, 2018, and . . . the agency is taking this action to give recently arrived Agency officials the opportunity to conduct a substantive review of the revised Certification of Pesticide Applicators rule."

The delay means minors or poorly trained applicators can continue to handle some of the most toxic pesticides in agricultural, commercial, and residential settings, putting themselves and the public at risk. According to EPA, there are about one million certified applicators nationwide. Before delaying implementation, the agency said the revised rule could prevent some 1,000 acute poisonings every year.

Court Revokes Federal Approval of Nanotech Pesticide

In early June, the U .S. Court of Appeals for the Ninth Circuit concluded that the U.S. Environmental Protection Agency (EPA) failed to show that its conditional registration of the antimicrobial, nanosilver pesticide product "NSPW-L30SS" (previously "Nanosilva") is in the public interest and revoked its registration. The case, brought by the Natural Resources Defense Council and the Center for Food Safety, challenged the approval of the novel nanotechnology, which was marketed for use in more than 400 products, including textiles and plastics. The decision underscores the need for EPA to ensure pesticide products, including nanomaterials, at least meet the standards of federal pesticide law.

The court decision further warns, "Nanosilver, due to its much smaller particle size, can have significantly different properties than conventional silver. These different properties provide new benefits and opportunities to industry. But with these new benefits come new risks." Studies find that nanoproducts carry with them significant risks to people and the environment, including DNA damage to plants, increasing bacterial resistance to antimicrobials, and toxic and potentially lethal impacts on fish.

This case also highlights the deficiencies of the controversial conditional registration process at EPA. EPA's conditional approval of the nanoproduct exemplifies the agency's allowance of products into the market without sufficient and legally required data. A 2013 U.S. Government Accountability Office report concludes that, "EPA does not have a reliable system to track key information related to conditional registrations, including whether companies have submitted additional data within required timeframes." This latest court decision shows that products must be fully evaluated before being allowed on the market, and that continued conditional registration of products is contrary to EPA's mission.

The ligitation follows a 2008 petition filed by 13 organizations, including Beyond Pesticides, a lawsuit in 2014, and an EPA agreement in 2015 to evaluate nanotach pesticides.

EPA Administrator Scott Pruitt

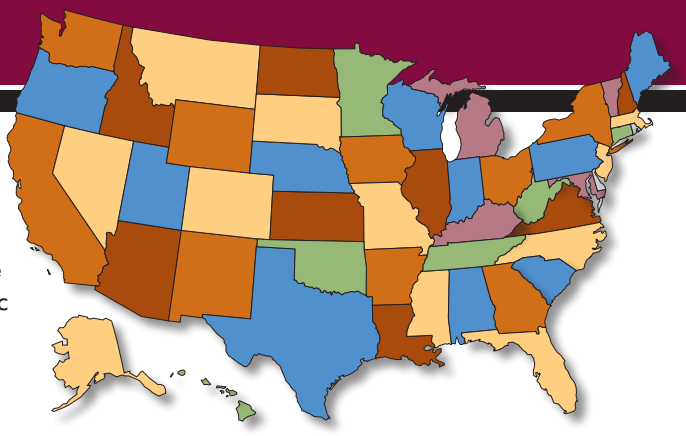
© Creative Commons/Gage Skidmore

Groups, AGs Challenge EPA Decision to Allow Insecticide Chlorpyrifos in Agriculture

Numerous farmworker organizations in June filed an administrative appeal to the U.S. Environmental Protection Agency (EPA), seeking to reverse Adminstrator Scott Pruitt's order to continue allowing the toxic organophosphate insecticide chlorpyrifos in agriculture, and revoke all tolerances (allowed food residues) of the chemical. On the same day, Attorneys General (AGs) from seven states announced legal objections to the order, also calling for a reversal of the decision and a revocation of all tolerances. Allowing the continued use of chlorpyrifos runs counter to findings of independent science and EPA's own scientists, which establish unacceptable risks to humans and the environment.

The administrative appeal, filed by Earthjustice on behalf of 12 environmental, labor, and civil rights organizations, resulted from the decision by EPA to allow the use of chlorpyrifos while it studies the safety of the chemical. The seven AGs, in their filing, are charging that EPA wrongfully approved the continued use of chlorpyrifos in agriculture without first gathering and assessing the full safety data, as required by the *Federal Food, Drug, and Cosmetic Act*. Chlorpyrifos is part of the organophosphate class of pesticides, which were used in World War II as nerve agents. As potent neurotoxicants, organophosphates are extremely harmful to the nervous system and the developing brains of children.

In March 2017, Mr. Pruitt reversed a tentative EPA decision from 2015 to revoke food residue tolerances of chlorpyrifos due to the chemical's neurotoxic impacts. This would have effectively banned chlorpyrifos from agriculture. This decision stemmed from a petition and lawsuit filed by the Natural Resources Defense Council (NRDC) and Pesticide Action Network North America (PANNA) ten years ago, calling for EPA to revoke all chlorpyrifos tolerances and cancel all registrations. A federal appeals court mandated that EPA take final action by March 31, 2017.



Montgomery County, MD Pesticide Restrictions Supported in Face of Industry's Legal Challenge

With a chemical and lawn care industry lawsuit challenging the right of Montgomery County, Maryland to restrict pesticides on private property throughout the community, nine organizations, including Beyond Pesticides, filed an Amicus brief in support of a 2015 landmark Montgomery County, Maryland ordinance. Intended to protect children, pets, wildlife, and the wider environment from the hazards of lawn and landscape pesticide use, the law is facing a legal challenge filed in November last year by the pesticide industry group Responsible Industry for a Sound Environment (RISE).

The plaintiffs, which include local chemical lawn care companies and a few individuals, allege that the local ordinance is preempted by state law, despite the fact that Maryland is one of seven states that has not explicitly taken away (or preempted) local authority to restrict pesticides more stringently than the state.

The law at issue, 52-14 (*the Healthy Lawns Act*), which restricts the cosmetic lawn care use of toxic pesticides on public and private land, protects over one million people, the largest number to be covered by any local jurisdiction to date.

Passing the Montgomery County Council by a vote of 6-3, the bill allows time for transition, training, and a public education program over several years. In limiting the pesticides allowed to be used for turf management, the law defines acceptable materials as those permitted for use in organic production, or identified by the U.S. Environmental Protection Agency (EPA) as "minimum risk pesticides" under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), Section 25(b).

"It is not just a longstanding right, but a responsibility, of counties in the state to exercise their powers to the fullest to protect the health and well-being of their citizens. This lawsuit unfortunately seeks to strip Montgomery, and other counties in the state, of their critical role in the protection of public health," said Chris Nidel, partner at Nidel & Nace, PLLC, which represents the amici.

© Thinkstockphoto/Zhengza Ishuru

Walmart and True Value Pledge to Phase Out Bee-Toxic Pesticide

Walmart and True Value announced in May that they will be phasing out neonicotinoid (neonic) pesticides from their retail supply chains. These announcements follow numerous scientific studies that have consistently implicated neonics in the decline of honey bees and wild pollinators. The decision stems from an ongoing consumer and environmental campaign urging retailers to stop selling plants treated with neonics and to remove products containing them from store shelves.

Neonicotinoids are systemic pesticides, or whole plant poisons, taken up by a plant's vascular system and expressed in the pollen, nectar, and guttation droplets. They are also highly persistent, with research showing the potential for certain chemicals in the class, such as clothianidin, to have a half-life of up to 15 years. Studies show significant cause for concern when it comes to pollinators and exposure to these pesticides.

In April 2015, Lowe's announced a commitment to phase out products containing neonics within 48 months. Home Depot followed shortly after that. In January 2016, Aldi Süd, the German supermarket chain with stores in the U.S., became the first major European retailer to ban pesticides toxic to bees. In April 2016, major pesticide manufacturer Scotts Miracle Gro announced that it will immediately begin phasing out neonicotinoid insecticides, including imidacloprid, clothianidin, and dinotefuran, from its outdoor-use Ortho brand

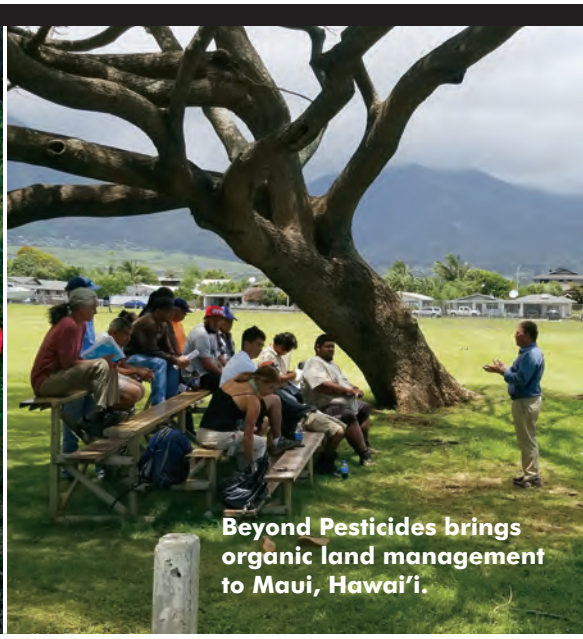
this year. Smaller local stores are leading the charge as well, by removing bee-toxic neonicotinoids from store shelves and working to reorient customers toward holistic organic practices—over 18 retailers in the Boulder, Colorado area have signed a "pollinator safe retail" pledge.

Eliminating the sale of harmful pesticides does not mean that retailers will have nothing left to sell to their customers. Last year, Beyond Pesticides released its video, *Making the Switch*, and *The Well Stocked Hardware Store*, an online toolkit that identifies organic compatible products for hardware stores seeking to find replacement products that can be used with an organic systems approach to land management.

San Juan Capistrano, CA Passes Organic Landscape Policy

San Juan Capistrano (SJC) in April became the latest community in Orange County, CA to pass an organic landscaping policy for city parks and open spaces. The city's move was brought forward by a strong contingent of local advocates, health practitioners, and city officials working together to safeguard public health and the environment. By a vote of 4-0-1, SJC's City Council put the community on the cutting edge of local changes to pesticide use that are taking place across the country.

SJC's policy is the result of persistent pressure and engagement by community group Non-Toxic San Juan Capistrano with city officials. A change.org petition hosted by the group, which received over 300 signatures, detailed the discussions and responses the group received from local leaders. At the time the City Council took up the issue at a mid-April meeting, Mayor Kerry Ferguson made a strong statement indicating that, "Chemical pesticides . . . have been proven to be toxic to children, pets, and the general public." Mayor Ferguson further said, "While [chemical pesticide] use is somewhat limited in our parks and open spaces at the present time, it would be helpful for a policy to be put into place that gives clear guidelines to present and future contractors to guide them in their practice on our city properties."


Beyond Pesticides brings organic land management to Maui, Hawai'i.

The city's new policy provides these clear guidelines by prioritizing "long-term prevention and suppression of pest problems" and putting a focus on "prevention and non-chemical control measures before the use of pesticide controls." The measure directs landscape managers to use a prioritized approach to pest management by choosing plants with low susceptibility to pests, forgoing treatment unless necessary, and, when treatment is required, apply organic pesticides first, and U.S. Environmental Protection Agency "caution" labeled pesticides only "when deemed necessary to protect public health and economic impact. . ."

Maui County, HI Starts Organic Management of Parks and Roadsides in Pilot Project

Four parks in Maui, Hawai'i, have kicked off a year-long pesticide-free pilot program to transition to organic management. A series of training events in May focused on soil-based approaches to land management. Beyond Pesticides' executive director, Jay Feldman, and Beyond Pesticides board member Chip Osborne, president of Osborne Organics, taught training sessions with county Parks and Recreation staff, "discussing lawn care that relies less on outside products and feeds the soil, not just the plant." Beyond Pesticides is working to support the pesticide-free parks movement in Maui by sponsoring these training sessions for Maui County Parks, Department of Transportation (DOT), Maui public schools, several local resorts, and golf course management groups. Beyond Pesticides' board member Lani Malmberg, of Goats Green, used 60 goats to show the state DOT how to replace the herbicide Roundup (glyphosate) with more sustainable managed goat grazing.

