Pesticides and You

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

Volume 27, Number 4 Winter 2007-2008

Facing Scientific Realities, Debunking the "Dose Makes the Poison" Myth

How Safe is Your Bait? Pesticides May Be Labeled as "Nonvolatile," But Still Release Poisons into the Air ■ Grounding out Grubs: Managing grubs with prevention and least-toxic strategies ■ The Secret History of the War on Cancer

Danger at (Really) Low Dose

Motivates changes that reject the use of toxic chemicals

Harm resulting from really low dose exposure to toxic chemicals is now accepted in scientific circles. However, the pesticide regulatory process still does not reflect the science, nor does it comply with a 1996 statutory requirement that the agency have in place by now a protocol for evaluating pesticides that may be endocrine disruptors, known to wreak havoc at miniscule doses in developing organ systems. More data emerges year by year.

Lab experiments link exposure to brain effects

In this issue of PAY, we print a talk given by Warren Porter, Ph.D., professor of zoology at the University of Wisconsin, Madison, at the 25th National Pesticide Forum in which he discusses the scientific literature and his own laboratory work that find in some experimentation, "The low dose effect is the greatest effect." Dr. Porter is talking about effects on the brain.

What spurred Dr. Porter to delve into this topic was a headline in his local newspaper in 1997 which read, *Cost of Accommodating: As special education grows*, so does the cost of staffing. He was astonished, as anyone would be, by the statistics between 1990 and 1995: 87 percent increase in the emotionally disturbed, 70 percent increase in learning disabilities. So as he looked into this, he found that it reflected a nationwide trend. Laboratory studies trying to capture a possible connection between pesticide exposure and children's ability to learn —not something evaluated by the current regulatory review process— find that learning capacity is adversely affected at the lowest doses, typically referred to as an inverse dose response. So that throws out the window using only 'dose makes the poison' theory and maximum tolerated dose experimentation, the foundation of EPA's regulatory review process.

Dr. Porter in his lab confirmed the ability of pesticides to induce learning deficiencies. One area where he sees a low dose effect is on the prefrontal cortex of the brain, that portion of the brain that scientists believe is responsible for executive function, or planning, reasoning and problem solving. He found that one chemical actually affects different parts of the brain, some effects seen at lower doses and the others at higher doses.

How safe is your bait?

As more questions emerge that further challenge the adequacy of the regulatory process allowing toxic pesticide products on the market, it raises additional scientific issues of concern. For example, as the pest management industry moves away from spraying pesticides indoors and adopts the use of bait formulations –pastes, gels, and granules, it is generally viewed as a positive evolution. However, given the reliance on toxic formulations, the use of baits raises questions about exposure that have not been fully answered. It is assumed that because many of the baits are low to extremely-low volatility (meaning that very little chemical evaporates into the ambient air at a point in time), then exposure is not an issue. Even the classification for volatility on the low end assumes that the chemical can be measured in the air, with the exception of boric acid, which is commonly found in bait formulations. With the science on low level exposure and potential adverse impact, we know why there ought to be concern, especially when the chemical is placed for long periods in and around the perimeter of a room in a sealed indoor environment. Our article sheds some important light on this topic.

When we do not have all the answers

This discussion adds important weight to the already heavy support for the precautionary approach to pest management. Use approaches and practices that do not rely on toxic chemicals, but instead seek to prevent, build out or exclude pests and adopt practices that do not invite them in. This approach informs our practical strategies for day-to-day insect and plant problems that we may face. In this issue of PAY we continue our *Changing Cultural Practices Series* and apply the preventive first approach to grubs in lawns and the least-toxic methodology which, in this case, utilizes biological controls.

The history of the war on cancer in the U.S., and the new book, *The Secret History of the War on Cancer* by Devra Davis, Ph.D., reviewed in this issue, lays out the challenges that we have faced and will continue to confront in getting adequate legal controls. The author concludes: "The absence of extensive information confirming that human health is endangered . . . lulls most of us into assuming that no such hazard exists. The lesson of this book is that we should all question this presumption. A lack of definitive evidence regarding human health is not proof that no such harm occurs." Put in the context of a regulatory system that is not current scientifically and fails to ask all the questions needed to fully determine harm, precaution and avoidance is the best and much-needed course.

Organizing

This spring we join together in California for the 26th National Pesticide Forum, *Reclaiming Our Health Future: Political change to protect the next generation*, to delve into the science and organize to advance sound and safe practices. We know that because of the success of non-toxic approaches, we do not have to accept pesticide hazards for workers who handle and work around pesticides, and children who eat treated food, breathe contaminated air, or touch toxic surfaces. We enter the new year with a recommitment to develop new and improved strategies and approaches to eliminating toxic chemicals in the management of land, agriculture, and buildings.

Thanks again to all those who supported Beyond Pesticides' program in 2007 and best wishes to all our members and friends in 2008.

- Jay Feldman is executive director of Beyond Pesticides

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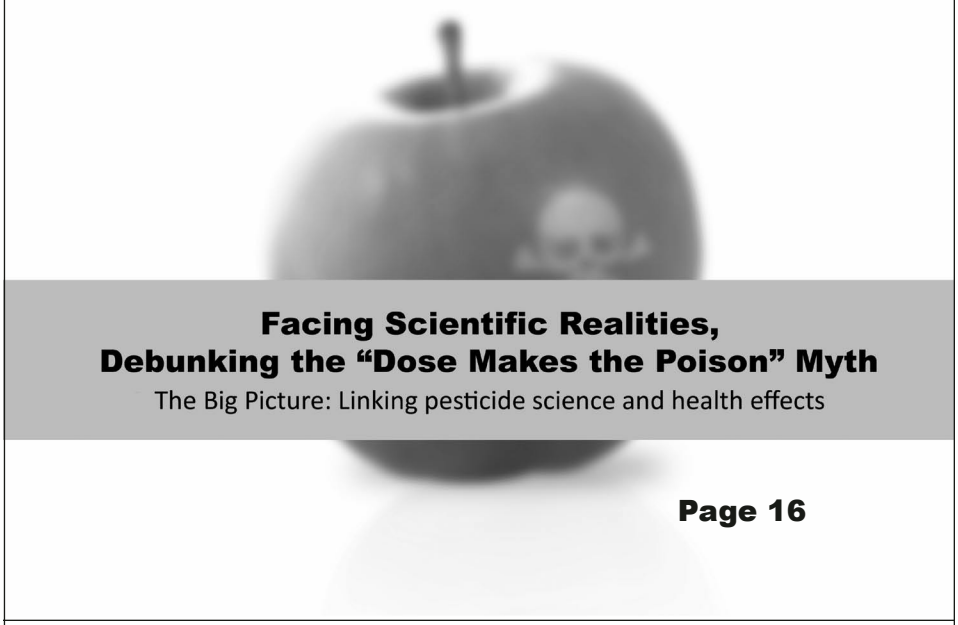

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What Is "Organic" Fertilizer?

Hi there,

I own a company that manufactures fertilizer, which we would like to market as organic. We do not use biosolids, but do not know of any other requirements we must follow. Do you have a list of allowed ingredients? Thanks.

Rusty
via email

Dear Rusty,

Thank you for contacting Beyond Pesticides with your question regarding organic fertilizer requirements. As you may already have discovered, the answer is, unfortunately, not quite as cut-and-dry as one might expect. This lack of clarity regarding organic fertilizers is symptomatic of a larger misinformation problem, which ends up threatening the integrity of organic products.

The trouble stems from the difference between what may be marketed as "organic" fertilizer, and what may be used to fertilize organic crops. The United States Department of Agriculture's (USDA) National Organic Program (NOP) does, indeed, have strict standards for agricultural fertilizers, to the point where farmers using products labeled as organic can lose their certification over the confusion. Organic labeling is actually managed by state members of the Association of American Plant Food Control Officials (AAPFCO) instead of USDA, and its definition of organic includes things like sewage sludge, which NOP does not.

In 2004, the Organic Trade Association sent a letter to AAPFCO requesting that it align its fertilizer categories with NOP definitions, rather than the variety currently used, including "organic fertilizer," "natural organic fertilizer," "natural fertilizer," and "organic base fertilizer." The National Organic Standards Board (NOSB) endorsed this request in a letter to USDA, written by then-NOSB Chair and Beyond Pesticides board member James Riddle. In the past three years, however, there has been no action by either USDA or AAPFCO to clarify label requirements for organic fertilizer.

For your product, I would recommend that you follow the guidelines set by NOP, which you can view on its website: www.ams.usda.gov/nop. Doing so will both preserve the integrity of the term "organic," and will also ensure that your customers can use your product without fear of losing their organic certification through confusion over its labeling. Best of luck!

Hold the Roundup

Dear Pesticides and You,

I can't agree with the San Francisco Parks Deptartment decision in 1992 as described by Debbie Raphael – the decision to use Roundup on median strips on busy streets, "Replacing Poisons with Precaution in Pest Management" (Pesticides and You, Vol. 27, No. 3). I hope things have changed. My reaction when I walk by a Roundup lawn is urinary incontinence followed by hyperactivity, then great fatigue.

I cut down poison ivy with long handled cutters, including the roots and/or pull it up with newspaper as a shield and/or elbow length leather gloves. Wash tools afterward.

Did the Parks Department people stop to think about pedestrian traffic? About wildlife? Birds eat poison ivy berries. What about the health of the pesticide applicator or those unfortunate enough to work in Roundup manufacturing facilities?

I hope that your reprint of this story does not encourage others to follow.

Ellen
Glastonbury, CT

Dear Ellen,

Thank you for your feedback on Debbie Raphael's piece from last fall's issue of Pesticides and You. While we certainly agree that using Roundup in median strips is never the preferable choice, San Francisco has made extremely significant strides in reducing their use by 90 percent. Hopefully, in the future they will consider additional alternatives, perhaps such as mulching around ornamental plants or changing the times or protective practices under which the work is done. As you know, the city is concerned about the danger to workers spending any significant time working in median strips and subject to fast-moving

cars. What is most positive about Ms. Raphael's message, however, is how San Francisco has embraced public input during the transitional process. The door is open to public input so that in the future, a solution that works for everybody can be found.

Speak Your Mind!

Whether you love us, disagree with us or just want to speak your mind, we want to hear from you. All mail must have a daytime phone and verifiable address. Space is limited so some mail may not be printed. Mail that is printed will be edited for length and clarity. Please address your mail to:

Beyond Pesticides, 701 E Street SE #200, Washington, DC 20003
info@beyondpesticides.org, fax: 202-543-4791

Beyond Pesticides Daily News Blog

Excerpt from Beyond Pesticides original blog post (9/10/07):

Lawsuits Filed Against Georgia Utility Pole Plant Over Health and Environmental Concerns

After years of failed political maneuvering, residents in East Point, Georgia have taken legal action in a case against a local utility pole manufacturer. More than 200 residents near the William C. Meredith Co. (WCMCo) on Lawrence Street near downtown have signed onto three lawsuits complaining about noxious odors and dangerous chemicals.

Suzanne Says:

My husband and I are considering moving to East Point (EP). Over the past year, we have visited EP many times during daytime hours and had not noticed a smell, although we had noticed an odd smell at night. Over the last month or so, while looking at homes, we could not help but notice a very heavy, sickeningly sweet smell in the air. My husband nailed it right away - creosote. We followed our noses and found the Meredith Company. If their attorneys say they are not fouling the area with odors, they are not speaking the truth.