Beyond Pesticides is working with Maui County to provide guidance on transitioning its parks to organic practices. Analysis of soil samples at each site has been conducted, which will provide a baseline to implement cultural changes to improve the biological health of the soil, making it more resistant to weed and insect pressures. The next step includes creation of a report and action plan for each county park by Beyond Pesticides and Osborne Organics, detailing the timeline for implementing practices of soil improvement

and long-term management. In discussing the parks' pilot program with Maui News, Chip Osborne stated, "There was a lot of fungal life and a lot of bacterial life [in these soils], but it wasn't active. All the years of pesticides and salt-based fertilizers had diminished it. So the first thing that's going to happen —far more important than a bag of fertilizer—is to restore that biological level." These programs give land managers the knowledge, understanding, and tools necessary to make a broader transition to organic land care.

Consumers Sue Monsanto for Misleading Labeling of Roundup Herbicide

In late June, a lawsuit was filed in a Wisconsin federal court against Monsanto, the manufacturer of Roundup brand herbicides, and Scotts Miracle-Gro Company, a marketer of Roundup brand products. The complaint, filed by six consumers from states around the country, focuses on the promotion, marketing, and sale of Roundup brand products, rather than physical injury from the pesticide products. The lawsuit alleges that Monsanto and Scotts label, advertise, and promote their Roundup products with the "false statement that Roundup's active ingredient, glyphosate, targets an enzyme that is not found 'in people or pets.'" Plaintiffs assert that this is a false and deceptive claim, as this enzyme is found in the gut bacteria of people and pets and glyphosate can disrupt the health and functioning of their immune system.

This suit mirrors the lawsuit filed by Beyond Pesticides and Organic Consumers Association in April 2017 against Monsanto for misleading the public by labeling the weedkiller Roundup as "target[ing] an enzyme found in plants but not in people or pets." Monsanto aggressively markets Roundup as safe for humans and animals, despite newer studies indicating that glyphosate is carcinogenic and affects human and animal cardiovascular, endocrine, nervous, and reproductive systems. No reasonable consumer seeing these representations would expect that Roundup targets a bacterial enzyme that is found in humans and animals and affects the health of their immune system.

In the latest lawsuit against Monsanto and Scotts, plaintiffs seek "compensation for themselves and Class Members equal to the amount of money they paid for Roundup products that they would not have purchased had they known the truth, or in the alternative, the amount of money they paid based on the false statement." The defendants use these false statements for marketing purposes, including video ads on their YouTube channels and websites and on their Roundup weedkiller labels.

Citing a Serious Health Threat, Over 200 International Scientists Call for Limit on Antibacterial Triclosan

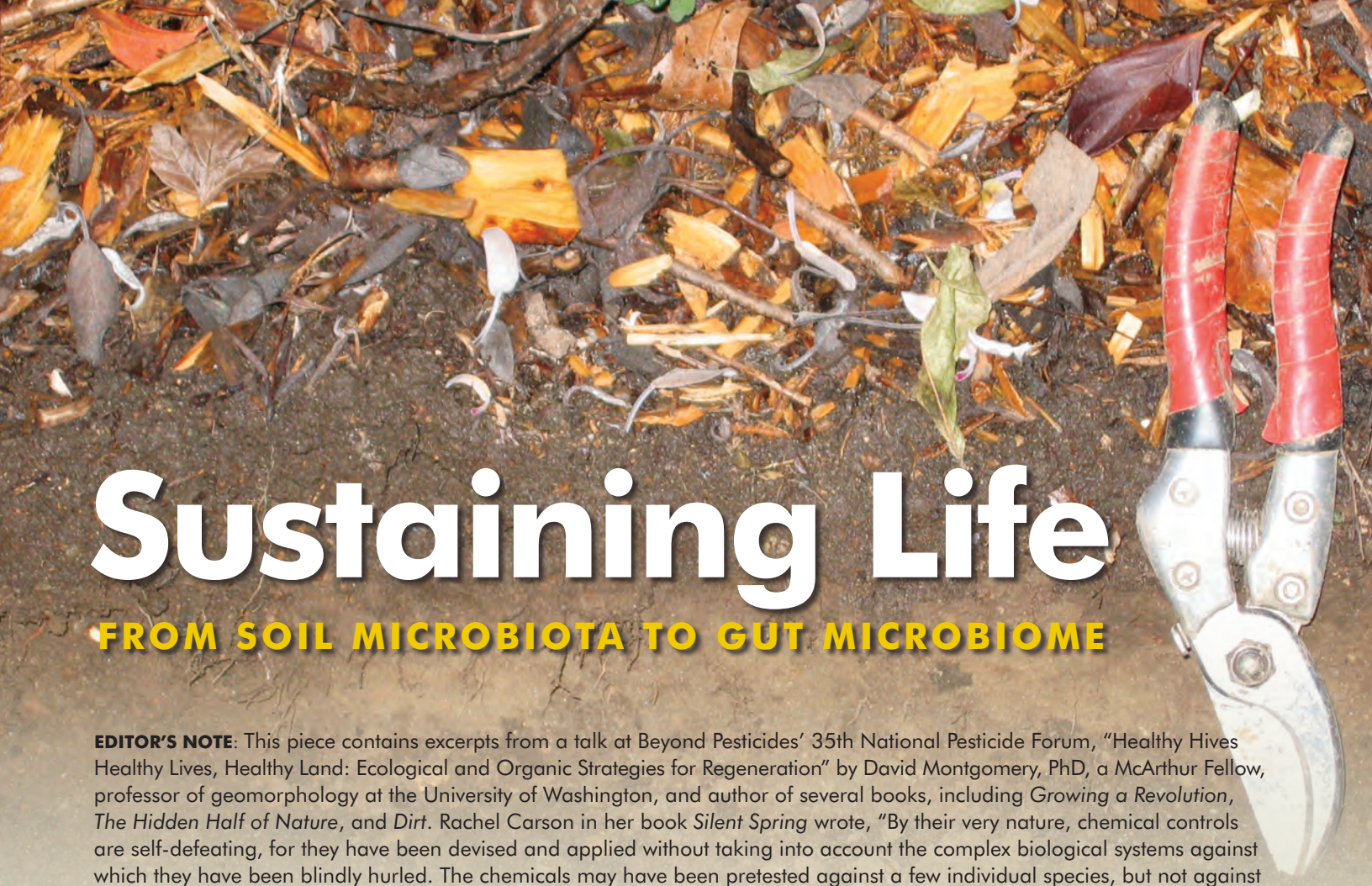
More than 200 international scientists and medical professionals have signed the Florence Statement on Triclosan and Triclocarban, which states that triclosan and its chemical cousin triclocarban pose a risk to human health. It urges the international community to limit use of these antimicrobials, which are associated with bacterial resistance and are no more effective than soap and water. In 2016 after manufacturers failed to prove efficacy, the U.S. Food and Drug Administration (FDA), which regulates cosmetic triclosan products, announced that manufacturers must, by September 2017, remove triclosan from over-the-counter hand soaps. The agency still allows the chemical in toothpastes and other products, such as hand wipes.

The Florence Statement on Triclosan and Triclocarban is "based on extensive peer-reviewed research," and "concludes that triclosan and triclocarban are environmentally persistent endocrine disruptors that bioaccumulate in and are toxic to aquatic and other organisms." The statement includes evidence of human health threats, and provides recommendations intended to mitigate harm from triclosan, triclocarban, and other similar antimicrobials.

© Thinkstockphoto/Byoung Joo

The Environmental Protection Agency (EPA), which regulates triclosan in household items, textiles and plastics, still permits wide use of the chemical in a range of products. EPA has not been receptive to petitions and requests to cancel registered products containing triclosan. In May 2015, EPA issued its long-awaited response to a petition filed by Beyond Pesticides and Food & Water Watch, denying the request. This means that non-cosmetic consumer products containing triclosan (frequently marketed as microban) are still being sold in stores. These chemicals are in all types of products, from toys, cutting boards, hair brushes, sponges, and computer keyboards to socks and undergarments.

Be conscious of labels when buying products, such as toothpaste and consumer products. When purchasing home products, you can research whether or not they contain triclosan and plan to avoid buying those products.



Sustaining Life

FROM SOIL MICROBIOTA TO GUT MICROBIOME

EDITOR'S NOTE: This piece contains excerpts from a talk at Beyond Pesticides' 35th National Pesticide Forum, "Healthy Hives Healthy Lives, Healthy Land: Ecological and Organic Strategies for Regeneration" by David Montgomery, PhD, a McArthur Fellow, professor of geomorphology at the University of Washington, and author of several books, including *Growing a Revolution*, *The Hidden Half of Nature*, and *Dirt*. Rachel Carson in her book *Silent Spring* wrote, "By their very nature, chemical controls are self-defeating, for they have been devised and applied without taking into account the complex biological systems against which they have been blindly hurled. The chemicals may have been pretested against a few individual species, but not against living communities." In this vein, Dr. Montgomery, in this talk, brings modern scientific understanding to one of the most critical public health and environmental issues of the modern era—how complex microbial or biological systems that Ms. Carson identified are essential to the health of the soil microbiota and the gut microbiome in humans. Dr. Montgomery's complete talk can be viewed on Beyond Pesticides' YouTube channel at *bp-dc.org/Forum17*.

Pesticides disrupt critical microbial communities that support plants and people

DAVID MONTGOMERY, PhD

Thank you all for coming to the Forum, and for the invitation to talk to you today. I'm a geologist by background. My wife Anne Biklé, co-author on the book *The Hidden Half of Nature: The Microbial Roots of Life and Health*, which I'll be talking about today, is a biologist. Why would people like us, who were trained to study in the more traditional natural history disciplines of things we can actually pick up, look at, see, and feel for ourselves, write a book about microbes? This was very much a collaborative effort, as you'll see as I go through what it is that we learned along the way.

A BONAFIDE SCIENTIFIC REVOLUTION

The real message is that the way we understand the microbial world has been going through a revolution in thought, which Anne and I think is akin to a genuine bonafide scientific revolution. The way that we are now thinking about how microbial communities interact with plants and with people—and are central to their health and well-being—is completely shifting the way that we have thought about and looked at how we interact with the microbial world. This has fundamental implications, we argue, for both agriculture and medicine, which relate to the themes that you all are very interested in, in terms of the application of broad spectrum biocides as routine measures. As we got into researching this book about the stars of the microbial world, and their interactions not only with each other, but with other organisms, we realized that a big-scale change is occurring in the way that we think about our relationship to nature—that is centered in the microbial and microscopic world.

INTERACTING WITH MICROBIAL COMMUNITIES

The title of our book, *The Hidden Half of Nature*, is actually meant to be taken literally. If we look at the range of scales—

moving up by factors of ten from down at the nanometer scale of DNA up to the scale (the meter scale) that we live in, you will notice that the boundary between the microscopic world, the invisible world, and the visible world lies halfway through the scale. There is as much of a range in size in the microscopic world of nature as there is in the world of nature that we know, from the size of amoebas up to humans. If you actually weighed all the microbes on this planet, and you compared that to the weight of all the plants and animals on this planet, they are about equal. There are about a nonillion microbes on this planet. (A nonillion is a one followed by 30 zeros.) If you took all the bacteria, all the microbes in the world, and laid them end to end (it takes 50 thousand of them just to go around my thumb), they would reach the nearest star and back. In other words, microbes, if they ever got organized, could actually get off this planet before we could.

So, how is it that we came to actually recognize and get interested in the microscopic world? Well, it may seem like a bit of a *non sequitur.* We bought a house in Seattle and it came with an old growth Seattle lawn. It was a lawn planted in 1918. Nothing much had been growing there after that, and I thought it was a perfectly fine lawn. The dog liked to chase balls on it, and I got to get the graduate students over for cookouts once a year. But my wife is a gardener and viewed this as her garden to-be. One of the main reasons we bought this house was that she wanted to actually transform the property from something other than that lawn. So, when we pulled off the lawn, we discovered that we actually had this incredibly rich, dark, fertile soil. Uh, no! We had glacial till.

Seattle is a town that was overrun by a glacier that scraped off bits of British Columbia, bulldozed it down to where we live in Seattle, and then overran it with a mile-high pile of ice. That pile was about three times the height of the space needle, if you are looking for scale. It was basically nature's concrete. We did not find a single worm in the soil when we pulled that lawn off. There were no macroscopic life forms. Now, I'm sure there were some microbes in there, but we will get back to that a little later. We realized that we did not have soil. We had dead dirt.

Now, when you think about what it is that actually makes for rich, fertile soil, it is the marriage of geology and biology. You would think that people like Anne and I would have understood this. But, I did not think to dig a soil pit in our yard when we bought the house, and neither did she, so we were faced with this when we started to try to turn that yard into a garden. We realized that we had the geology—we had all those bits of Canada that had been scraped down our way—but we did not have the biology. The organic matter content in our soil and our area when we started was less than one percent. This led us—I should say more correctly it led Anne—to think that what we really needed to do was add a lot of organic matter to the yard. She started what we call in the book her "organic matter crusade," which meant going to every place that we could get organic matter, bringing it in, putting it on as compost or mulch in the yard, and trying to rebuild our soil.

THE ORGANIC MATTER CRUSADE

At the time, I was writing a book about the way that agricultural practices had destroyed civilization after civilization by degrading their soil, and it was a revelation to me as to how fast you could actually revive soil. It was happening right under my nose, in my own yard, as Anne was indulging in her grand experiment of bringing life back to the yard. The soil pit that we actually ended up digging in the yard about five years into her organic matter crusade had wood chips and the mulch that she was layering on the surface of the soil and glacial till down at the bottom—she was not a digger, she was a composter and a mulcher. The plant roots go down to the till and then go sideways. They are not going down into the till. Nevertheless, we found about two inches of halfway decent soil that formed in about five years.

If you actually look at geological literature, at how fast soils form, you get rates that are measured in tenths of a millimeter a year. Here, we have two inches in five years. This was not from breaking rocks down to form more soil—it was forming good soil out of the geology that was already there by adding the biology. It started me thinking: What if the key to soil restoration is not the way a geologist usually thinks about it, in terms of making more soil from rocks, but it is actually turning the stuff at the surface into more of a fertile soil by adding the biology?

We were cycling organic matter into this underground ecosystem and started us on this view of a completely different relationship of the natural world to human societies.

The change in our soil transformed the yard above ground too. We ran into an explosion of plant life. What happened? Why was this organic matter crusade, adding dead material to the surface of the soil, leading to an explosion of life, both above and below ground? Basically, that compost that we were adding at the surface was being consumed by microbes, bacteria, and fungi, the smallest creatures in the soil food web, which were then being consumed by larger creatures, which are consumed by larger creatures. We were cycling

organic matter into this underground ecosystem in ways that led us to learn things that frankly quite surprised us and started us on this view of a completely different relationship of the natural world to human societies.

One of the things that Anne and I both noticed when she started her composting and mulching activities is that we would lay a good bed of mulch down in the fall and it would be virtually gone come the spring. Initially, we were starting to think, "Is somebody coming into our yard at night and taking all our good stuff?" No. It turns out, actually, that our neighbors are quite happy to have us go rake up their leaves and bring them back to our yard. But, still, this stuff was disappearing and breaking down. We were good enough scientists to realize it was not just disappearing. It was being transformed.

The microbial life—the bacteria and fungi—were the things primarily responsible for that transformation, and they turned out to be very nutrient rich—rich in nitrogen, rich in phosphorus, and rich in the micronutrients that all life forms need. Why? Well, because they are breaking down organic matter that used to have those nutrients—used to be living matter. When nematodes and microarthropods can graze on and consume these smaller creatures, it comes out later in a transformed state that can be fairly good fertilizer. I like to think of them as tiny livestock that are manuring the soil from the inside out. We are adding all that organic matter to the yard, basically feeding our grazing animals, which are then in turn being grazed. That is essentially building up the nutrient levels in the soil through a two-step soil-food web.

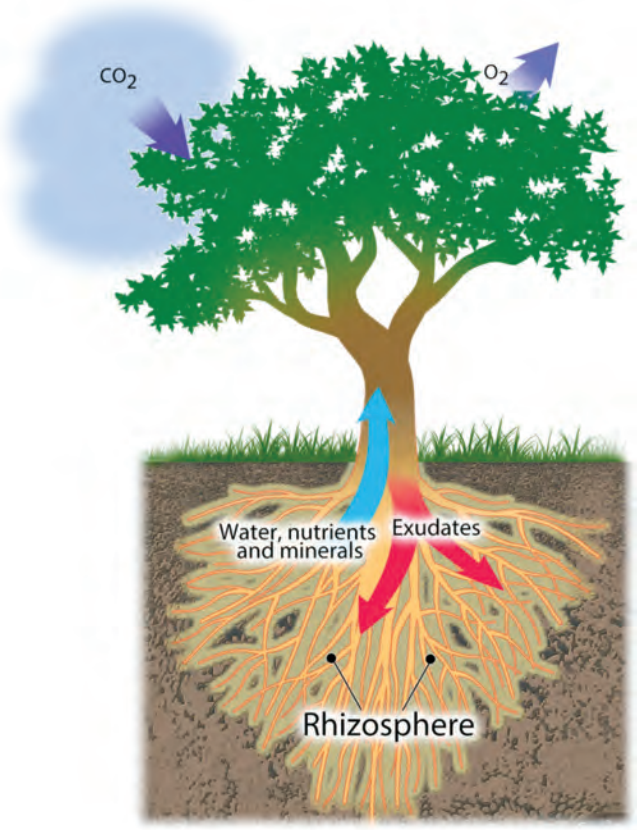
To be honest, to a geologist, that was not completely new thinking—that is systems thinking we are fairly accustomed to. But we started to look into and learn things that really quite surprised me. They center on what happens in the rhizosphere, that zone around the root system of a plant that is incredibly rich with life. It is one of the most life-dense zones on the planet, and it started us thinking: "Why is that?"

THE RHIZOSPHERE: A BIOLOGICAL BAZAAR

I was quite surprised to learn that roots are actually two way streets. When I took soil science a few decades ago in graduate school, I was basically taught that plant roots were like straws. They bring up water and the nutrients contained in them that have been derived from rocks into plants. It turns out that plants actually push out into their soil up to 30 or 40 percent of the carbon and the carbon-rich compounds that they manufacture with their monopoly on photosynthesis. They will push that stuff out of their roots and into the soil. Why would a plant do that? How many of you take 30 to 40 percent of your income and just go throw it on a street corner somewhere? If you think about it in those terms, it is an utterly irrational thing for a plant to do. And yes, I know plants do not have brains, but they do communicate. Why would plants be essentially pushing out such nutritious material, what Elaine Ingham, PhD (U.S. Soil Microbiologist, founder of Soil Foodweb, Inc.) likes to call the equivalent of cakes and cookies, into the soil? It is to feed the life that is living in the rhizosphere. Why would a plant do that, and maintain that over the entire history of plants? If you go back and look at the very first plant fossils 400 million years ago, they have mycorrhizal fungi intertwined with their roots. This has been going on as long as there have been plants. Why would they do that? Well, it is not because most of the microbes are pathogens. That would be an evolutionary dead end. It is because they are feeding life forms in the soil that provide benefits to the plants. So, Anne and I learned to see the rhizosphere, this life-dense zone around the roots of plants, as what we call a biological bazaar, where microbes and plants trade nutrients, metabolites, and exudates.

If you blow up the area around the root or root hair of a plant, what is happening is in the rhizosphere. There is a high concentration of bacteria and mycorrhizal fungi connecting with the plants. Most of those exudates that come out of the plant roots make it only a millimeter or centimeter out into the soil before they are consumed. They get rapidly eaten, and what happens to things that get eaten? They get transformed

FIGURE 1: **Rhizosphere Rich with Life**



Source: David Montgomery

into metabolites, the byproducts of some living organism. Those bacteria are pushing out into the soil, in their metabolites, things like plant growth promoting hormones. They are helping to dissolve the materials out of the soil and get them back into the plant. Why would bacteria make plant growth hormones? This is like one kingdom of organisms creating something to help another. It is a classic example of a symbiotic relationship. The plants are helping to feed the microbes, the microbes are helping to nurture the growth, and, it turns out, the health of the plants. Mycorrhizal fungi, reaching out into the soil, are going out and excavating things like phosphorus, manganese, or iron from the soil, bringing it back, and trading it to the plant in exchange for a cut of the photosynthetic harvest.

When Anne and I learned this, we were really quite surprised that these kinds of relationships that have developed in the rhizosphere seem to be every bit as complex and evolutionarily fine-tuned as the relationships between plants and pollinators above ground. But we have not known about that because they are occurring in this invisible world, a microscopic world, and they are happening below ground. It is sort of the double hidden nature of the hidden half of nature. We were even more surprised when we started looking into some of the other aspects of the relationship between plants, their roots, and the microbes living in the rhizosphere. For example, when some insect herbivores snack on your favorite plant, or a crop, that plant will push exudates out into the soil that are tailored to feeding the growth of very particular microbes or microbial communities, which will then produce very particular exudates that are taken back up by the plant and can produce compounds that taste bad to that particular insect. This is a really fined-tuned evolutionary relationship. This kind of thing is why Anne and I ended up writing *The Hidden Half of Nature*. It is utterly fascinating. Thirty years ago, we did not understand most of the mechanisms. We did not have the technology to actually study the connections, and to establish that symbiosis is not just wishful thinking. The modern science that has been coming out in the last couple of decades has nailed these relationships as cutting edge science, even though they are very similar, in terms of their broad implications, to some of the things Sir Albert Howard and Lady Eve Balfour (principal figures in the early organic movement) were proposing in the 1930s and 1940s. The science is finally catching up with some of the insights of the early pioneers of organic agriculture.

THE SOIL BODY CONNECTION

What does this mean in terms of how we think about plant health and plant diet? Anne and I have defined something we like to call the "fertilizer diet"—if you provide a plant with most of the macronutrients that it needs (the nitrogen, phosphorus, potassium [NPK]) that you usually find on the label of a synthetic fertilizer bag) those plants will not put as much energy into creating an extensive root system, and they turn into what we like to call "couch potato crops." The fertilizer diet provides plants with the stuff they need for growth. However, the system that they rely on to promote their health and their defensive capabilities requires micronutrients and metabolites that the microbes in the soil produce. When you feed them a heavy diet of macronutrients, they do not invest in their root system to put the exudates out into the soil to recruit the microbes that make the beneficial microbial compounds. They are getting a heavy dose of macronutrients and a light dose of beneficial microbial metabolites.

On the other hand, plants grown in soils that are rich in organic matter will grow extensive root systems, put out lots of exudates, and essentially recruit microbial allies. That is a recipe for plant health. What does that soil life diet look like? It turns out it looks a lot like the kind of thing that Anne did to our yard. In adding our composted coffee grounds (we have a surplus of them in Seattle), our leaves and woodchips, we were basically bringing back the biology to feed the subsurface biology that is the other half of fertility in fertile soils.