Please know that the homes we were looking at were over a mile away from WCMCo. The fumes from this company are affecting a very large area. In addition, two hours after leaving the EP area, our clothes still smelled of creosote. The EPA should do a new air quality check. The smell is horrible.

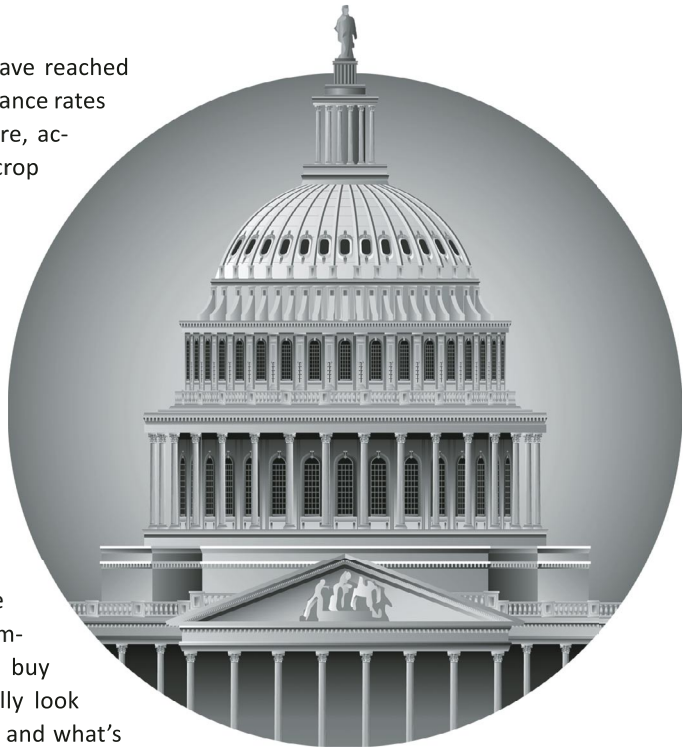
"EPA is currently working through the reregistration process with creosote and pentachlorophenol to evaluate environmental and health concerns. That process began in the mid-1990s and was originally slated for completion in 1998, with the publication of Reregistration Eligibility Decision (RED) documents. The agency initially pushed the publication date back to 2003 and now claims that the REDs will be available by September 30, 2008."

Are you kidding me?? Over TEN years?? Forgive my jaded outlook, but who or what is the EPA protecting?? The environment and people of this community? Or could it be the Meredith Co. the EPA is protecting?

In closing, please remember I do not live in this area. We're not sure if we will move into this area. We have no financial interests in the area. Plain and simple, what is right is right and what is wrong is wrong. The noxious odors we smelled are wrong for the environment and the people. It's just that simple.

USDA Gives Break to Farmers Who Plant Monsanto GM Seeds

The U.S. Department of Agriculture (USDA) has struck an arrangement with agribusiness giant Monsanto that gives farmers in Illinois, Indiana, Iowa and Minnesota a break on federal crop insurance premiums if they plant a majority of Monsanto-brand genetically-modified seed corn this spring. The arrangement has raised some eyebrows, particularly among organic farm groups that argue the government agency should not be promoting corn that increases herbicide use (the seeds are resistant to Roundup) and contains chemicals that harm insects and other plants. The deal with Monsanto was approved in September 2007 under a provision called the Biotech Yield Endorsement (BYE) program, which is part of the *Agricultural Risk Protection Act of 2000*. The insurance premium benefit to farmers will be about $2 per acre. Crop insurance prices have skyrocketed for farmers as corn prices have reached near-record highs. Crop insurance rates can be as high as $50 an acre, according to AgriSource Inc., a crop insurance agency in Iowa.



Ronnie Cummins, national director of the Organic Consumers Association, characterized the USDA-Monsanto BYE arrangement as one of many examples in which the department has sided with big agribusinesses instead of smaller farmers and farm groups. He said the BYE program would leave farmers with little choice but to buy Monsanto seed. "If you really look at our crop subsidy program and what's given to farmers," Mr. Cummins said, "you really see a lot of those subsidies going to purchase genetically engineered crops." Of the 11 million acres planted in corn in 2006 in Illinois, about 9 million acres, or 79 percent, had federal crop insurance, according to USDA. In Indiana, 68 percent of corn acres were insured, in Iowa, 87 percent and in Minnesota, 89 percent. *For more informtion, contact Beyond Pesticides.*

National Mall Tests Organic Lawn Care

One of the nation's most visible and heavily used plots of turf is now a demonstration site for organic lawn care. According to the National Park Service (NPS), over four acres of Washington, DC's National Mall will be maintained using environmentally friendly treatments at no cost to NPS. SafeLawns.org, a non-profit organization dedicated to promoting natural lawn care and grounds maintenance, will manage the National Mall Soil and Turf Improvement Project. The group's techniques include aeration, compost and compost tea applications and overseeding, all of which comply with the Department of the Interior Integrated Pest Management procedures. The Environmental Protection Agency's Environmental Stewardship Program will compile complete records of the project. The project will conclude August 31, 2009. "If we can grow resilient grass on the National Mall, where 27 million people trample the lawn each year," said SafeLawn.org's founder, Paul Tukey, "then we will have demonstrated that we can grow grass anywhere. Most importantly, we'll have proved that you can grow grass without relying on chemical fertilizers and pesticides that can harm wildlife and contaminate drinking water, as well as cause harm to people and their pets."

Groups Challenge Legality of Human Pesticide Testing

In January, the second circuit federal appellate court heard a challenge to an Environmental Protection Agency (EPA) rule that allows people to be used as guinea pigs in tests of toxic pesticides. The lawsuit, NRDC V. EPA, was brought before the court by a coalition of environmental, farmworker and health groups. The groups contend that the agency's human testing rule, released in 2006, violates a law passed by Congress in 2005 mandating strict ethical and scientific protections for pesticide testing on humans. The groups also argue that the EPA rule violates international ethical standards enumerated in the 1947 Nuremburg Code by permitting EPA to set safety standards based on tests conducted with only a handful of healthy people. A loophole in the new EPA rule allows testing of pregnant women, infants and children. Low-income people and students are the most likely to participate in these dangerous experiments, for which they usually receive a few hundred dollars.

Human testing, which was stopped by a moratorium in 1998, was reintroduced in 2003 by a court ruling on a pesticide industry suit. Following the reintroduction of human studies, EPA began to develop a rule for such testing. This came despite flaws found in such studies, and took into account industry pressure to approve testing of children and pregnant women, among other allowances. EPA released its final rule in 2006, despite the Congressional report condemning human testing in 2005. At the time, committee member Representative Henry Waxman stated, "What we've found is that the human pesticide experiments that the Bush Administration intends to use to set federal pesticide policies are rife with ethical and scientific defects."

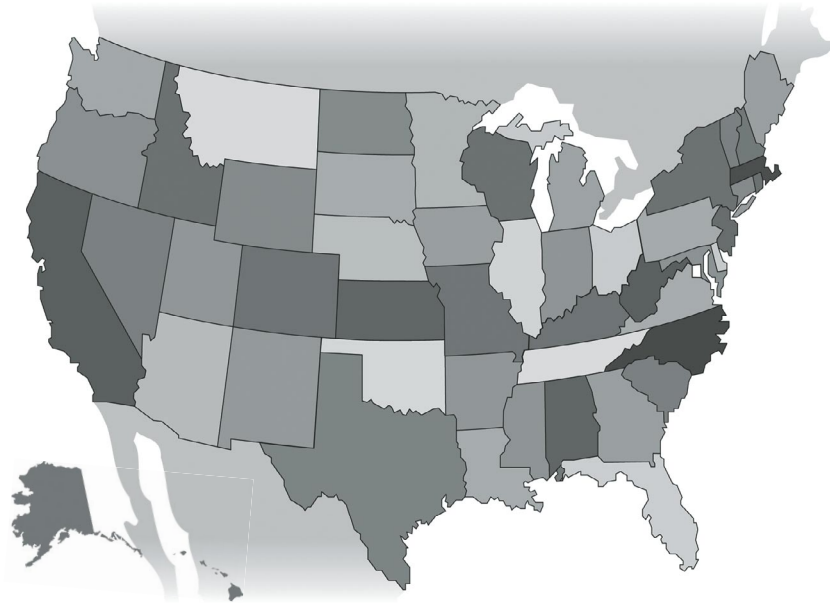
See the history of this issue on Beyond Pesticides' website, www.beyondpesticides.org/watchdog/humantesting, and its comments challenging the use of human testing before EPA's Human Testing Review Board.

Target Settles with EPA on Labeling Violations

Target Corp. has been fined over $40,000 by the Environmental Protection Agency (EPA) for violating pesticide-labeling rules under the *Federal Insecticide, Fungicide and Rodenticide Act* (FIFRA). As part of the penalty, EPA (Region 5) filed a consent agreement and final order with Target to halt the distribution and sale of the products in violation. According to EPA, Target sold and distributed products from its stores and website that made pesticidal claims on its labels. Some products' properties also made comparisons to other registered products sold by competitors. The products identified were: Antimicrobial Toilet Seats, Home Ultimate Mattress Pads, Home Ultimate Pillows- which made "germ-killing" claims, and Cleaner With Bleach, which compared its disinfectant properties with a competitor.

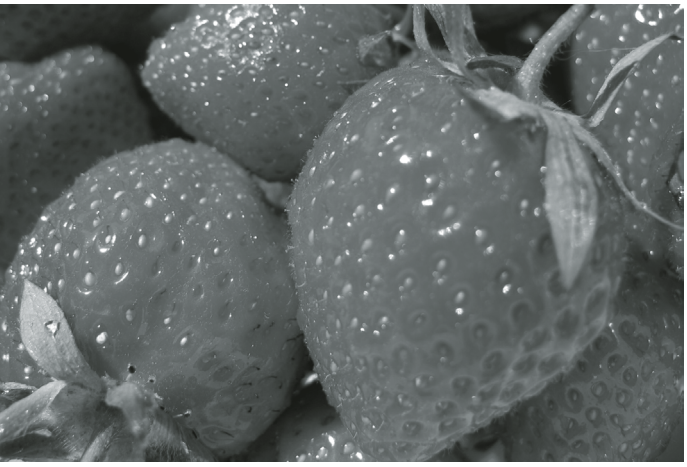
Under FIFRA (Section 2(u)), any substance or product intended for "preventing, destroying, repelling, or mitigating any pest," which includes germs and bacteria, is defined as a pesticide and must be registered with EPA prior to sale and distribution. Disinfectants, antimicrobial and antibacterial products are by law pesticides. This settlement is one of several recent EPA crackdowns concerning the sale and distribution of unregistered mislabeled pesticides. EPA maintains that this is a serious violation that can result in harm to public health and the environment.

Contact Beyond Pesticides for further information on antimicrobial pesticide hazards and alternatives.



CA Reports Overall Pesticide Use Down, Use on Strawberries Up

The California Department of Pesticide Regulation (DPR) released its newest pesticide use data, detailing 2006 use statistics showing an overall decrease in pesticide use statewide, but an increased reliance on the highly toxic, ozone depleting fumigant methyl bromide for strawberry growers. Overall statewide pesticide use declined by nearly six million pounds from 2005 to 2006 (from 195.3 million to 189.6 million). While use increased in landscape maintenance, public health and other categories, production agriculture saw a 10 million pound drop. Use of many high-toxicity chemicals, including carcinogens, neurotoxic pesticides and chemicals linked to reproductive effects, dropped for the third consecutive year. DPR analysts note that pesticide use varies from year to year based on many factors, including types of crops, economics, acreage planted, and weather conditions. For example, cool wet spring weather often prompts increased use of sulfur and other fungicides, as was the case in 2005. But similar weather conditions in 2006 did not produce as much vineyard disease in most areas, so wine grape growers actually used less sulfur. Total pesticide use in wine grapes dropped by about 8.5 million pounds.