SOIL, HUMAN IMMUNE SYSTEM, AND GUT MICROBIOME

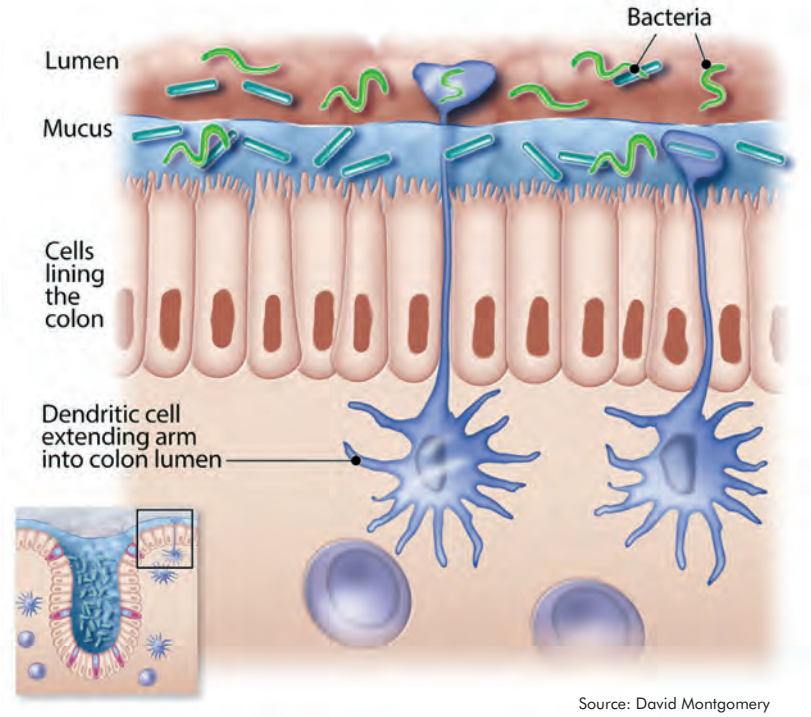
We watched the transformative effects on both the life in our yard and the development of our soil, but we got thrown a curve ball. We were starting to think that the microbial world is this really neat, symbiotic world in terms of what was happening in our yard, and then Anne was diagnosed with microbial-caused cancer. This was a very serious event in our lives, obviously, and thankfully now she has just passed her five-year anniversary of being cancer-free. So it is an episode that we hope is well and truly behind us. That episode started Anne thinking very strongly about what it is that actually supports health, and, particularly, the human immune system. Because, with an event like cancer in your life, you start thinking about what are the things that we can do to really bolster the effectiveness of our immune system to try and make sure we do not have any future episodes along those lines. So, while we were thinking of the microbial world as this incredibly symbiotic thing, this curve ball reminded us that not all microbes are on our side. There are very bad microbes in this world, and it led us into thinking about the human microbiome and its relationship to our immune system.

This is an area of science that has been exploding. If you graph the numbers of publications on the human microbiome since 2000, you will notice an exponential growth curve that keeps going up. The numbers of papers and interest in the human microbiome have obviously exploded in the last couple of years, and this led Anne and me to look into the relationship between the human immune system and human health. This has led to something that I never thought I would ever be doing, which is standing in front of an audience and talking about the human colon.

GASTROENTEROLOGY AND SOIL SCIENCE

A little geography here. Looking at a cross section of the colon, the lumen is the center. It turns out that most of the human immune system—some 80 percent of our immune cells—occur in the lining of the colon just outside the colon wall. The colon is also where 80 percent of our microbiome lives. What is our microbiome? It is the indigenous and endemic microbial community that lives on and within us. When we started looking into immunology journals and we started to run across wording that talked about the mucus layer that lines the lining of our colon as an exudate that your colon wall cells produce and push out into the lumen, we started recognizing a very similar set of terms in both the gastroenterology literature and in the soil literature. Why is it that our colon lining would be producing exudates that actually support and feed a fair number of the microbes in our microbiome? It is starting to sound a little bit like what plants do. To basically understand the connection to the human immune system, we have to dive in to what is happening across our colon lining. It turns out that your colon lining is one cell thick; one cell separates the inside of us from the outside of us. If we look at a cross section from the lumen down into the inside of our colon wall, there is this mucus layer, and there are microbes living both in the lumen and the mucus.

FIGURE 2: **Human Colon: Immune System and Microbiome**



Source: David Montgomery

Immune cells, called dendritic cells, are like shape-shifting amoebas. They can extend an arm, stick it between the cells that line your colon, go out into the lumen or the mucus, and grab a sample of something. They bring that sample back inside and share it with T-cells, which are other cells in our immune system. Those dendritic cells will sample those microbes, bring their pieces (antigen) back, and show them to the T-cells. T-cells are essentially major players in our immune system, but they are inactive most of the time. Each T-cell is tailored for a very particular antigen. When the dendritic cell brings the antigen to the T-cell, the T-cell gets activated. The dendritic cell sampling of the microbes in our colon and colon lining activate T-cells in two different ways. We are used to thinking about our immune system as a system that goes after pathogens and kills them, kind of like a paramilitary organization living within us. But, it turns out that there are two kinds of T-cells that get activated by this mechanism. Certain microbes, when they get sampled, activate T-cells that trigger inflammation. Other T-cells, when they get triggered, quell inflammation (they are anti-inflammatory). In the classic way of thinking about our immune system, we just think about them as things that would trigger inflammation, because inflammation is the process through which our body does remodeling. It takes out cells we do not want, but like all remodeling projects, there is always incidental damage. You do not want inflammation to be happening all the time. If you do not need inflammation to be combating some kind of malady, you want inflammation to be turned off. This idea that the regulation of our immune system, to quell inflammation, is dictated in part by microbes that are living in our gut, is a completely new way of looking at the immune system, and it also leads us to a completely new way of thinking about and looking at what we eat.

If you look at what has changed over the course of the 20th century, in terms of infectious and chronic diseases, there is a relationship here that we are going to try to get at the heart of. If we look at what has happened in terms of infectious diseases since the Second World War, they have really dropped dramatically. Why? Well, obviously, antibiotics came into play in that era. There were great increases in public sanitation during that same era as well, and the development of vaccines and their widespread use. Infectious diseases have gone through the floor in the last couple of generations. At the same time, rates of chronic disease have gone through the roof. So, what is happening with that? There is a hypothesis that researchers in the microbiome world have been investigating that is in great part based on that sort of teeter-totter balance of our pro- and anti-inflammatory immune cells and that relates to what is happening in our gut. That hypothesis can be framed as questions: Are we missing some of our microbes? Have the microbial communities in our gut changed enough that the puppeteers, if you will, that have been running our immune system, are actually misfiring, or getting bad information?

Diseases Associated with Microbiome

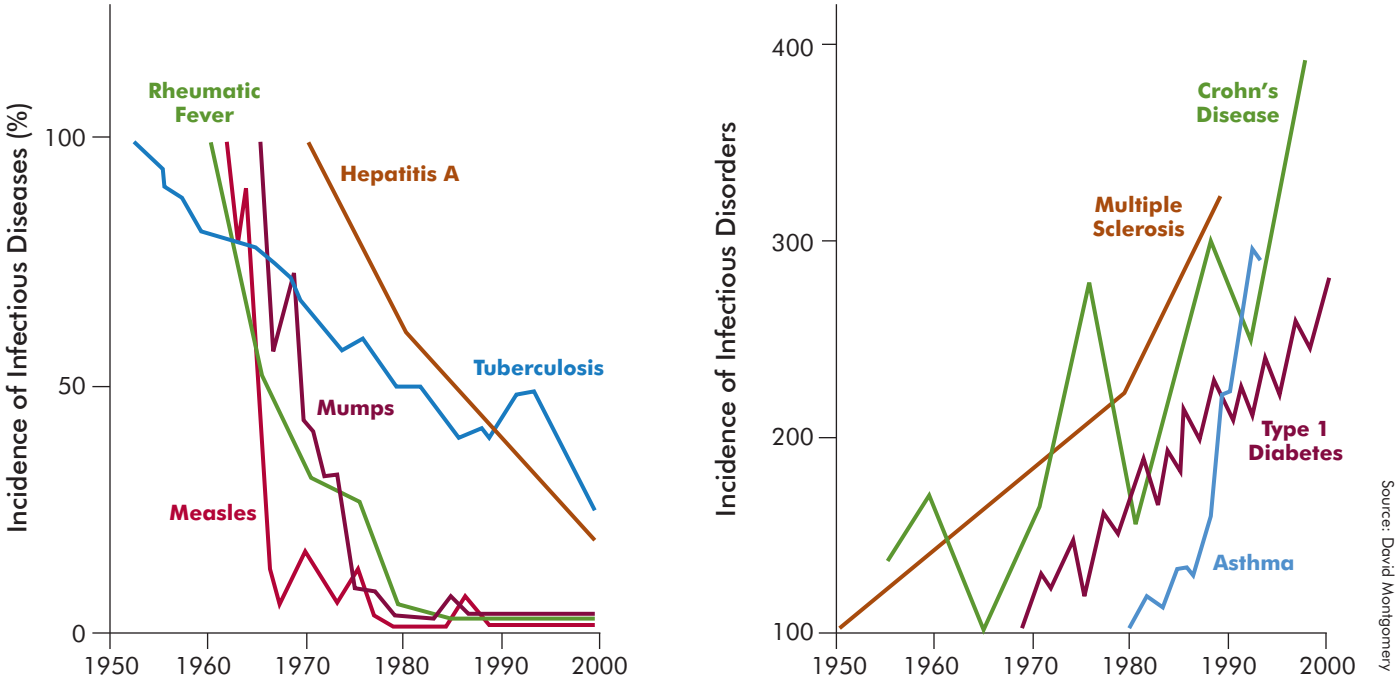
Allergies, Asthma, Autism, Bacterial vaginosis, Cardiovascular Disease, Certain cancers, Crohn's Disease, Depression, Inflammatory Bowel Disease, Leaky Gut Syndrome, Multiple Sclerosis, Obesity, Type 1 and Type 2 Diabetes, and Parkinson's.

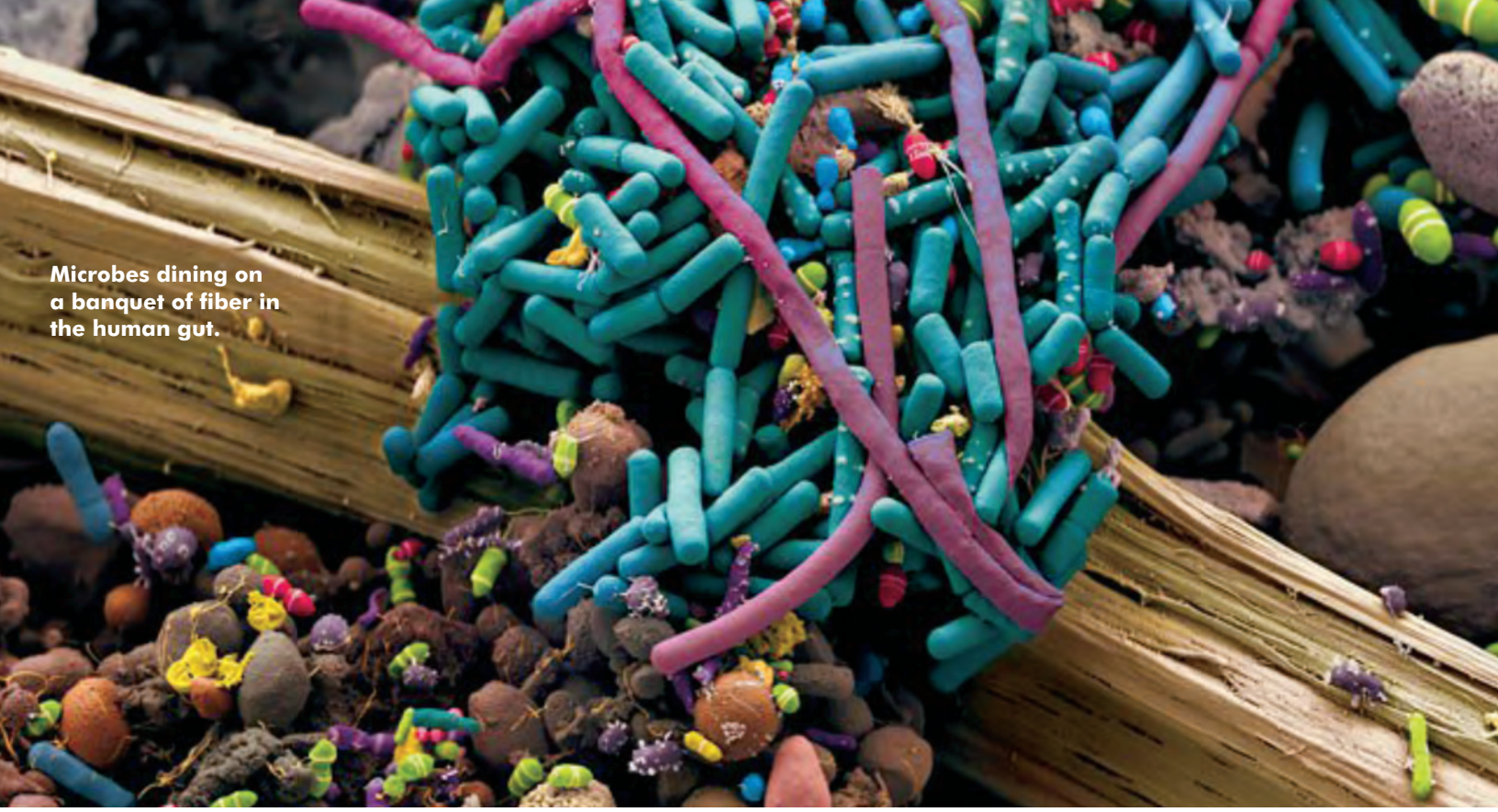
Think about our immune system not so much as a police force, but more as an intelligence arm. Have we been getting bad intelligence for the last few decades, in terms of what our bodies should do in relation to inflammation? This is a hypothesis that is being pursued by many researchers around the world. There is a whole bunch of maladies (see box)—and I notice that there is an article that came out a couple days ago that added Parkinson's to the list—for which causal links are starting to be established. Every one of these diseases is one in which people have hypothesized and demonstrated correlative effects, and some of them have demonstrated causative effects.