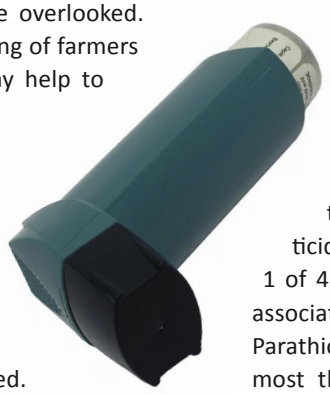
On the other hand, the *Los Angeles Times* reports that state strawberry growers, primarily around Oxnard and in the Salinas and Watsonville areas, applied fumigants to 5,000 more acres, using 132 more tons of the chemicals than in the previous year. That is a 9% increase in acreage treated and a 3% increase in tonnage. Methyl bromide is injected into the soil at rates of 100-400 pounds per acre to kill soil-borne organisms. The Environmental Protection Agency (EPA) has recently approved methyl iodide as a replacement to the ozone-depleting methyl bromide. In EPA-reviewed lab studies, methyl iodide causes thyroid tumors, changes in thyroid hormone levels, which are closely tied to metabolic disorders, respiratory tract lesions, neurological effects, and miscarriages.

CA Lindane Ban Protects People and Water Quality

Banning lindane is a viable solution for protecting health and the environment without resulting in increasing problems with head lice and scabies, according to a recent study published in the online edition of *Environmental Health Perspectives* (doi:10.1289/ehp.10668). In 2002, California banned pharmaceutical use of lindane when high levels of this treatment for head lice and scabies were found to be impacting wastewater quality. According to the study, wastewater treatment plant monitoring showed that lindane contamination declined in California after the ban. Records from the California Poison Control System show that unintentional lindane exposure calls declined. The impact on clinical practice was assessed via a survey of 400 pediatricians. Most physicians were aware of the ban (81%) and had used lindane previously (61%). Unfortunately, the majority of survey responses show that the physicians' lice and scabies treatment choices are now permethrin and malathion, both neurotoxins, even though there are several non-toxic options available.

Pesticide Exposure May Increase Risk of Asthma

Researchers from the National Institute of Environmental Health Sciences (NIEHS) show that exposure to several commonly used pesticides increases the risk of asthma in farmers. In September 2007, NIEHS researchers presented findings to the European Respiratory Society Annual Congress in Stockholm that show that farmers who have a history of high pesticide exposures are twice as likely to have asthma. Sixteen of the pesticides studied are associated with asthma. Use of coumaphos, EPTC, lindane, parathion, heptachlor, 2,4,5-TP, DDT, malathion, and phorate have the highest odds ratios. "This is the first study with sufficient power to evaluate individual pesticides and adult asthma among individuals who routinely apply pesticides," lead author Jane A. Hoppin, Ph.D. told Reuters Health. "Because grains and animals are more common exposures in agricultural settings, pesticides may be overlooked. Better education and training of farmers and pesticide handlers may help to reduce asthma risk."



Another study by these same NIEHS researchers finds a correlation between women's exposure to farm pesticides and allergic asthma (Am. J. Respir. Crit. Care Med. 2008; 177:11-18). Dr. Hoppin cites the lack of information on the risks incurred when women apply pesticides, saying, "Farm women are an understudied occupational group. More than half the women in our study applied pesticides." The study evaluated 25,814 women who are participating in the Agricultural Health Study in Iowa and North Carolina. For farm women who applied or mixed pesticides, the researchers find an average increase of 50 percent in the prevalence of all allergic asthma. According to the study, 7 of 16 insecticides, 2 of 11 herbicides, and 1 of 4 fungicides are significantly associated with allergic asthma. Parathion is associated with an almost three-fold increase in allergic asthma. Malathion is associated with a 60 percent increased prevalence of allergic asthma. Permethrin is associated with both allergic and non-allergic asthma.

Bt Corn Harms Aquatic Ecosystems

Corn genetically engineered (GE) to tolerate the biological pesticide *Bacillus thuringiensis* (Bt) has been found to harm non-target aquatic insects. A new study by researchers at Indiana University (Proc Natl Acad Sci 2007; 104:16204-8) suggests that the crop, which has been licensed for use since 1996, poses an unforeseen risk to aquatic ecosystems. According to the study, roughly 35 percent of American corn acreage is Bt corn. Plant byproducts such as pollen and detritus are traveling beyond the fields in which they are planted, carrying Bt toxins through watersheds and being consumed by close relatives of the corn's targeted pests. Caddisflies experience high mortality and stunted growth as a result of exposure. As researcher Todd V. Royer, Ph.D. observed, plant byproducts "are a food resource for higher organisms like amphibians and fish … I think probably the risks associated with widespread planting of Bt corn were not fully assessed." In addition, the study raises concerns of pesticide resistance in target species, contamination of non-GE crops, and corporate monopolies on seed. James Raich, a National Science Foundation program director, warned that "increased use of corn for ethanol is leading to increased demand for corn and increased acreage in corn production. Previous concerns about the nutrient enrichment in streams that accompany mechanized row-crop agriculture are now compounded by toxic corn byproducts that enter our streams and fisheries, and do additional harm."

Boulder, CO Activists Successful in Delaying Herbicide Spraying

Boulder, Colorado officials will delay herbicide spraying for unwanted plants defined by state law as noxious weeds in a community park for at least a year after activists protested the application. Boulder City Manager Frank Bruno said the decision to delay herbicide spraying at the park was made because the weed situation is not a life-threatening one. City officials say they have tried to eradicate the jointed goatgrass by mowing, weed whipping and mulch-covering with little success over the past five years. The delay allows officials to consider what other alternatives are available and to educate the public on their decision, whether it is non-toxic methods or chemical controls. Some local activists are suggesting grazing goats as a non-toxic, environmentally-friendly alternative method of control. Goats eat the unwanted plants, add fertilizer and aerate the soil with their hooves at the same time. Boulder County has used goats and other non-chemical solutions like bio-controls for years to combat noxious weeds on open space. Bruno said goats are not likely a realistic solution at the park because the area is active with people and pets.

For more information non-toxic rangeland management or for information on the toxic hazards of commonly used herbicides, contact Beyond Pesticides.

States Sue EPA over Relaxed Toxic Reporting Requirements

Twelve states sued the Environmental Protection Agency (EPA) in November over a new regulation that exempts thousands of companies from disclosing to the public details about their use and emission of toxic chemicals. The lawsuit, filed in U.S. District Court in New York by Arizona, California, Connecticut, Illinois, Maine, Massachusetts, Minnesota, New Hampshire, New Jersey, New York, Pennsylvania and Vermont, accuses the agency of jeopardizing public health and seeks to force it to return to more stringent requirements. In joining the lawsuit, California Attorney General Jerry Brown said EPA was "subverting a key public safety measure that helps communities protect themselves from toxic chemicals."

EPA's measure, which took effect in January 2007, raised the threshold for reporting most chemicals under its national Toxics Release Inventory (TRI) program. EPA officials say they changed the regulation to cut companies' costs of monitoring emissions and filing complex annual reports. The agency says the changes will save industry $6 million a year and affect about 6,700 facilities. In its original proposal unveiled in 2005, EPA had planned to grant even broader exemptions. But after an outpouring of opposition among the more than 100,000 received comments, EPA dropped about 60% of the proposed exemptions. The goal, EPA officials said, is to cut costs for smaller facilities that contribute less than 1% of total emissions in the country. But Mr. Brown said even small companies should be forced to provide the more detailed information because they pose a public threat.

How Safe Is Your Bait?

Pesticides May Be Labeled as "Nonvolatile," But Still Release Poisons into the Air

Editors Note: The issue of volatility (chemical evaporation into the air) is confusing because the classical definition of this chemical characteristic disregards very low level emissions, often referred to as "negligible," that escape into the air. We are aware of volatility when we see and/or smell a pesticide being applied as a spray or aerosol. However, this may not be the case with pesticides in bait formulations that are commonly placed throughout buildings in bait stations, or as gels, pastes or granules in cracks and crevices, or behind walls, cabinets, and appliances. While many of the chemical bait products may be characterized as nonvolatile because old technology could not measure the low level vapors, their use may actually result in exposure in indoor environments, particularly those areas that are sealed tightly. These low level exposures resulting from the use of baits have not been evaluated by the regulatory agency, EPA. This piece provides an overview of the pesticide bait volatility issue and reinforces the notion that the best precautionary approach is to adopt practices (cultural, mechanical and biological) that prevent insects and rodents from entering structures. Door sweeps, sealing cracks and crevices, moisture control (including proper drainage and dry conditions) and sanitation management all go a long way in reducing the need for chemical products. -- Jay Feldman

By Raymond Koytcheff

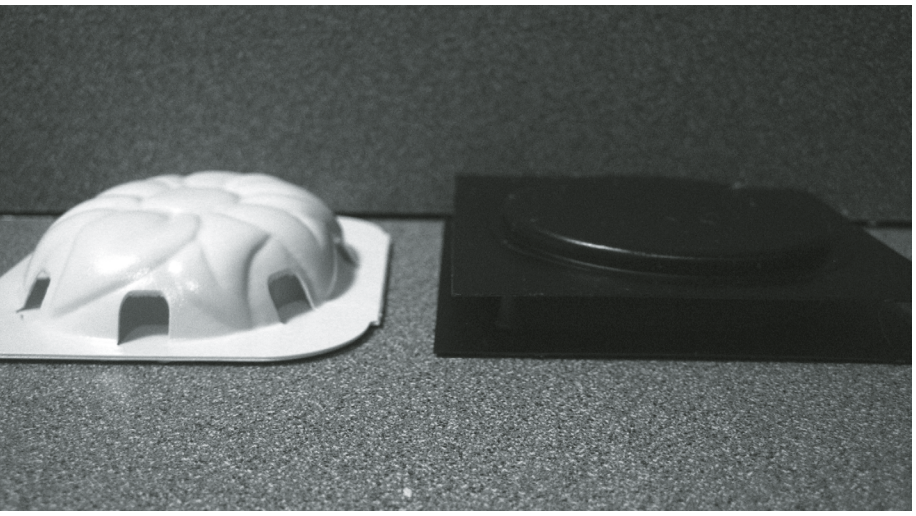
Open up your local Integrated Pest Management (IPM) plan, and you may see baits mentioned often. Touted as the preferred method of application by pest control operators and pest management officials, many people assume baits are safe and do not release dangerous chemicals into the surroundings. But really how hazardous are these products and how much does one get exposed to harmful pesticides from supposedly contained baits?

Baits refer to products that combine an active ingredient(s) with an attractant(s), such as flour or sugar. Popular active ingredients in baits include abamectin/avermectin, acetamiprid, boric acid, disodium octaborate tetrahydrate, fipronil, hydramethylnon, oxypurinol and xanthine, propoxur, sodium tetraborate decahydrate, and sulfluramid. All these chemicals are intended to kill the target organism, which means that baits are inherently poisonous. By definition, however, there is no guarantee that the bait is sealed, secure, or that exposure does not present a health risk.

Some baits are contained so as to minimize exposure, and, all else equal, using these baits as part of a targeted treatment is preferable to applying aerosols or sprays over a larger area. Also, one does not need to locate a nest if using baits, as the formulation either attracts pests or is put in a place where the organisms will find it and consume the contents. While baits may provide some

Table 1. Classical Definitions of Volatility

Non-volatile	Less than 10-7 mm Hg (millimeters of mercury)
Slightly volatile	10-7 to 10-4 mm Hg
Volatile	10-4 to 10-2 mm Hg
Highly volatile	Greater than 0.01 mm Hg



All baits are not created equal. The bait on the left contains avermectin and the one on the right contains boric acid. See Table 2 to compare the relative volatilities.

advantages to other pesticide options, they should by no means be assumed to be a non-toxic, problem-free solutions.

Modernizing the Bait Debate

Given the frequency that baits are used in homes and other buildings—especially in kitchens, gardens, food-storage and processing areas and facilities, and refuse disposal areas—the conventional wisdom about baits needs to be retooled to properly take account of the hazards where they are identified. Children and pets may be attracted to baits and improperly handle them if the bait is not properly placed or not contained in a sealed bait station. Regardless of the exact type of bait used, baits need to be used with caution. All substances evaporate into the air, at least to some degree, so poisonous vapors from baits may very well enter and linger in the ambient air. The clear exception to this is boric acid, which does not volatilize under normal conditions.

Defining Volatility

A key question to ask is how volatile is a bait formulation, and this, along with the toxicity of and the level of exposure to the pesticide, needs to be considered to determine how likely a product is to be harmful. Volatility gives at a first glance a measure of the likelihood of coming into contact with a pesticide that is not already present in the air. The *Basic Guide to Pesticides* defines volatility as "the capacity of a substance to evaporate, thus moving through the air, being easily inhaled, and moving widely as its persistence permits." Volatility is commonly quantified by the vapor pressure (typically measured in millimeters of mercury [mm Hg]) and measures the tendency of a liquid or a solid to turn into a gaseous form. The lower the vapor pressure, the less a pesticide vaporizes into the air after application.

Classical Volatility Definitions

There are different ways of classifying volatility of pesticides. Generally, a substance with a vapor pressure of less than 10^{-7} mm Hg is identified in scientific texts as nonvolatile. The *Basic Guide to Pesticides* rates volatile substances, those with a vapor pressure above 10^{-7} mm Hg, in three categories: slightly volatile, volatile, and highly volatile (see Table 1 for details). The National Pesticide Telecommunications Network (NPTN) agrees on the threshold for nonvolatile chemicals, but only ranks volatile substances as slightly volatile (vapor pressure between 10^{-7} and 10^{-3} mm Hg) or volatile (vapor pressure greater than 10^{-3} mm Hg). These definitions, however, do not suggest that a nonvolatile rating (unless zero volatility) does not result in movement of the chemical into the air. With new technology, vapors that would not be measured are now detectable. In sealed rooms and buildings there can be build up over time. Table 2 lists vapor pressure for active ingredients that are commonly used in baits.

Factors Affecting Volatility

Despite the certainty in measuring vapor pressure of chemicals in a controlled setting, volatility is affected by many variables, even in the indoor environment. Scientists have found that temperature and humidity are significant factors influencing pesticide volatility. High temperature and low humidity increase volatility, and UV radiation and the types of microorganisms present affect how quickly a substance vaporizes and enters the air. Also, air flow plays a role in determining air quality and the levels of pesticide

Table 2. Vapor pressure & health effects of commonly used active ingredients

Boric acid	Not measurable (below detection)	RD
Indoxacarb	1.9 x 10-10	EN, N
Abamectin/ avermectin	1.5 x 10-9	ED, EN, N, RD
Fipronil	2.8 x 10-9	C, ED, EN, N
Isoxaben	4.13 x 10-9	C, EN
Hydramethylnon	2.0 x 10-8	C, EN, RD
Sulfluramid	4.3 x 10-7	EN, RD
Propoxur	9.68X10-6	C, EN, N
Acetamiprid	4.4 x 10-5	EN, N, RD
Water	23.8	--

Key: C = associated carcinogenicity; ED = endocrine disruption; EN = environmental effects; N – associated neurotoxicity; RD = reproductive/developmental effects

residues present indoors. "We conclude that to maintain good air quality, ventilation is important and special care must be taken when spraying insecticides on different surfaces," write Hsien-Wen Kuo and Hsin-Mou Lee, authors of *Volatility of Propoxur from Different Surface Materials Commonly Found in Home*s. Building characteristics—such as volume and surface area of building, products and materials used in structure and furnishing, and mechanical air movement system—also change the distribution and level of pesticide residues.

Under any conditions, all substances will volatilize, albeit to different degrees, so one cannot claim that a pesticide is safe because it is nonvolatile. The toxicity of the pesticide and the level of exposure, both length and frequency, need to be determined to properly gauge the hazard of the pesticide. In the case of most bait applications, exposure is constant, as pesticides remain in the vicinity indefinitely. Exposure to pesticides through inhalation of fumes from baits has not been studied. So for now, think twice before you place some bait packs in your cupboard against those pesky ants or reach for some roach bait to slide under your fridge. Those baits may not even be effective if there are other more accessible or desirable food sources available.

How to choose a pesticide residue-testing lab

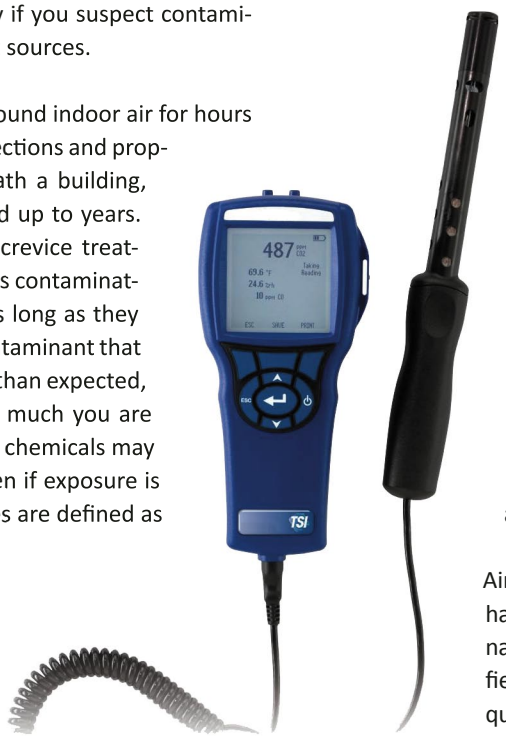
Testing may detect the presence of a chemical in the physical environment and may involve soil, water, air, surface swabs, wood scrapings, carpet samples, etc. A reputable lab should be using validated methods of analysis for the particular pesticide, such as those published in the Pesticide Analytical Manual, in the Association of Official Analytical Chemists Manual, or by EPA. Numerical data should be reported in clearly identifiable units, for example, milligrams per liter, parts-per-million, etc. Results should also include the adequacy of the method chosen for analysis, including percent recovery of spiked samples, results of a standard curve, and results of assay blanks. Before testing, it is best to have a consultation with the lab scientist, either a toxicologist or an analytical chemist, to determine how sensitive the method of analysis must be to be useful.

Indoor Air Quality Testing

Did you know that the air inside your home may be more polluted than the air you breathe outside? That is to say that many times there are more contaminants and greater concentrations of these substances present indoors than outdoors. Given that most people spend 65 to 90 percent of their time indoors, indoor air pollution is more likely to have an impact on human health than outdoor air pollution. Living or working in a "sick" building can lead to respiratory complications or other illnesses, so it may be helpful to measure the indoor air quality if you suspect contamination from one or a number of different sources.

Pesticide and solvent vapors can hang around indoor air for hours even when applied according to label directions and properly ventilated. Pesticides applied beneath a building, can contaminate inside air for weeks and up to years. Baits used indoors and even crack and crevice treatment around a room can result in residues contaminating the air following application or for as long as they are around. Pesticides are one type of contaminant that may be present at concentrations higher than expected, and air testing can help determine how much you are being exposed to toxic substances. Some chemicals may be present at measurable quantities, even if exposure is assumed to be nil because the substances are defined as nonvolatile.

Any air sampling should be part of an overall evaluation of the building and not the first step to addressing a problem with indoor air quality.



Testing usually finds measurable quantities of some sort of contaminant, but it is difficult to determine what level should be flagged as a reason for concern. No standards for indoor air quality exist for schools and residences, and different guidelines have been set for other types of buildings. For instance, the Occupational Safety and Health Administration (OSHA) and the American Industrial Hygiene Association (AIHA) have different guidelines for indoor air quality, which should be treated as such, recommendations rather than firm levels.

Before deciding on air testing, you should use your senses to detect obvious problems in the building. This begins with determining people who are affected, their location inside the building, and the timing of their symptoms. You can then perform an inventory of potential sources of environmental agents that may be related to indoor air quality problems; look for locations and sources of moisture intrusion or water damage; and investigate heating, ventilating and air conditioning (HVAC) system problems and air movement pathways.

Air sampling is useful after all practical steps have been completed and a particular contaminant or contamination source has been identified. Then testing can be done to document quantitatively the degree of the effects of this

contaminant. Although home-testing kits are available, it is advisable to hire an air quality consultant to focus on a particular issue and provide a thorough analysis. You should be sure to verify that a consultant has the proper training and project experience and be as specific as possible in defining project expectations when looking for a consultant.

Ray Koytcheff was a research fellow at Beyond Pesticides in 2007

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Commonly Used Baits and Active Ingredients

FC Professional Insect Control Ant Bait Stations (fipronil), Drax Liquidator Ant Bait (boric acid), Gourmet Ant Bait Gel (disodium octaborate tetrahydrate), Niban-FG Fine Granular Bait (boric acid), Terro-PCO Liquid Ant Bait (sodium tetraborate decahydrate), Prescription Treatment® brand Advance® 360A Dual Choice® Ant Bait Stations (abamectin), Transport™ Ant Bait (acetamiprid), Combat® Ant Products (fipronil), Hasta La Vista, Ant!™ (boric acid), Prescription Treatment® brand Advance™ Dual Choice® Ant Bait Stations (Formula 1) (sulfluramid), Maxforce Professional Insect Control Roach Bait Stations (fipronil), Advion Cockroach Gel Bait (indoxacarb), Prescription Treatment® brand Avert® Cockroach Bait Stations Formula 1 (abamectin), Cleary Roach Terminal (a.k.a.Ecologix Roach Bait) (oxypurinol & xanthine), Focus® Termite Attractant (corn oil), Firstline® GT Plus Termite Bait Station (sulfluramid), Firstline® Termite Bait Station (sulfluramid), Advance® Compressed Termite Bait System (diflubenzuron), Recruit™ IV Termite Bait (noviflumuron), Requiem® Termite Bait (chlorfluazuron), Subterfuge® Termite Bait (hydramethylnon)

These five baits available for over the counter purchase contain the following active ingredients (clockwise from top left): sodium tetraborate pentahydrate & boric acid, avermectin, sodium tetraborate decahydrate, propoxur, and hydramethylnon.

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Grounding out Grubs

Managing grubs with prevention and least-toxic strategies

By Nichelle Harriott

Do you have large swatches of brown or yellow patches on your lawn? Does your lawn peel back like carpet? If yes, chances are, you have grubs.