THE 20TH CENTURY DIET

What might have happened to our microbiome that could have led to such serious proposals to investigate the idea of very widespread effects? Well, what about what we eat? We know about changes in antibiotics after the Second World War, and how that might affect the human microbiome should not be much of a mystery. Broad spectrum antibiotics kill microbes broadly. What about what we eat? To understand the connection of diet with the human microbiome, we need to think a little bit about the human digestive track. I'm going to take you on a field trip through the human digestive track, and we are going to start at the stomach, where there are hardly any bacteria (1 to 10 per milliliter of fluid). It is an incredibly acidic environment. What happens there? Well, things are supposed to be dissolved. So, food will come in, and we start to dissolve it. In the small intestine, we have the enzymes to break down and absorb things like proteins, simple sugars, and fats. They will get absorbed in the small intestine, and there are more microbes there than there are in the stomach. It is not until you get down to the colon that we start getting numbers in the hundreds of millions to trillions of microbes. Most of our microbes are living in our colon. And, like all organisms, they need to eat. Most of

FIGURE 3: **Inverse Relation between the Incidence of Prototypical Infectious Diseases (left) and the Incidence of Immune Disorders (right) from 1950 to 2000.**





Microbes dining on a banquet of fiber in the human gut.

those microbes are eating whatever does not get absorbed by us through our digestive tract. That tends to be whole plant foods (complex carbohydrates).

What do those microbes living in our colon do with those whole plant foods that get down there with those complex carbohydrates? They ferment them. We basically have an on-board fermentation tank called our colon. And, the microbes living within it are essentially living off of the part of our diet that actually makes it down to what we like to think of as the tranquil grazing pastures for the microbes in our colon.

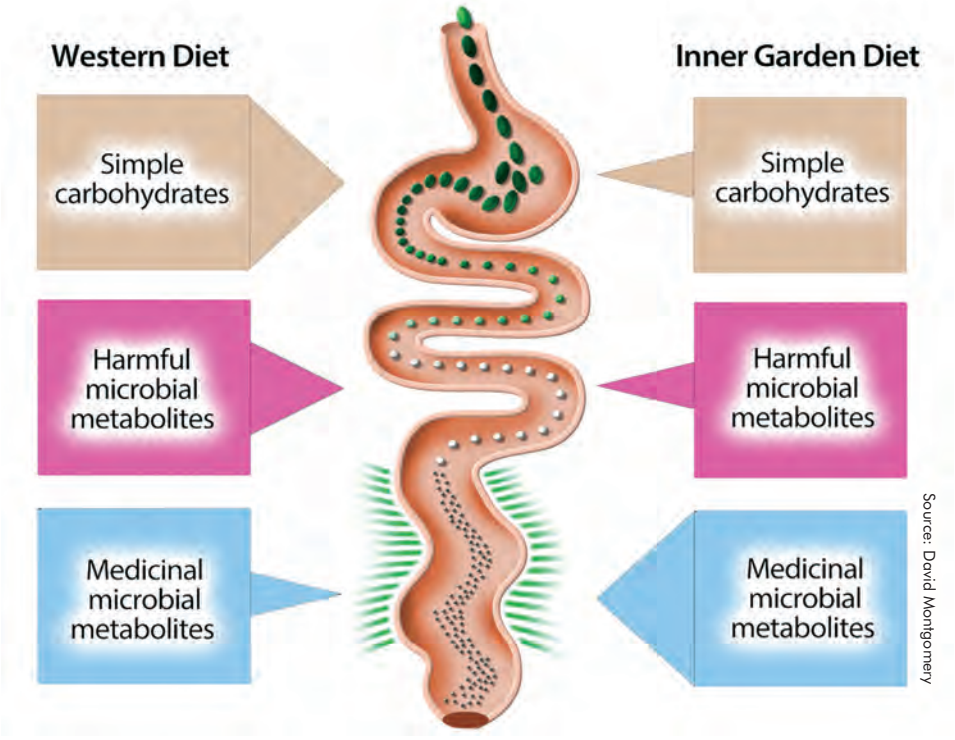
So, what happens if we have a diet that does not have much in the way of complex carbohydrates? We are basically starving what is down in your colon. What has happened to the human diet in the last 100 years or so in the developed world? Well, we have changed our carbohydrate consumption. If you look at total carbohydrate consumption in grams per day from 1910 to 1997, you will notice that we had a high carbohydrate consumption but a high fiber content. What is another word for complex carbohydrates? Fiber! That is what your doctor or nutritionist would call them. So, carbohydrates come in simple forms, as simple sugars, and as complex carbohydrates, or fiber. We had a high carbohydrate, high fiber diet early in the 20th century, and a lot of changes happened during the century. Late in the century, the carbohydrate component of our diet went back up, so that it is about the same as it was early in the 20th century—but the form is different. We're eating simple sugars, not complex carbohydrates. Any why is that? Well, two-fold. The processing of grains has greatly reduced the complex carbohydrates in our diets, and there has also been a great increase in simple sugars being added to everything.

A photograph of microbes dining on a banquet table of fiber in the human gut (see above) could just as easily be a photograph from the garden. The message that I want to convey is that there are really strong parallels in what is happening in terms of the relationship between the microbial world out in agricultural fields and in the garden, and within the garden of our own gut. How does this matter to our own health? I'll try to drive it home here. We have all these different fiber sources, they get into our colon, consumed by the microbiota within our colon, our microbiome, and then produce their own metabolites. A lot of them produce fatty acids, like acetate, butyrate, and propionate.

I am going to focus just on butyrate. Why? Well, what feeds the cell lining of our colon wall? Most of the cells in our body are fed by our blood. Our colon lining gets most of its energy from the butyrate that is produced by microbes living in our gut. Those microbes depend on a diet of fiber. If they do not get enough butyrate, the gaps between the cells start to grow because the cells shrink, and, as you might imagine, it is would not be crazy to posit that this might be linked to something called leaky gut. So, what happens when dendritic cells sample that butyrate, bring the antigen back, and show it to the T-cells? It activates T regulatory cells. Those are the kind of T-cells that quell inflammation, and that basically block an inflammatory response. Here we have all the pieces connected between our diet and the inflammatory response in our bodies, and the way our immune system is working and mediated greatly through the role that microbial metabolites play in our gut.

Where does this leave us in terms of thinking about the human diet? Well, if we think about what is happening with

FIGURE 4: **Western Diet vs. Inner Garden Diet**



The Western diet is heavy on simple carbohydrates and light on medicinal microbial metabolites. An Inner Garden Diet is light on simple carbohydrates and heavy on medicinal microbial metabolites.

the western diet, it is rich in simple carbohydrates. We are getting a lot of stuff that is being absorbed in our bodies into the small intestine, but we are really not putting a whole lot of fiber down into the colon, so we are getting a low dose of these medicinal microbial metabolites. Butyrate is just one of many compounds that the microbiota in our colon are actually making. There are estimates that 30 to 40 percent or more of the metabolites—of the compounds circulating in our blood—are metabolites from microbes in our colons. We like to think of our microbiota, our microbiome, as microbial alchemists. They are transforming that fiber into beneficial metabolites. On the other hand, if we think about something that Anne has termed the "inner garden" diet— and she got to name it because she is the gardener—it can include modest simple carbohydrate consumption. It also produces a lot of medicinal microbial metabolites—things that could actually be very useful in preventive medicine.

So, what does an "inner garden" diet look like? It contains a lot of whole plant foods, some kind of a protein source, and unprocessed whole grains as a great source of fiber. The key thing, and the thing that transformed our diet after we did this research, was thinking that we really need to feed our microbes first. I now think, after I have fed my microbes enough of a whole plant food based diet, I can go have dessert, or I can have a burger, or whatever I want to go eat. The idea of prioritizing the feeding of our microbial crew is actually really crucial for health. This understanding led Anne and me to the revelation that transformed the way that we framed and wrote *The Hidden Half of Nature*.

We need to think about our microbial crew, or the microbiomes of both plants and people, in terms of protecting, restoring, and cultivating the beneficial microorganisms that are key elements of those communities.

THE PARALLELS: SOIL HEALTH AND THE HUMAN GUT

When we started writing *The Hidden Half of Nature*, we thought we were writing a book about restoring soil and restoring our yard, and we ended up devoting half of it to the human microbiome. Why? Well, when you look at these two systems, the human gut and the root system (rhizosphere of a plant), you realize that they are very similar, but inside out. You take your colon and turn it inside out, and it is not all that different from the root system of a plant; do the opposite, and you get kind of the same thing. This is in terms of how the microbial communities in those organs are actually interacting to promote the health of the host. They are basically assisting with nutrient acquisition. The microbes in the soil are really helping to bring micronutrients and some major nutrients into plants, while the microbes in our body help facilitate nutrient transfer across our colon wall. The role of microbial metabolites, promoting the health of both plants and people, has become very clear in the literature in the last few decades. The parallels, when you get into it, are actually quite striking.

HUMAN IMMUNITY AND PLANT DEFENSE

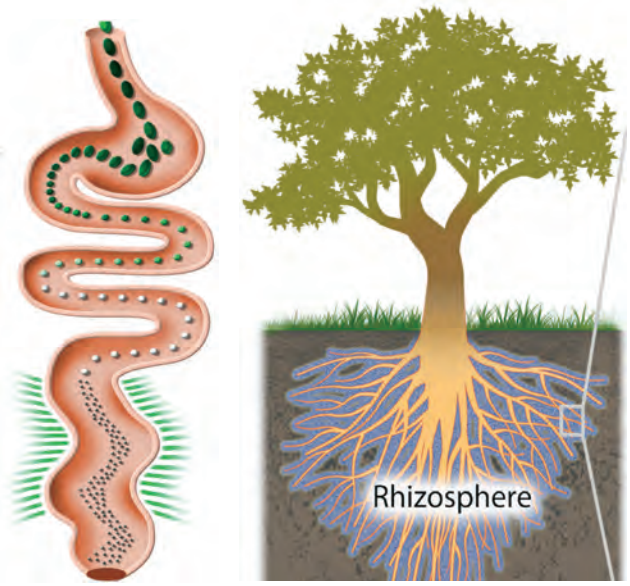
The other parallels are in terms of immunity and plant defense. The defense system of our bodies and the defense system of plants are different. After all, we can move around and we take nature inside of us, whereas a plant is stuck outside and cannot move around in nature. The role of

We really need to think about avoiding the routine use of broad-spectrum biocides, because if we use a broad spectrum biocide, we are taking out all the beneficial organisms, as well as the pests and pathogens.

microbial communities and their metabolites in supporting plant defense and our own immune systems are actually strikingly parallel. What does this essentially mean for thinking about our relationship to the natural world? Well, first of all, it means that we need to think about our microbial crew, or the microbiomes of both plants and people, in terms of protecting, restoring, and cultivating the beneficial microorganisms that are key elements of those communities. That has clear implications for both medical and agricultural practices.