Grubs, or more specifically white grubs, are the larvae of scarab beetles, Japanese beetles, June beetles, chafers, and others. They are one of the nation's most destructive lawn pests. These organisms are C-shaped, off-white in color with a characteristic dark brown head. The larvae feed on grass, plant roots and organic matter in the soil. As a result, grubs can be found at the root zones of damaged areas of the lawn. It is important to identify grubs as the source of your browning lawn before utilizing biological treatments highlighted below after trying preventive methods. Other factors, such as drought, disease, excessive fertilizer, poor soil or even another pest, may be the cause of your lawn's brown spot.

Prevention

Grubs are periodic pests that can attack your lawn with varying intensity from year to year. If you live in an area with above normal rainfall and have high soil moisture content, you may have a pre-disposition for grubs and may want to take preemptive measures.

■ **Proper Lawn Maintenance**

● **Mowing height.** Adult beetles prefer to lay their eggs in short grass. Cutting your grass tall – minimum of 2 inches high – may discourage egg laying, and reduce future grub populations.

● **Aeration.** Cultivate a healthy lawn by encouraging deep grass roots. Deep roots have a greater chance of surviving a grub infestation. Grubs that may be feeding on roots deeper into the soil are spread out over a larger area, making their damage less discernable. Aerate your soil, either by hand or aerating equipment, in the spring and fall to promote deeper roots.

● **Watering.** Lawns that are heavily managed and watered regularly, especially during the summer months, may actually attract beetles. Eggs require moist soil conditions in order to hatch and prevent the larvae from drying out. Therefore, deep periodic soaking of the turf is more beneficial than frequent, light watering. Infrequent watering also encourages roots to grow deeper into the soil. If there is moderate grub infestation, watering in late August or September, can promote tolerance and recovery.

■ **Encourage Natural Parasites and Predators**

● **Parasitic wasps.** Certain species of wasps, such as Tiphia spp. and Scoliids prey specifically on white grubs. They seek out grubs in which they lay their eggs. Their larva, when hatched, feed on

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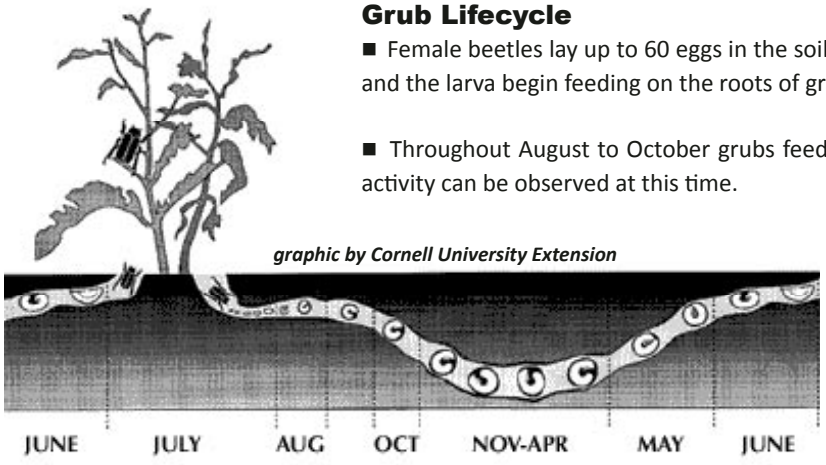
Grub Lifecycle

■ Female beetles lay up to 60 eggs in the soil over the course of 2-3 weeks. Eggs hatch 2 weeks later and the larva begin feeding on the roots of grass near the surface of the soil throughout the summer.

■ Throughout August to October grubs feed and molt into larger bodies. Evidence of their feeding activity can be observed at this time.



graphic by Cornell University Extension

■ As temperatures fall, grubs burrow deeper into the soil to winter.

■ During the spring, grubs return to sub-surface soil and feed. By late spring, feeding stops and the grubs turn into pupae. In late June and July, beetles emerge from the pupae and crawl out of the soil.

Biological Control of Grubs

There are several least toxic methods for controlling grubs, many of them involving cultural and structural control. For these methods to be effective, it is important to plan ahead and of course, follow label directions:

Milky Spore

The milky spore disease is a naturally occurring host specific bacterium (*Bacillus popillae-Dutky*) that once applied to the lawn, releases spores that are swallowed by the feeding grubs. The ingested bacterium then begins to cripple and kill the grubs within a period of 7-21 days. The build up of spores in the grubs causes them to take on a characteristic milky appearance. Once the grubs are dead, new spores are released into the soil, providing years of protection. Milky spore has been effective in the eastern U.S., but not in the Midwest. This treatment is recommended for long term rather than short-term control. Note: Milky spore targets the Japanese beetle species of grub only.

Nematodes

These microscopic worms live and breed in the soil and infect and kill feeding grubs. Commercially available nematodes for grub treatment can be obtained at local suppy stores, and the strains *Steinernema carpocapsae* and *Heterorhabditis spp* seem to be the most effective against grubs. When applying nematodes to your lawn, it is important to irrigate before AND after application, since nematodes require moist soil conditions. It is recommended to treat the entire lawn.

Bacillus Thuringiensis (Bt)

Though not as popular as milky spore, Bt can also be used to control grubs. Bt is a naturally occurring soil bacterium that, when ingested, acts as a stomach poison that interrupts feeding, and eventually leads to death. Bt is a microbial pesticide and is available at local garden shops. There are several strains of Bt used to control various types of pests, so it is important to use the strains specific for grubs.

Control and treatment of grubs vary depending on the species. It is therefore recommended that you determine which species of grub is affecting your lawn. Take a sample to you local county extension agent for identification before starting treatment. Remember, a healthy lawn is key to deterring pests. For tips on maintaining a healthy lawn, contact Beyond Pesticides or visit, www.beyondpesticides.org.

Grubs, which cause lawn damage in their larval stage, develop into various adult insects, including the Japanese beetle.

the grub hosts. It is estimated that Tiphia wasps can parasitize up to 60% of grub in an area. However, a sizable population is required. To attract these wasps plant maple, cherry and elm trees, and peonies. These wasps are not aggressive and normally will not sting.

- **Birds.** Some birds can consume large number of insects in your yard, including adult beetles and grubs. Crows, starlings, robins, cardinals, meadowlarks, and grackles gobble up beetles and grubs. Attract birds to your property by providing bird feeders, houses and baths. For more information on attracting birds to your property, contact Beyond Pesticides.

■ **Adult Beetle Management**

Noticing when adult beetles arrive on your property and taking action can prevent eggs being laid to produce the next generation of grubs.

● **Hand Picking.** Hand picking adult beetles off plants can help prevent larger populations from visiting your property. Adult beetles can be destroyed by placing them in soapy water.

● **Plant Beetle Repelling Plants.** Adults tend to avoid garden balsam, begonia, buttercups, carnations, cornflower, daisies, dogwood (flowering), firs, forget-me-not, forsythia, hemlock, hydrangeas, junipers, kale (ornamental), lilacs, lilies, magnolias, maple (red or silver only), mulberry, pines, poppies, sweet pea, tulip tree, violets and pansy, or yews. You can plant some of these plants in and around your garden, or around your lawn to discourage beetles.

● **Avoid Beetle Attracting Plants.** Adult species are attracted to certain host plants. If Japanese beetles are common in your area, do not plant roses, grapes, hibiscus, sunflowers, and lindens around highly maintained lawns. May/June beetles prefer oaks while the green June beetle loves feeding on ripening fruit.

● **Traps.** Mechanical traps that lure adult beetles (with food type lures or pheromones) can be placed around the borders of your property and can capture around 75 percent of beetles that approach it. Setting up traps should coincide with the emergence of beetles in your area. Since these traps attract more beetles than they can catch, it is advised that traps be placed away from plants susceptible to beetle damage. However, do not use traps if you currently do not have beetles visiting your property!! Traps can be obtained from many garden centers.

■ Control

■ **Make sure you have grubs!** To determine whether you have a serious grub problem, check the extent of lawn damage. If the sections of damaged lawn detach from the soil and peel away, you have severe grub damage. White grubs may be seen here as you lift away the turf. To prevent significant damage, locate and treat high grub populations before they start doing damage:

● **Sample lawn.** Sample in early to mid August, at the start of the grub's life cycle. Early sampling of your lawn is one way to identify young grubs before they are capable of seriously affecting your lawn. With a spade or shovel, cut three sides of a square into your turf and peel back the turf like you would a carpet. Look for c-shaped grubs on the exposed soil and under the sod mat. Repeat this every 20-30 feet.

● **Count grubs.** For an otherwise healthy lawn, a couple grubs per square foot (0-5 grubs per sq ft) is not considered to be a problem. If there are 6-9 grubs per sq ft, you may want to take into consideration the overall health of your lawn. If your lawn is healthy, has a robust root system and is dense, it can probably withstand a few grubs. Otherwise, you may want to consider treating your lawn. For more than 10 grubs per sq ft, treatment should be carried out.

■ **Know when to us biological controls!** Treating your lawn for grubs is most effective in late summer or early fall, when grubs are most susceptible. This is because grubs are small and near the soil surface while the temperature is warm. Treatment done at other times may not be as effective once the grubs have grown bigger.

Common Hazardous Grub Control Insecticides

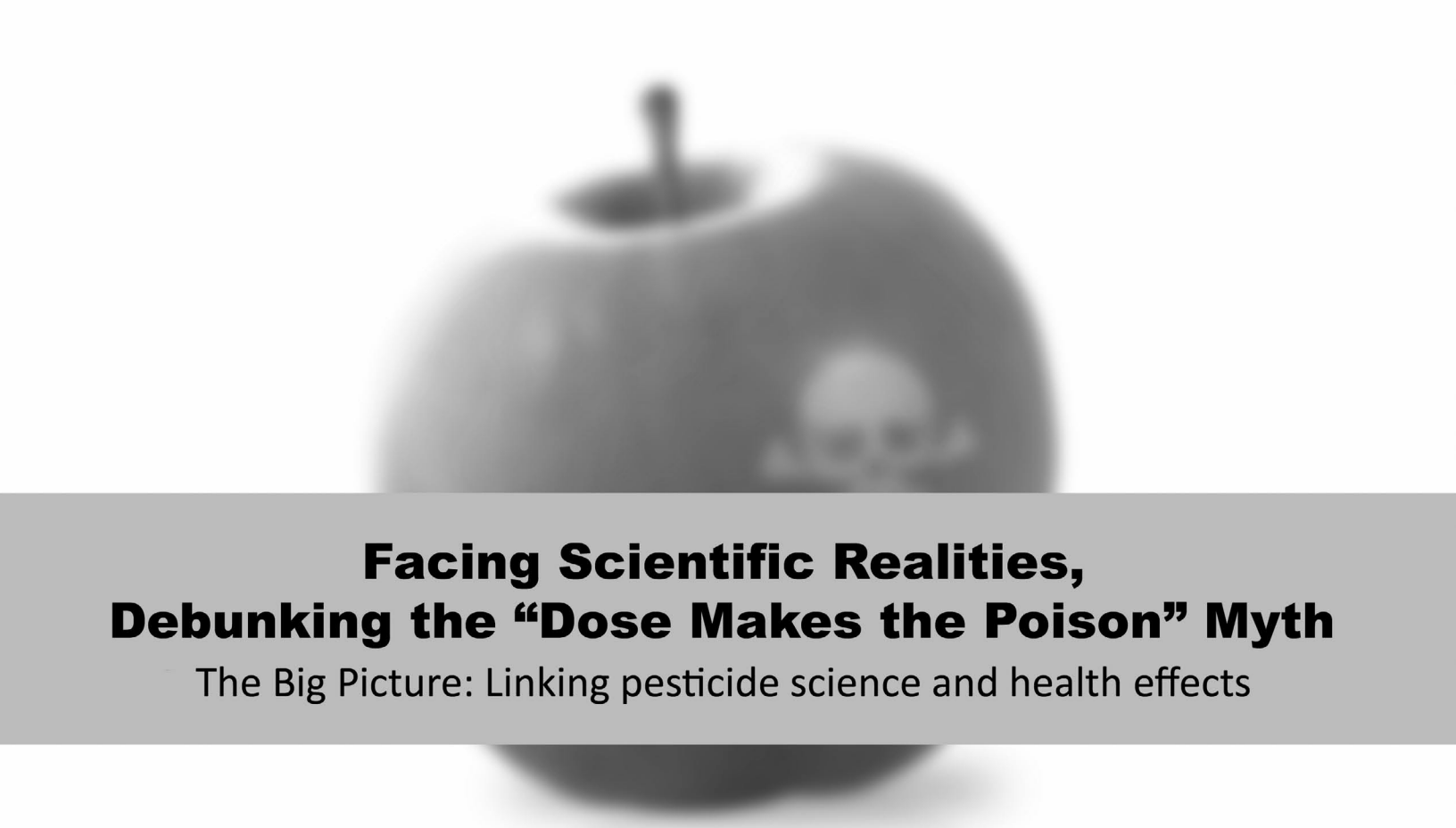
The chemicals listed below are commonly used for grub control, but are toxic and are associated with numerous adverse health and environmental effects. Use the steps above so that you do not have to use these chemicals on your lawn.

Imidacloprid (Merit) – This chemical, a chloro-nicotinyl insecticide, is toxic to the nervous system and is very toxic to beneficial insects like wasps and bees, as well as upland game and birds. Symptoms of acute poisoning include twitching, cramps, muscle weakness and fatigue.

Isofenphos (Oftanol) – Isofenphos is an organophosphate insecticide that has been proven to cause delayed neurotoxicity in animals and is toxic to birds, fish and beneficial insects. Symptoms of exposure include headaches, fatigue, nausea/vomiting, convulsions, respiratory depression and even death.

Carbaryl (Sevin) – One of the most widely applied insecticides in the U.S., this carbamate is neurotoxic and toxic to bees and other beneficial insects. Primary exposure occurs via the skin and can cause allergic dermatitis and irritation. Acute signs and symptoms of carbaryl poisoning include blurred vision, nausea, headaches, breathing difficulties, muscle twitching and ataxia. Long-term effects in humans include behavioral disturbances such as aggressive behavior, irritability and paranoia. Carbaryl is also toxic to the liver and kidneys, and damages ovaries and testes.

Trichlorfon (Dylox) - Trichlorfon can cause a reduction of the enzyme necessary to transmit nerve impulses, chlolinesterase; that is, it can over-stimulate the nervous system causing nausea, dizziness, confusion, and at very high exposures can cause respiratory paralysis and even death.



Facing Scientific Realities, Debunking the "Dose Makes the Poison" Myth

The Big Picture: Linking pesticide science and health effects

by Warren Porter, Ph.D.

Warren Porter, Ph.D., professor of Zoology at the University of Wisconsin-Madison, WI delivered the following talk at the 25th National Pesticide Forum, Changing Course in a Changing Climate: Solutions for health and the environment, June 1-3, 2007 in Chicago, Illinois. Dr. Porter is a board member of Beyond Pesticides.

Introduction

I am very honored to have the opportunity to be here with many old friends, and to be making many new friends. Tonight what I want to talk about is linking pesticide science and health effects, particularly related to what is happening to our children and wildlife –-because our children are getting cancer, but there are also a whole lot of very subtle and maybe not so subtle things that are happening. In terms of the science, it is amazing how much information is out there. My biggest challenge is how to get this talk down to a reasonable amount of time so I do not take up your whole evening.

An explosion of childhood learning disabilities

I am going to start by asking you, when you see this picture of a boy and a girl looking at each other, what does it say to you? What do you see in this picture? When I asked my Zoology 101 class that I teach every fall, "What do you see in this picture?" somebody in the back of the room the first time called out, "Raging hormones!" I laughed just like you did, and I said, "Yes, that's true. But clearly, it is also our future that we are looking at here." And we can spend great amounts of energy and time and money on our children; we love them, we nourish them, and we give up sports cars for college education funds for them.

There are things, though, that are happening to our children. On the tenth of February, 1997, in Madison Wisconsin, where I live, the *Wisconsin State Journal* was running a series of articles on our schools. We have many schools of national excellence in Madison, and we are very proud of them. But this particular issue was entitled, "Cost of Accommodating: As special education grows, so does the cost of staffing." There was a chart with statistics that are very chilling.

From 1990 to 1995, in the Madison school district, by disability we had an increase of 87 percent in the emotionally disturbed category over a five year period. The learning disabilities category jumped 70 percent and birth defects increased 83 percent in a five year period. This was astonishing, so I began to dig further. We were having big increases in the state of Wisconsin. California was having big increases. Pennsylvania was having big increases. Iran, where my wife is from, was having big increases. Australia, which I had visited a couple of years earlier, was having big increases. Something was happening to our children. And so I am going to start this talk by talking a bit about learning disabilities and behavioral disorders. What is the science on this? What are some of the things we know?

In 2006, a paper appeared by Chensheng Lu, Ph.D. et al.,[1] where the researchers looked at the urine of children in the Seattle area, and monitored a couple of pesticide metabolites –- in one

case the insecticide malathion, which is neurotoxic by design. The children in the study were on standard ordinary diets, and then they put them on organic diets, and then they put them back on their regular diets. The researchers measured the daily concentration in parts per billion (ppb) of a malathion metabolite. Then, they also looked at another pesticide, chlorpyrifos. They used the same study design: regular diet, organic diet, and then regular diet again. An organic food diet dramatically reduced chlorpyrfos metabolite levels in the urine. This metabolite measurement is important because, as Robert Foxenberg, Ph.D. et al.[2] showed, the chlorpyrfos metabolite is close to the same concentration as a highly reactive oxon also produced by the breakdown of chlorpyrfos. Thus, the metabolite urine concentration is an indirect measure of the formation of a highly reactive form of chlorpyrfos in the body. Chlorpyrifos is particularly cogent here, in the sense that the U.S. Environmental Protection Agency (EPA) has failed to remove it from agricultural usage, which means that it winds up on the food of our children.

Pesticide exposure impacts brain development and affects children's ability to learn.

Inverse dose response

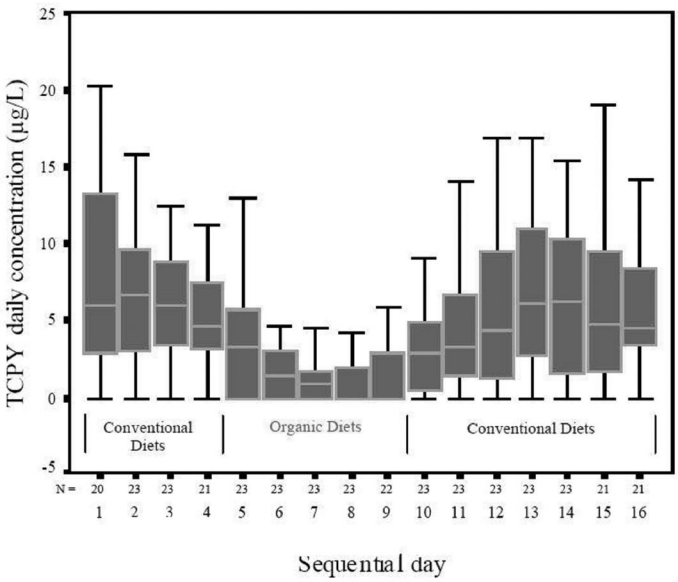
Could this kind of compound possibly be impacting children's ability to learn? In 2002, Edward Levin, Ph.D. and his colleagues in North Carolina[3] ran tests on chlorpyrifos with rats –-both male and female rats. They put them in a maze and then the rats had to learn a bunch of problems to solve. They made errors at first and, as they gained more experience, they learned and their error rate dropped. However, the females, especially the females on the intermediate concentration of exposure, took much longer to figure things out. When they summarized the results, the control animals that had no exposure had a low level of error (4 errors/trial), the males were in the same range as the controls, but the females were very much higher (7 errors/trial), or showing greater effects. Then at the high concentration, 5 ppm, the effect dropped off again.

Basically, this research suggests an inverse dose response. The lower doses had a greater effect, and it was the females that were being affected the most. What may be typically going on in these circumstances is that we are just beginning to drop into the realm of concentrations where physiological responses occur. If we were to continue to decrease the dose, the response would reach a maximum, then decline as we continue to decrease the dose. Male rats also suffer in terms of the impact on learning at higher doses, but the big deal is their reproductive impairment. There is a major reduction in their capacity to reproduce when exposed to chlorpyrfos at these concentrations.

Replicating previous effects on learning

Just this spring we finished repeat experiments, but with mice instead of rats. We looked at this same question of induced learning deficiencies and got slightly different results, but showed again how chlorpyrfos can affect learning abilities. We used the same chemical, chlorpyrifos, at the same doses, using the same protocols as Dr. Levin. This time we measured how long it took the hungry control and treated mice to find food. There were four pieces of food in the eight arm maze that they run. The control animals run the maze the quickest. Those exposed to one part per million (ppm) did not do quite so well, and the 5 ppm group, which is the highest dose, did much more poorly. There is a significant difference in learning abilities between control female animals and treated animals. The study showed no effect on male mice.

Figure 1. Organophosphates are neurotoxic by design (TCPY = chlorpyrifos metabolite)



Lu et al. Organic diets significantly lower children's exposure to organophosphorus pesticides. Env. Health Persp. 114 (2) Feb. 2006.

Why is this significant? It is significant because rats and mice, the two species that were used in these experiments, are very different physiologically. Rats are capable of a lot of detoxification because they live in dumps and places where they are ingesting all kinds of noxious food. Mice are not so much that way. Yet, we see the impacts in learning abilities in physiologically widely different kinds of mammals, and we see our children ingesting these kinds of compounds and excreting levels of these pesticide metabolites that are beginning to approach the same levels that cause learning disabilities in two different species of other mammals. This is of great concern.

Adverse brain effects

It is not just chlorpyrifos that is capable of altering neurological function. The herbicide atrazine can increase estrogen levels because it affects the enzyme involved in the production of estrogen, aromatase. It also changes the concentration of neurotransmitters in the prefrontal cortex of the brain, responsible for decision-making capabilities. It shows up in a paper by Veronica Rodriguez, Ph.D. et al.,[4] in *Environmental Health Perspectives*, with findings that in the prefrontal cortex there are three treatment levels. There is a control, there is a 5 ppm, which is what we just saw in chlorpyrifos and there is a 10 ppm exposure group. But what is interesting is, again, the low dose effect is the greatest effect, for the prefrontal cortex. The striatum, which plays a pivotal role in modulating motor activity and higher cognitive function, is affected by the highest dose. Chlorpyrfos is impacting two very critical parts of the brain, changing the ability of neurons to function appropriately.