In case you want to convey to somebody the essence of what I am talking about, in terms of all these microbes, we have boiled the book down to six words for you, which should be fairly easy to remember. It's basically, "Mulch your soil—inside and out."

FIGURE 5: **The Root is the Gut (inside-out)**



Nutrient Acquisition
Microbial Metabolites
Immunity and Defense

Source: David Montgomery

STOPPING BIOCIDES THAT KILL INDISCRIMINATELY

There is also another really big implication of the realization of the fundamental role of microbial community ecology in the health of both plants, and therefore crops, and people. We really need to think about avoiding the routine use of broad-spectrum biocides, because if we use a broad spectrum biocide, we are taking out all the beneficial organisms, as well as the pests and pathogens. We have thought about microbes for a little over a hundred years now, in terms of germ theory, as being bad—we need to keep them off of us, and we need to sanitize our world. But we actually have been learning very recently about how the science is very misguided. That is not to say that antibiotics or even pesticides should never be used—what is absolutely clear in my mind is that the idea of relying on them as our routine front line applications in both agriculture and medicine makes absolutely no sense in light of the modern science that has been revealing these intricate and highly involved relationships between the microbial communities and the health of plants and people.

My book, *Growing a Revolution,* focuses on how we can apply some of these ideas in agriculture, how we can turn one kind of soil into another kind of soil, depending on how we actually farm the land. If you are interested in soil and its relationship to human societies and the broader ecological world, and how to restore soil, I refer you to my book *Dirt,* part of my trilogy. *Dirt* talks about the role in which farming practices have destroyed soils over the course of history, and continue to do so under modern conventional agriculture. *The Hidden Half of Nature* talks about the nature of the microbial world in terms of what really makes for fertile soil. The *Growing a Revolution* is about how to actually fix the problem—because it turns out that I think we actually could restore fertility to the world's agricultural soils shockingly fast if we put our minds to it and completely changed our agricultural practices.

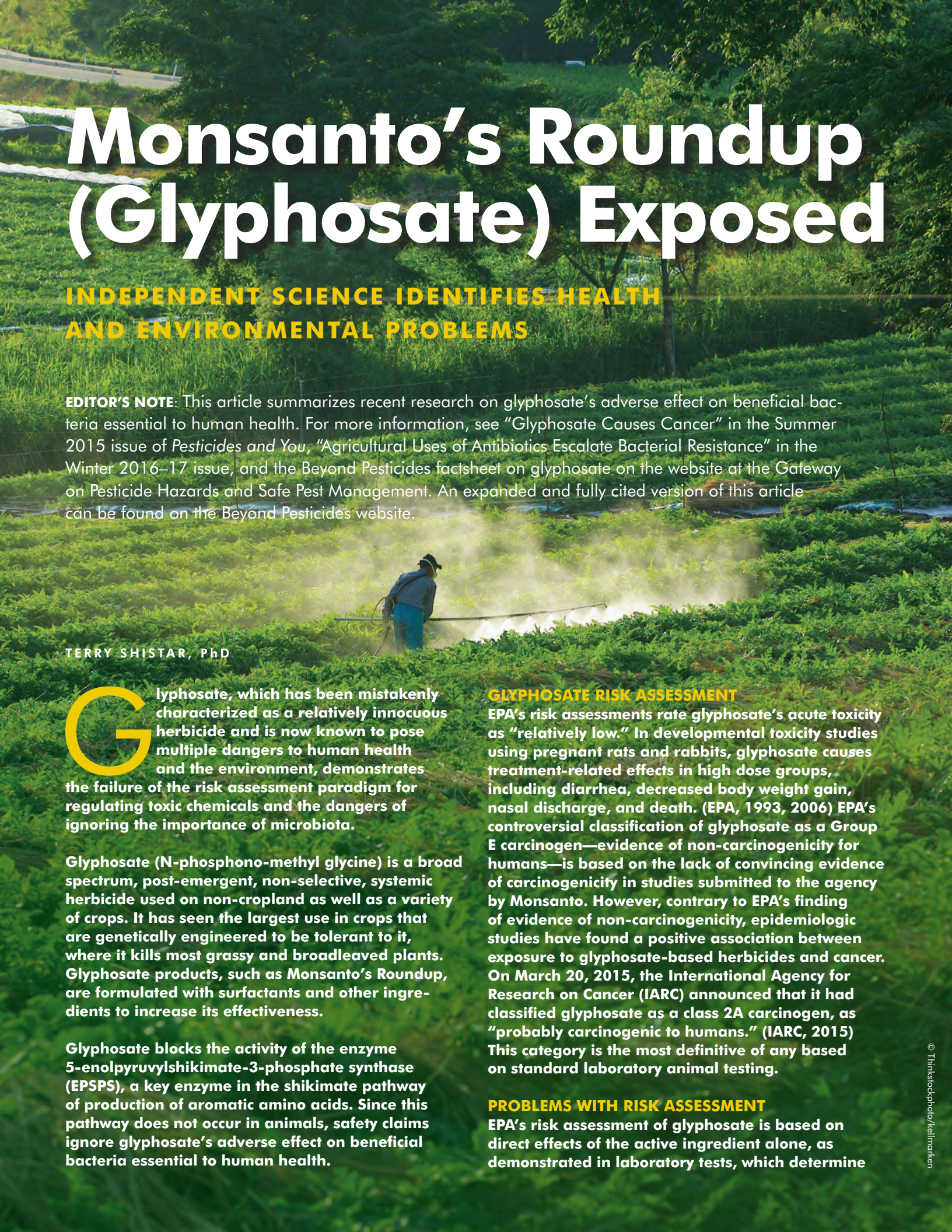
I'd like to thank you all very much.

David R. Montgomery, PhD *is a MacArthur Fellow and professor of geomorphology at the University of Washington. He is an internationally recognized geologist who studies landscape evolution and the effects of geological processes on ecological systems and human societies. An author of award-winning popular-science books, he has been featured in documentary films, network and cable news, and on a wide variety of TV and radio programs. He plays guitar and piano in the band Big Dirt. He lives in Seattle with his wife Anne Biklé and their black lab guide-dog dropout Loki. Connect with him at www.dig2grow.com or follow him on Twitter (@dig2grow).*

Monsanto's Roundup (Glyphosate) Exposed

INDEPENDENT SCIENCE IDENTIFIES HEALTH AND ENVIRONMENTAL PROBLEMS

EDITOR'S NOTE: This article summarizes recent research on glyphosate's adverse effect on beneficial bacteria essential to human health. For more information, see "Glyphosate Causes Cancer" in the Summer 2015 issue of *Pesticides and You*, "Agricultural Uses of Antibiotics Escalate Bacterial Resistance" in the Winter 2016–17 issue, and the Beyond Pesticides factsheet on glyphosate on the website at the Gateway on Pesticide Hazards and Safe Pest Management. An expanded and fully cited version of this article can be found on the Beyond Pesticides website.



TERRY SHISTAR, PhD

Glyphosate, which has been mistakenly characterized as a relatively innocuous herbicide and is now known to pose multiple dangers to human health and the environment, demonstrates the failure of the risk assessment paradigm for regulating toxic chemicals and the dangers of ignoring the importance of microbiota.

Glyphosate (N-phosphono-methyl glycine) is a broad spectrum, post-emergent, non-selective, systemic herbicide used on non-cropland as well as a variety of crops. It has seen the largest use in crops that are genetically engineered to be tolerant to it, where it kills most grassy and broadleaved plants. Glyphosate products, such as Monsanto's Roundup, are formulated with surfactants and other ingredients to increase its effectiveness.

Glyphosate blocks the activity of the enzyme 5-enolpyruvylshikimate-3-phosphate synthase (EPSPS), a key enzyme in the shikimate pathway of production of aromatic amino acids. Since this pathway does not occur in animals, safety claims ignore glyphosate's adverse effect on beneficial bacteria essential to human health.

GLYPHOSATE RISK ASSESSMENT

EPA's risk assessments rate glyphosate's acute toxicity as "relatively low." In developmental toxicity studies using pregnant rats and rabbits, glyphosate causes treatment-related effects in high dose groups, including diarrhea, decreased body weight gain, nasal discharge, and death. (EPA, 1993, 2006) EPA's controversial classification of glyphosate as a Group E carcinogen—evidence of non-carcinogenicity for humans—is based on the lack of convincing evidence of carcinogenicity in studies submitted to the agency by Monsanto. However, contrary to EPA's finding of evidence of non-carcinogenicity, epidemiologic studies have found a positive association between exposure to glyphosate-based herbicides and cancer. On March 20, 2015, the International Agency for Research on Cancer (IARC) announced that it had classified glyphosate as a class 2A carcinogen, as "probably carcinogenic to humans." (IARC, 2015) This category is the most definitive of any based on standard laboratory animal testing.

PROBLEMS WITH RISK ASSESSMENT

EPA's risk assessment of glyphosate is based on direct effects of the active ingredient alone, as demonstrated in laboratory tests, which determine

toxic effects related to the dose received. When this model is applied to glyphosate, it fails to identify the most important impacts of glyphosate as it is used. The first problem is that glyphosate is not used alone.

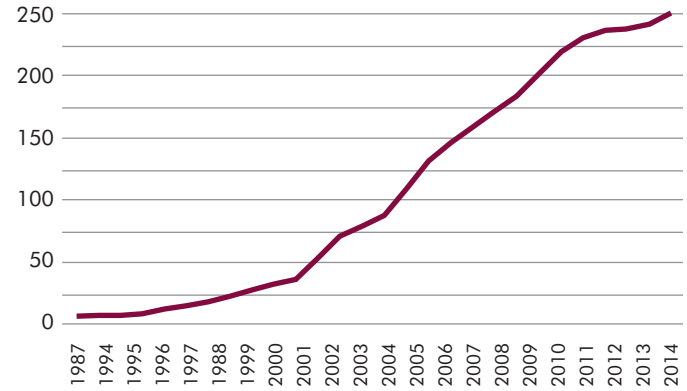
A number of surfactants and other ingredients are added to glyphosate products to make them more effective as herbicides. Some health effects that are associated with these so-called "inert" ingredients are genetic damage, reduced fertility, thyroid damage, eye irritation, anemia, reduced survival of offspring, and skin irritation. (Cox, 2004) Polyethoxylated tallowamine or POEA—a surfactant used in Roundup and other herbicidal products—has been identified as particularly toxic. (Tsui and Chu, 2003)

An increasing number of studies have found that formulated glyphosate products (e.g., Roundup) are more toxic than glyphosate. Symptoms following acute 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. (Cox, 2004) Glyphosate and its formulated products adversely affect embryonic, placental, and umbilical cord cells, as well as fetal development. Human cell endocrine disruption at the androgen receptor, inhibition of transcriptional activities at estrogen receptors, and DNA damage and cytotoxic effects occurring at low concentrations have also been observed. (Gasnier et al., 2008)

NEW SCIENCE AND GLYPHOSATE

Newer scientific studies have also looked in greater depth at glyphosate's mode of action and the implications for human and ecological health. 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 do use the shikimate pathway, and 90 percent of the cells in a human body are bacteria. The destruction of beneficial microbiota in the human gut (and elsewhere in and on the human body) is, therefore, a cause for concern—and a major contributor to disease. In addition, the destruction of soil microbiota leads to unhealthy agricultural systems with an increasing dependence on agricultural chemicals. Assessing the mode of action of glyphosate, scientists have found that it starves and sickens the very crop plants that it is supposed to protect. It is dangerous to base the review of chemicals on the assumption that microbiota is irrelevant to assessing dangers. While it is well known that taking a course of antibiotics disturbs microbes that help digest food, disturbing the microbiota has greater consequences than a bout of diarrhea. It 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.