Childhood brain and hormonal effects in Sonora, Mexico

Of course we must not forget the classic work of Elizabeth Guillette, Ph.D. at the University of Florida, who with her colleagues studied the children in the Yaqui Valley of Sonora, Mexico, which is where we get a lot of our winter fruits and vegetables. This is a story of the purchase of the valley by chemical agriculture interests to "advance" agriculture with intensive pesticide spraying. Half of the population left and went up into the mountains, and after a while the women in the valley began to get breast cancer and the children were very different. So they called in Dr. Guillette and her Mexican colleagues, and they began to study these preschool children to control for possible economic differences between the kids in the highlands and the valley, where the families were working in these fields.

One of the things Dr. Guillette and her colleagues did was to ask the children to draw a human figure. The kids up in the mountains who were not exposed were drawing standard stick figures that you would expect from a four or five year old –-facial features, digits on the hands and feet. The children in the valley were drawing abstract and incomplete figures. The valley children began their drawing at the bottom and worked up. Any occupational therapist who sees this happening will immediately attribute this behavior to major neurological problems in terms of integration of motor skills. These children are also very aggressive. They have very short memories and they are very weak physically. They cannot jump rope long or do a whole lot of other physical tasks. Now these children are reaching puberty. The boys are developing breasts, which are very painful and they have mammary tissue in those breasts. The girls have breasts which have nothing but fat, resulting in an inability to ever nurse any of their children. So it is the boys who might get a chance to nurse if they are given the right hormone, not the women.

I have a sister who is an occupational therapist, and she told me that they are trying to deal with these problems now because they know that the vestibular, or the balance centers, and the auditory impulses travel in the same nerve bundles. So what they are doing in private practice in Madison, WI and other places is treating children with attention deficit hyperactivity disorder (ADHD), autism and bipolar conditions, using sound or music of certain rhythms to help them improve their communication and interpret their environment and their behavior. These children have had their developmental profiles changed permanently by the exposures that they have experienced in utero and postnatally.

Figure 2.

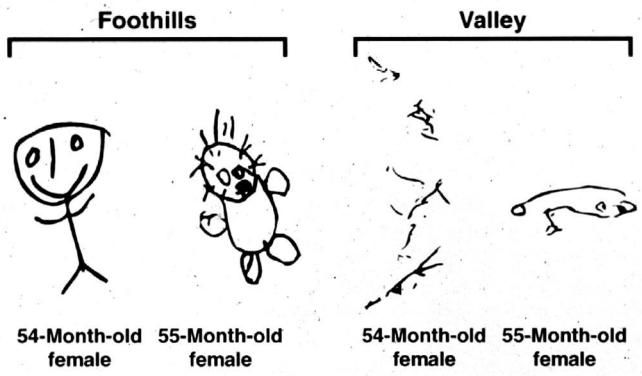


Figure 1. Representitive drawings of a person by 4-year-old Yaqui children from the valley and foothills of Sonora, Mexico.

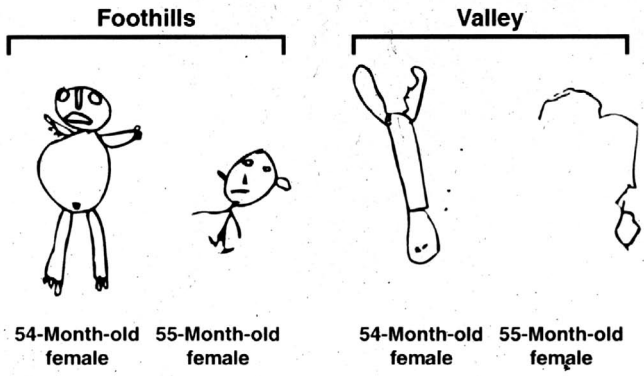


Figure 2. Representitive drawings of a person by 5-year-old Yaqui children from the valley and foothills of Sonora, Mexico.

Designed to Kill: The mechanism of poisoning

I want to talk a little bit about how one designs a pesticide to kill. Because once we understand this, we understand why all pesticides are biologically active. This is a very, very important concept.

Becasue pesticides are biologically active, their toxic properites usually have impacts far beyond the intended target.

First, you want to get a pesticide into the body of the organism that you want to kill, whether it be a plant or an insect or anything else. So you take the active ingredients and the so-called "inert ingredients." The inert ingredients consist of two categories: **(i) Non-ionic solvents**, with no electrostatic charges on it. Loosely I am calling these "organic soaps," which have nothing to do with the kind of organic we think about. You add these solvents to pesticides and that allows them to get through the waxy surfaces because these solvents are fat-soluble. So you get right through anything that has a waxy surface on it. **(ii) Surfactants**, a kind of soap, if you will, that is designed to penetrate the water film bubble that lines the respiratory surface of a leaf, for example. The hole through which they breathe, the stomate, as it is technically called, has a little hemisphere of a film of water and it acts as a physical barrier to block dust and other material from entering. But if you have a surfactant, you weaken that surface tension barrier and you get more rapid penetration. Unfortunately, our skin, is a waxy surface, and in our lungs, every single little tiny respiratory surface in our lungs, little hollow air sacs called alveoli, has a thin film of water with surface tension on it.

So the addition of these solvents and surfactants is anything but benign or inert because it promotes rapid penetration through the skin and in the lungs, which means you get it right into the blood. Then these same properties allow it to cross the blood-brain barrier and get to the brain, the command and control center of the body. This process largely bypasses the liver and the kidneys, which means it is getting around the defenses of our body by being able to get in by these routes of entry instead of through the gut.

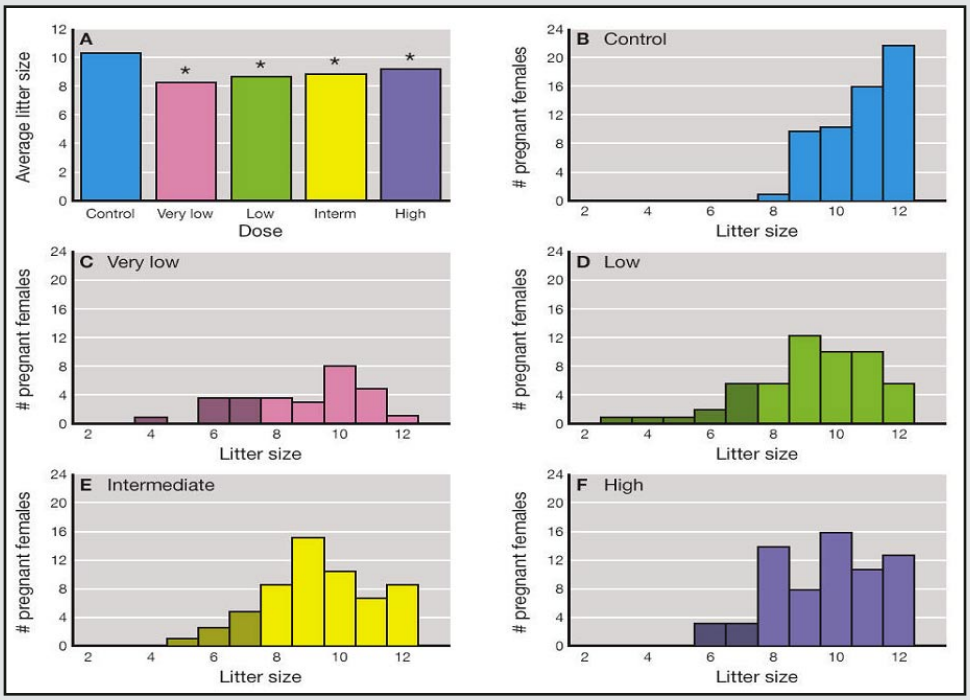
Once it gets inside the body, how does it kill? That is the next question. A pesticide design, whether an insecticide or herbicide, is typically a ring-shaped structure of some kind. These ring-shaped structures confer lipid solubility, fat-solubility. Fat solubility is the master-key, the cell-entry key to any cell in the body. What you do is hang off of these rings charged particles, like a nitrogen and two hydrogens to provide an electrostatic charge. This allows the chemical to be water-soluble. So we have, collectively, a molecule that can dissolve both in fat and in water. The way it works, and the way you get into every cell of the body is that the fat part dissolves in the cell membrane, which is a lipid surface. Once you dissolve in that, you get inside and now the electrostatic charge can take over, and this positive group will go to anything negatively charged, because opposite charges attract. You might be targeting the mitochondria, which have a net negative charge. This is the powerhouse of the cell and by getting in there you could disrupt the flow of electrons and "turn off" the energy supply of the cell, thereby killing it. It turns out, of course, that other molecules like DNA also have a negative charge. If the pesticide has a positive charge, opposite charges attract and the flat, round, dinner plate-shape ring can slide right in between the rungs of the DNA ladder. When the DNA unwinds to copy itself and comes to this point it breaks. We call that a mutation. If you start this at the right chromosome at the right position, you can start cancer on the first break. But typically, there are anywhere from six to a dozen breaks needed in chromosomes to start cancer in a cell. It is not just the DNA that has a net electrostatic charge. Many other organelles, molecules and ions in the cell like sodium, potassium, and chloride ions, have electrostatic charges. These ions are communication ions, both within the cell and between the cells. They are critical in neurotransmission (the transmission of nerve impulses), for example. They are electrostatic and so anything that enters the cell with an electrostatic charge can interact with the fundamental communication mechanisms of the cell, including the way the cell sends out its instructions in some cases. And so we have, essentially, a generic pesticide that is a molecular bull in a china shop here, and it is why we can get such a wide diversity of responses to a single molecule that might enter the cell.

Real world findings

If we look at the work of Paul Winchester, M.D. in Indiana, who has been looking at month of conception in humans compared to the presence of the amount of atrazine in one river in the state, and the rate of malformed baby male genitalia problems, we see that the peaks of atrazine and the male malformations coincide. It is not just in Indiana that he finds these kinds of results. When he looked at all the data in the U.S. from 1996 to 2002 and looked

Lawn Chemicals that Kill

Here is an example of what is put on lawns all across the country: 2,4-D, mecoprop, and dicamba, a very common mix in lawn chemicals. 2,4-D has a ring-shaped structure, strong negative charges on the chlorides and the acid group; a ring-shaped structure for mecoprop, negative chloride acid group; ring-shaped structure in dicamba, negative charges on the chloride and acid groups. These molecules are fat-soluble and water-soluble. And, by the way, I just found out today in our board meeting from one of our members that Monsanto and Nebraska have just come up with a dicamba-resistant soybean to replace the Roundup-resistant soybeans. These will be dissolving in the soy that children may eat.



When we saw this 2,4-D, mecoprop and dicamba mix (we just bought it off the shelf), we wondered whether it might be capable of changing or altering the capacity to keep fetuses in utero. So we decided we would take what EPA said was a relatively safe dose, about 77 ppm 2,4-D, and we would allow mecoprop and dicamba in this mixture to go along for the ride, and we would dilute it because we had a very concentrated solution. We brought it down to 400 ppm as a super high dose, 77 ppm, then a low dose at 0.32 ppm and 39 ppb here as the very lose dose. We would dose in two different ways: we would dose either from the day of fertilization to day 15, the end of organ formation, or from day five, which is implantation, to day 15.

So how do you find out whether or not you are getting fetal losses? The way we get at embryo losses is to determine how many are born, and then after the ones that are born are weaned, we remove the uteri from the moms. And we can stain them with an ammonium sulfide stain and every black spot shows us where a placenta was attached. The uterus of a mouse is a bifurcated uterus, and so you can just count them like peas on a pod. That is how we can determine how many were implanted, and the difference between the implants and the number born is how many were lost.