FIGURE 1: **Glyphosate Use in U.S. Agriculture in Millions of Pounds**



Source: Benbrook 2016

THE HUMAN GUT AND 21ST CENTURY DISEASES

The 90 percent of human cells that are microbial in origin are mostly symbionts who help the human body function as it should. The body is a biological community or "superorganism," a product of coevolution. The microbial community in the mammalian gut reflects the coevolution of host and microbiota, resulting in a mutually beneficial balance. As well as aiding the nutrition of the host human (or other mammal), microbiota contribute to developing and maintaining a healthy immune system. In return, the human host provides a niche in which the individual microbes and their community can persist, providing essential nutrients and habitat. As one review summarized current science, "Recent studies have provided firm evidence that skewing of the commensal community, often referred to as 'dysbiosis,' can result in inflammatory diseases not only of the intestine, but also of organs at distal sites. Such diseases can be triggered not only by pathogenic microbes, but also by otherwise harmless commensal microbes or those that are normally held in check by the microbial ecosystem and/or the metabolic state and immune response of the host. Thus, disturbance of this homeostasis by intrinsic or extrinsic influences, e.g., treatment with broad-spectrum antibiotics, can result in life-threatening dysbiosis." (Littman and Pamer, 2011)

Not all disturbance in the microbiota comes from the conscious use of antibiotics. Swanson et al. (2014) have recently documented that the rise in these same diseases is tightly correlated with the use of the herbicide glyphosate. They have also shown that glyphosate exposure can result in the inflammation that is at the root of these diseases. All of this is not surprising, since glyphosate is patented as an antibiotic. (U.S. Patent number US7771736 B2)

GLYPHOSATE AND GUT DYSBIOSIS

Researchers synthesizing mountains of peer-reviewed research relating to health effects driven by glyphosate's mode of action have shown that a long list of 21st century diseases are linked

to imbalances in the human gut connected to pervasive exposure to glyphosate. (Samsel and Seneff, 2013) Although the precise mechanisms may be unclear, the evidence for a causal link is strong. The evidence comes from two directions—first, that glyphosate causes dysbiosis in the gut microbiota, and second, that gut dysbiosis is a causal factor in many 21st century diseases.

The patent for glyphosate as an antibiotic provides the first piece of evidence. It contains a long list of families of susceptible microorganisms. Scientists who have looked at the impacts on the microbiota of poultry and cattle have found that glyphosate appears to have more negative impacts on beneficial bacteria, allowing pathogens to flourish. For example, Shehata et al. (2013) found that "highly pathogenic bacteria as *Salmonella entritidis*, *Salmonella gallinarum*, *Salmonella typhimurium*, *Clostridium perfringens* and *Clostridium botulinum* are highly resistant to glyphosate. However, most beneficial bacteria such as *Enterococcus faecalis*, *Enterococcus faecium*, *Bacillus badius*, *Bifidobacterium adolescentis* and *Lacto-bacillus* spp. were found to be moderate to highly susceptible."

GUT DYSBIOSIS AND 21ST CENTURY DISEASES

Normally, the human gut is host to an ecosystem composed of anaerobic bacteria that serve a number of beneficial functions, including assisting in the absorption of nutrients, producing short-chain fatty acids and vitamins, synthesizing amino acids, detoxifying xenobiotics, contributing to host immunity, preventing pathogenic infection, and maintaining the health and integrity of the colon wall. (See Dr. David Montgomery's Forum talk on page 9.) Some of these organisms live only in the human intestinal tract, which suggests a coevolved relationship. (Ding et al., 2016)

The imbalance (dysbiosis) of bacteria in the gut has been associated with many modern diseases. In addition to those cited above, they include diarrhea, inflammatory bowel disease, activation of HIV infection, allergies, infection by *Clostridium difficile* and other pathogenic bacteria, autism, liver disease, atherosclerosis, pancreatitis, fibromyalgia, polycystic ovary syndrome, and others. (Sekirov et al., 2010) The fact that such diseases are linked to dysbiosis of the gut does not in itself prove that glyphosate causes them. However, the increases in these diseases are correlated tightly with increases in the use of glyphosate. Glyphosate use dwarfs the use of antibiotics in human medicine. (Shistar and Curle, 2017) To characterize glyphosate's relationship to these disases, celiac disease and autism will serve as examples.

CELIAC DISEASE

Several studies demonstrate that celiac disease is associated with gut dysbiosis. In particular, it is associated with reduced levels of *Enterococcus*, *Bifidobacteria,* and *Lactobacillus* in the gut and increased pathogenic gram-negative bacteria. (Sanz et al., 2011) *Lactobacillus*, *Enterococcus*, and *Bifidobacteria* have been found to be significantly lower in fecal samples of children with celiac disease compared to controls, while levels of the pathogens *Bacteroides*, *Staphylococcus*, *Salmonella*, and *Shigella* were higher. (Di Cagno et al., 2011) Another study found *Bacteroides*, *Clostridium*, and *Staphylococcus* all to be significantly higher in children with celiac disease. (Collado et al., 2007) The imbalances found by these studies of celiac disease are the same as those seen with glyphosate exposure.

© Creative Commons/Mike Mozart

AUTISM

Another disease that has been linked to glyphosate exposure is autism. Studies show that dysbiosis of the gut is implicated in several neuro-immune and neuro-psychiatric disorders. (Wang and Kasper, 2014) It is beyond the scope of this article to provide a comprehensive review of the literature investigating the interplay between the gut microbiota and the brain, but a brief consideration of autism illustrates the relationship. In addition to autism, other neurological disorders connected with gut dysbiosis include dementia, mood disorders, schizophrenia, depression, and bipolar disorder. (Mangiola et al., 2016)

Autism, a neurodevelopmental disorder characterized by impaired communication and social interactions and restricted interests and behaviors, is on the rise. A growing body of evidence shows that children with autism spectrum disorders (ASD) have a different composition of gut bacteria from controls. These differences, along with results of animal studies, suggest that certain intestinal bacteria –such as *Clostridium* and *Sutterella* species—may contribute to the development of ASD. A recent review of literature on gut dysbiosis and autism concludes, "There is an increasing body of evidence demonstrating the clinical importance of microbes habituating the intestinal tract; compelling links between dysbiosis and many disease states are being formed. . . . [A]t least a subset of the cases comprising ASD are connected to, and perhaps dependent on, the health and well-being of the intestinal microbiota." (Ding et al., 2017)

The linkage between glyphosate and autism is substantiated in a recent case study of triplets diagnosed with ASD (two boys) and possible seizure disorder (one girl). All three children had very high levels of glyphosate in their urine, which decreased dramatically when the children were placed on an organic diet. Glyphosate levels decreased, and diagnoses showed that the children improved after two months on an organic diet. (Shaw, 2017)

ANTIBIOTIC RESISTANCE

The Centers for Disease Control and Prevention (CDC) call antibiotic resistance "one of the world's most pressing public health problems." Many bacterial infections are becoming resistant to the most commonly prescribed antibiotics, resulting 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. (O'Brien, 2002) Use of antibiotics like glyphosate in agriculture allows residues of antibiotics and antibiotic-resistant bacteria to emerge on agricultural lands, move through the environment, contaminate waterways, and ultimately reach consumers in food. The human gut, treated farm fields, and contaminated waterways provide incubators for antibiotic resistance.

The Monsanto patent for glyphosate as an antibiotic claims efficacy against the malaria plasmodium and other protozoan parasites. Other research supports this claim and identifies the shikimate pathway as a target for *Mycobacterium tuberculosis*, the cause of tuberculosis. (Schönbrunn et al., 2001) Thus, two of the most troublesome human diseases may be susceptible to antibiotics using glyphosate's mode of action. The use of glyphosate can thus be a contributor to the spread of resistance to medically important antibiotics.

The imbalance (dysbiosis) of bacteria in the gut has been associated with many modern diseases including diarrhea, inflammatory bowel disease, activation of HIV infection, allergies, and infection by Clostridium.

MICRONUTRIENT IMBALANCE

Some researchers have dived more deeply into the mechanisms by which glyphosate achieves its toxic effects. (See box, page 22.) A recent review article suggests, "As a metal chelator, glyphosate could deprive plants of important nutrients which have major roles as enzymatic co-factors and biomolecular constituents." (Gomes et al., 2014) In addition, several scientists have suggested that through interactions with rhizosphere microorganisms, glyphosate causes diseases that kill plants –including glyphosate-resistant crops. Glyphosate varies in its impacts on microbes—some species are inhibited by glyphosate, some are resistant, and still others may use glyphosate or its metabolite as a food source. (Kremer and Means, 2009) There are reports that glyphosate interferes with nitrogen fixation in glyphosate-resistant soybeans.

Disrupting the Integrity of Nature—Pesticides and Genetic Engineering

DON HUBER, PhD

EDITOR'S NOTE: *Don Huber, PhD, professor emeritus of plant pathology at Purdue University, spoke on glyphosate at Beyond Pesticides' 35th National Pesticide Forum, "Healthy Hives Healthy Lives, Healthy Land: Ecological and Organic Strategies for Regeneration", April 28–29, 2017. Excerpts of his talk follow.*

The U.S. uses 300 million pounds of glyphosate in agriculture and almost an equal amount for nonagricultural uses—for roadsides, rights-of-way, waterways, and other land areas. Looking at the increase over time, you can see the stimulation that genetic engineering [of crops designed to be herbicide tolerant] provided for the consumption, application, and indiscriminate use of this very simple, but very complex, chemical.

Glyphosate is a very persistent material. The half-life in soil can be from a year and a half to as long as 22 years.

Glyphosate was first patented as a mineral chelator to clean boilers and pipes. It is a broad-spectrum chelator—it chelates all kinds of cations [molecules or atoms with a positive charge]. That was in 1964. In 1974, Monsanto recognized it as a broad-spectrum herbicide. It is a broad-spectrum herbicide because it is a broad-spectrum chelator—and mineral ions are essential cofactors for physiological functions. In 2010, Monsanto also patented it as a very broad-spectrum antibiotic. It is an antibiotic against beneficial organisms, which we rely on in our GI [gastrointestinal) track or in the environment to supply us with minerals and the aromatic amino acids that we cannot produce ourselves. However, pathogenic microorganisms are over 4,000 times less sensitive than are the beneficial organisms.

Glyphosate is a very persistent material. The half-life in soil can be anywhere from a year and a half to as long as 22 years. It may take generations to eliminate it from some of our soils without some extra help. The carbon-phosphorous lyase enzyme required to degrade glyphosate is extremely rare in nature.

Glyphosate is a synthetic amino acid that has many other physiological functions that have only rarely been studied. It interferes with nutrient uptake. Reduced nutrition is available in the plant and in the seed. Farmers will say, "My crops aren't as vigorous as they used to be." They are starving. They do not have those micronutrients they need, and the consequence is that over 40 plant diseases and 32 human and animal diseases are now reaching epidemic proportions. These did not exist or were not a problem for us with our old controls.

The genes in these engineered plants are very promiscuous. We see it with the Roundup Ready creeping bent grass that is now an invasive weed in Idaho, Oregon, and Washington, and spreading out into the Pacific now. We know how to get the genes in; we do not know how to get them out when they are not wanted.

We have many more problems. The University of Wisconsin just released a study that says that one-third of a pound of phosphorous from glyphosate is going into Lake Erie every year from every acre of soil in the watershed. It is no longer being tied up because the system is already saturated.

Adverse impact on bees

Three of the factors responsible for colony collapse disorder in bees are a function of glyphosate. Then you combine glyphosate with the neonicotinoids, another endocrine disrupting chemical. Lorrin Pang, MD tells us that when you have two endocrine disrupting chemicals, it is not a one plus one equals two—it is a one plus one equals 30,000 times more damage. Glyphosate is a very potent antibiotic to the gut microbiome. Bees have to have *Lactobacillus* and *Bifidobacteria* in the honey crop in order to digest food. They are starving to death while they have plenty of honey and bee bread in the hive because they do not have the organisms there. Bees cannot utilize the food and their tissues are starved.

© USDA

Glyphosate in food

The quantity of glyphosate that is in our food is almost immoral. The USDA refuses to do the analysis because it knows what the levels are and what is happening. We see it in our youth and our wildlife. All of those consequences come from endocrine hormone disruption and the mineral deprivation that we have in those tissues.

A study shows an allergic response to the new proteins in GMO foods. When we feed genetically modified (GMO) foods to animals or people, you can see in their stomachs ulcerations and and deterioration of the gut linings and all of the diseases that go along with it.

And then we see the tragedy that is going on in Yakima, where researchers have been censored and threatened by the federal government if we talk about it. It started when Yakima began adding Rodeo to the water for invasive weed control in 2008, and the result was an epidemic of anencephaly. (Washington State Department of Health, 2016) There are also the spinal bifida, cleft palate, and other deformities now. And our children are at risk. Nobody is permitted to talk about it and to explain what is happening. Yet, if you look at Steve Druker's book *Altered Genes, Twisted Truths*—and I would recommend this to all of you, Steve shows how the venture to genetically engineer our food has subverted science, corrupted government, and systematically deceived the public.

The collusion and corruption in the system are why we have the problems that we have today. These two systems, the genetically engineered program and the chemicals that we are using are all impacting everything that we value in life. To summarize, future historians may well look back and write about our time, not about how many pounds of pesticides we did or did not apply, but about how willing we are to sacrifice our children and jeopardize future generations with this massive experiment we call genetic engineering that is based on false promises and flawed science, just to benefit the "bottom line" of a commercial enterprise.

Don Huber, PhD *is professor emeritus of plant pathology at Purdue University. His agricultural research the past 50 years has focused on the epidemiology and control of soil borne plant pathogens with emphasis on microbial ecology, cultural and biological controls, and physiology of host-parasite relationships. His research also includes nitrogen metabolism, micronutrient physiology, inhibition of nitrification, and nutrient-disease interactions. In addition to his academic positions and research, he is internationally recognized for his expertise in herbicide-nutrient-disease interactions, techniques for rapid microbial identification, and cultural control of plant diseases.*

Glyphosate adsorbed to soil particles may move in wind or water, affecting organisms off the target field.

(Zobiole et al., 2012) Several researchers have documented a number of diseases that increase in frequency or severity when grown in soil in which glyphosate is used to burn down weeds or cover crops prior to planting or applied to the previous year's crop. These diseases include *Corynespora* root rot of soybean, take-all of cereal crops, diseases caused by *Xylella fastidiosa*, and *Fusarium* diseases. Mechanisms observed for these increases in plant diseases include reduction in plant defensive compounds and reduced plant nutrition. (Johal and Huber, 2009) The reduced nutrition reaching plants from their microbial partners also affects the nutritional content of the crop, which has led to concern about impacts on the animals eating the crop. (Zobiole et al., 2010)

ECOLOGICAL IMPACTS

In addition to recent science showing the much greater toxicity of glyphosate products than the technical active ingredient to aquatic and semi-aquatic organisms (Tsui and Chu, 2003), glyphosate-resistant plants release glyphosate into the soil, where it has a continued impact. Glyphosate is also released to the soil by dead plants. "Once in soil, glyphosate may be adsorbed 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 phosphorous amendment, may re-solubilize glyphosate in soils, making it available for leaching and movement to the rhizosphere of non-target plants." (Gomes et al., 2014) Glyphosate adsorbed to soil particles may move in wind or water, affecting organisms off the target field. Its use in agriculture has had a significant impact on monarch butterfly populations through the reduction of milkweed stands. (Pleasants and Oberhauser, 2013) However, the potentially much greater impact of glyphosate through its effects on soil microbiota is not fully studied.

CONCLUSION

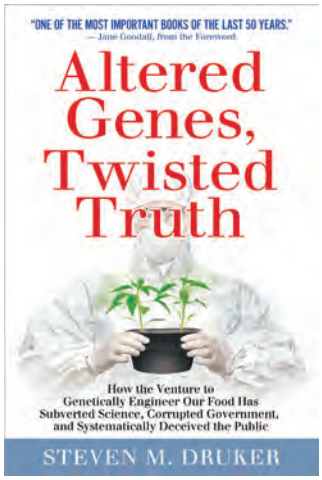
The recent science on glyphosate—and this article has only looked at the tip of the iceberg—reveals the inadequacy of the risk assessment model for protecting humans and the environment from pesticides. From toxicity testing of the technical active ingredient, glyphosate appeared to have minimal health and environmental effects. But when scientists looked at the effects of the complete product—and more importantly, the effects as mediated by microbiota in the soil and the gut—it is shown to have health and environmental effects that threaten the lives of myriad species, including humans.

For an expanded, fully cited version of this article, see bp-dc.org/RoundupExposedCited.

Reviewed by Terry Shistar, PhD

Altered Genes, Twisted Truth

HOW THE VENTURE TO GENETICALLY ENGINEER FOOD HAS SUBVERTED SCIENCE, CORRUPTED GOVERNMENT, AND SYSTEMATICALLY DECEIVED THE PUBLIC



Steven M. Druker
Clear River Press, 2015, 511pp.

The subtitle of *Altered Genes, Twisted Truth* is a summary of its contents—"How the venture to genetically engineer our food has subverted science, corrupted government, and systematically deceived the public." Steven Druker is a public interest attorney with a background in the history and philosophy of science, human development, and ethics. Like many of us, Mr. Druker did not set out to become an activist—he just wanted to learn the truth about genetically engineered (GE) foods. But the search for truth led him to start the Alliance for Bio-Integrity, to sue the Food and Drug Administration (FDA) for its failure to require labeling of GE foods, and, ultimately, to write a book informed by volumes of files released during the discovery portion of the lawsuit.

The search for truth led Druker to start the Alliance for Bio-Integrity, to sue the Food and Drug Administration (FDA), and to write a book.

The first ten of the 14 chapters are arranged institutionally. They demonstrate how various institutions—from the scientific establishment to various federal agencies to the media to risk assessors—have failed to inform the public and protect it from the dangers of GE foods. Throughout the book, the author's arguments are supported by case histories—including L-tryptophan and the FlavrSavr tomato—as well as other research and documentation.

In the beginning of Chapter 4, the book shows how proponents of GE food sought to overwhelm the public's impression of the unnaturalness of GE food with a counterimpression that genetic engineering is just a minor extension of conventional breeding. That claim would continue to be a major strategy. It is refuted, however, by the rest of the chapter, which serves as a primer on GE techniques.

The early chapters provide an institutional and political history of the development of GE foods and GE crops. As I read the account, I return with the recurring question, "Yes, I remember this problem. How did that go away?" I've learned here that what happened was a conspiracy among corporate interests, regulators, and especially scientists to hide the truth.

As a scientist with an organization that relies on science daily, I am particularly disturbed by that "especially scientists" part. Mr. Druker says that in focusing on companies like Monsanto as solely responsible for the problems their products pose, people "overlook the reality that these corporations could not have commercialized any GE foods if the scientific establishment (and especially the molecular biologists) had not prepared the way by systematically deluding the government and the public about the basic facts. . . . Further, it is important to realize that the endeavor to avoid regulation of genetic engineering pre-dated the modern biotechnology industry. When more than a hundred biologists convened at Asilomar in February 1975 in an effort to maintain control over how their research with recombinant DNA technology would be supervised, and to deter the involvement of outside regulatory agencies, no companies employing that technology even existed. . . . [M]ost of the early biotech companies were . . . launched by molecular biologists and venture capitalists, and major chemical companies like Monsanto and DuPont did not significantly enter the picture until much later…. Moreover, that initial lobbying endeavor was primarily conducted by university scientists, universities, and other scientific institutions." So, perhaps the scariest outcome of the GE revolution is the damage it has done to science, which results in the power that chemical companies can exert over universities to prevent independent research into the impacts of pesticides.

The promotion of GE foods—especially GE crops—depends largely on the myth of the benefits of those crops. This myth is refuted by an examination of the development of insect resistance to Bt through the use of Bt corn and the development of resistance to glyphosate and other herbicides to which crops have been engineered to be tolerant. The final chapter makes the case for abandoning the genetic engineering venture by refuting claims of benefits in view of the success of agroecological/sustainable methods like organic agriculture.

As Jane Goodall says in the Foreword, *Altered Genes, Twisted Truth* goes "a long way toward dispelling the confusion and delusion that have been created regarding the genetic engineering process and the foods it produces."

Watch videos from the 35th National Pesticide Forum (2017)

Healthy Hives, Healthy Lives, Healthy Land: Ecological and Organic Strategies for Regeneration

Vera Krischik, PhD
Associate Professor, Department of Entomology, University of Minnesota, Minneapolis MN on the effects of pesticides on pollinators.

David Montgomery, PhD
Professor, University of Washington, author, *The Hidden Half of Nature* on microbiota of soil and human gut biome.

Don Huber, PhD
Professor Emeritus, Purdue University on Roundup (glyphosate).

To view cutting-edge videos that support community change, go to ***bp-dc.org/Forum17***.

Beyond Pesticides – Donate Today

bp-dc.com/donate

Get your community off the toxic treadmill. We're here to help!

Did you know that we assist thousands of people each year through our website, by phone, email, and in person?

Sign Up and Donate

Your support enables our work to eliminate pesticides in our homes, schools, workplaces, communities, and food supply.

Have a pest problem?

bp-dc.org/pests

Tools for Change

bp-dc.org/tools

Action Alerts

bp-dc.org/alerts

Membership to Beyond Pesticides includes a subscription to our quarterly journal, *Pesticides and You*.

Join Beyond Pesticides

Membership Rates

$15 low-income • $25 individual
$30 all-volunteer organization
$50 public interest organization
$100 business

Two Easy Ways to Join

Donate Online
bp-dc.org/donate

Donate by Mail
Beyond Pesticides, 701 E St, SE
Washington, DC 20003

Questions? Give us a call at 202-543-5450 or send an email to info@beyondpesticides.org.

BEYOND PESTICIDES
701 E Street, SE, Washington, DC 20003
202-543-5450 phone • 202-543-4791 fax
info@beyondpesticides.org • beyondpesticides.org

NONPROFIT ORG
US POSTAGE
PAID
Washington DC
Permit No 345

Printed on 100% post-consumer waste paper with soy inks. Cover on Quest™, 100% non-deinked, non-rebleached, post-consumer waste paper.

Member of EarthShare

Summer 2017 ■ Vol. 37, No. 2

MOSQUITO MANAGEMENT AND INSECT-BORNE DISEASES

© Thinkstockphoto/Tevarak

As local pesticide spray programs targeting adult mosquitoes with West Nile virus continue throughout the U.S., and with the new emergence of Zika virus, it must be recognized that spray programs are of very limited efficacy. That is, spraying is NOT an effective or efficient way to prevent death or illness associated with insect-borne diseases.

Go to *bp-dc.org/mosquitoes* to view information on:

- **ChemWatch Factsheets**
- **Less Toxic Mosquito Repellents**
- **Mosquito Pesticides**
- **Smart Community Mosquito Management**
- **Mosquito Doorknob Hanger**
- **Mosquito Control and Pollinator Health**

If you are concerned about the spraying of pesticides in your community or local environment, want a copy of Beyond Pesticides' organizing packet, or want to get involved in any way, please act now and contact Beyond Pesticides (202) 543-5450.

Distribute doorknob hangers

The "Are You a Mosquito Breeder?" Door Knob Hanger is a tool to help spread the word about the dangers of pesticide spraying and effective alternatives. 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 *bp-dc.org/hangers*.

Public Health Mosquito Management Strategy
FOR DECISIONMAKERS AND COMMUNITIES

By Toni Nunes and Shawnee Hoover, et al.
Beyond Pesticides
National Coalition Against the Misuse of Pesticides

REVISED AUGUST 2012

Using the prevention and monitoring techniques outlined in this report, many communities will find that they can significantly reduce or even eliminate their reliance on pesticides, while calming the public's fears over uncontrolled mosquito populations.