We put this together several times, multiple research efforts by one of my students, Fernanda Cavieres, myself, and another student in the lab, and we found that when we looked at the dosage, very low doses have the greatest effect —-a very common endocrine response.

at the presence of nitrate and atrazine, he found a very similar pattern. He has recently announced the results of additional work where instead of looking at birth defects, he looked at the month of conception and related that to the scores on IQ tests, on learning tests for language and mathematical skills in children and found a similar correlation. I cannot show you those data because he has not published them yet, but he has announced them in a talk about two weeks ago.

We see birth defects in fawns in Montana. We see lower jaws that are thrust forward. When we look in Yellowstone National Park, we see fawns with a lower jaw protruding forward, teeth sticking out, and eyes that are very much pressed in the head. These things are happening to animals that are living in supposedly pristine environments. However, they use herbicides to control weeds in the forests.

As long ago as 1945, we were spraying DDT, and there were marketing ads on trucks (see picture) that pointed out what we were told about DDT: “Powerful insecticide, harmless to humans.” And yet we discovered afterwards that alligators in Lake Apopka, Florida that Louis Guillette, Ph.D. studies, were having a hard time finding their penises, as were Dr. Guillette and his coworkers. Lake Apopka is a lake near Disney World that had a spill of a chemical

very much like DDT and breakdown products that looked like estrogen, and when you feminize males, especially when they are developing in the eggs, they do not have much of a penis and certainly do not have much in the way of sperm.

The sign on the truck reads, "DDT: Powerful Insecticide, Harmless to Humans."

Immune Suppression

It is not just the endocrine (hormonal) or the neurological changes that are inversely sensitive to these doses, but a 1987 paper that caused us to lose EPA funding showed that aldicarb, the number one product for then-Union Carbide, (of Bhopal fame), was immunosuppressive relative to the controls, and the greatest effect was at the lowest dose. EPA said 100 ppb was totally safe. We did this four times, had the best statisticians in the world helping us analyze these data, and well, anyway, that is a long story.

Recently, Rodney Dietert, Ph.D. and Janice Dietert, Ph.D.[5] at Cornell published a very interesting paper talking about developmental immunotoxicity: what are the variables that affect the immune system during fetal development? We see that they indicate that certain herbicides, insecticides and biocides cause effects very early in conception. This is what the data of Paul Winchester, M.D.,[6] Indiana University School of Medicine professor of clinical pediatrics, also suggests.

Then there are a whole lot of other exposures all the way through the developmental process: heavy metals, xenoestrogen, certain fungi, toxins, PCHs, TCDD, polyaromatic hydrocarbons, and on and on. It is remarkable. The range of factors that can affect developmental immunotoxicity illustrates that various kinds of immune suppressions are consequently showing up as asthma and allergic diseases, autoimmunity, infectious diseases and ineffective vaccine responses, cancer, neurodegenerative diseases and neurocognitive loss, cerebral palsy, atherosclerosis, hypertension, and male sterility. All of them are consequences of early fetal exposures that resulted in immunotoxic responses that were to show up later in life.

Lately, another box could be added, and that's something that maybe many of you have not even heard about, and that is polycystic ovary syndrome (PCOS). At least ten percent of women in the United States today who are reproductively active suffer from this, and recently a colleague of mine, David Abbott, Ph.D. of University of Wisconsin-Madison, the Primate Center, showed that you could induce this very difficult disease, which has a long list of properties associated with it, but especially a tendency toward obesity, type-2 diabetes, health problems related to heart problems and atherosclerosis. The only way to deal with it is to keep your weight down. There is no cure for it, and it is extremely difficult to diagnose. You diagnose it only by exclusion. You exclude everything else and if nothing else fits, it is PCOS. What is really interesting is that PCOS is now starting to appear to be a disease that is a consequence of chronic, low-level immune suppression that generates a host of responses in people that have it. Dr. Abbott is able to induce this in Rhesus monkeys, monkeys that have placentas like humans. The way he induces this PCOS in his animals is to androgenize (masculinize with a chemical) the moms when they are pregnant.

How might this happen under natural conditions? Well, one way could be to change the concentration of the enzyme aromatase. Aromatase converts testosterone to estrogen, and it does it irreversibly. It goes only one way. The herbicide Roundup (glyphosate) can down regulate aromatase.[7] What happens when you reduce the amount of aromatase? Well, you are going to keep on making testosterone and you are going to build it up, so you conceivably could androgenize anything that has aromatase reduction happening. That means if you have a female fetus exposed to male hormones in utero, that female may become androgenized and may not to be able to reproduce appropriately. Right now we do not know the answer to this question. We need research to explore this question.

Looking at the whole

Here is how it may all fit together, how the neurological, endocrine, and immune and developmental processes may be fit together. When we had supper tonight, we were consuming mass and energy and nutrients, and fueling our cellular and molecular systems that keep us alive. We have organ systems like the central nervous system, the endocrine system, and the immune system, and these talk to each other all the time. There are almost 60 known right now that naturally communicate between these three systems. So if you hit one system, you are likely going to hit the other two just because of the communication going on.

Two systems, cellular-molecular and organ systems, support individual functions of reproduction, growth and behavior, and at the population level they support birth and death rates and social

structure, and at the community level they support immigration and emigration and relative species abundance.

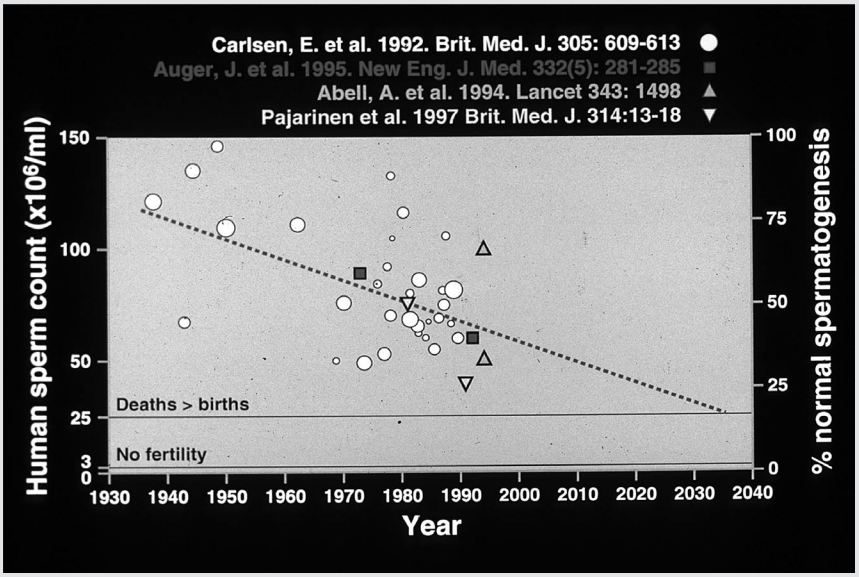
What is becoming apparent from all the scientific literature is that pesticides, which include herbicides, insecticides and fungicides, can act as nerve poisons, as well as altering hormone levels in various ways. Because of the interconnections and direct effects on immune function, they are impacting organ systems too. Because our ability to take in nutrients is a function of our ability to find food and have appetites and coordinate that, we may be subverting the very foundation on which this entire superstructure rests (see Figure 4).

These concerns are not quite so obvious to the general public, but it certainly illustrates how very important it is to understand the interconnectedness of the whole body. If we fail to remember this, then we are going to focus very narrowly and not get at fundamental issues of concern. We have to get at the causes, not just deal with the symptoms. Thank you very much!

Sperm Count Declining, Organic Farmers' Higher

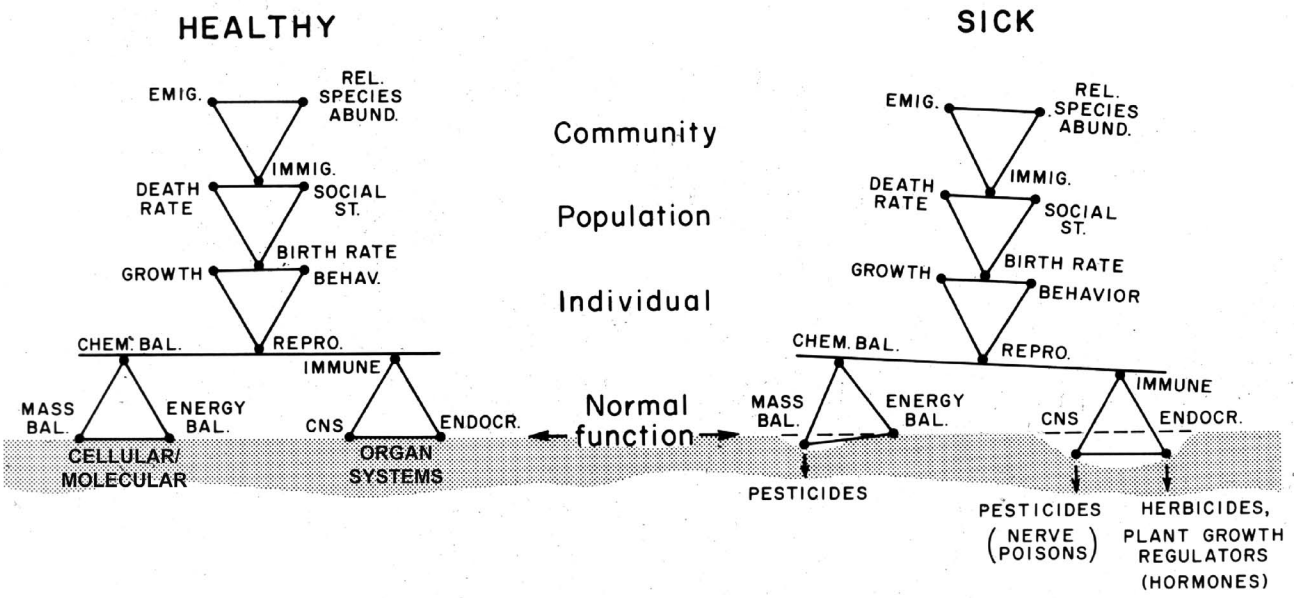
You remember, of course, that animals are often canaries in the mine for what could happen to humans, and when you look at the human sperm counts that are known from the literature now, about 168 of these studies, we have very strong data now that the sperm count in human males is now declining at a rate of 2.5 percent per year on a global average. This was all started by Elisabeth Carlsen, Ph.D. and Niels E. Skakkebæk, Ph.D. [8] in Denmark because most Danish males have very low sperm counts. And then Jacques Auger, M.D.[9] in France and his colleagues published a paper showing that in 1972 the average Parisian male had about 90 million sperm per milliliter (ml), but by 1992 that had dropped to about 60 million sperm per ml, and it is dropping faster than the global average here.

Figure 3. Human sperm counts declining in quantity and quality



Then Annette Abell, Ph.D.[10] and her colleagues in 1994 looked at the Danish population in general and then looked at the sperm counts of organic farmers, and it was pretty clear that something in the environment was causing changes in sperm count. Then finally, Jarkko Pajarinen, M.D.[11] says, okay, maybe the sperm count is dropping but how are we doing for normal sperm? So they looked at males in Helsinki, Finland. In 1981 about 50 percent of those sperm were normal. By 1991, 10 years later, about 25 percent of those sperm counts were normal. So the quality and the quantity of sperm are dropping very rapidly, and it is very clear that if this trend continues, within one generation we will have a negative population growth of this entire planet, on average.

Figure 4. Neurological, endocrine, immune, and developmental effects: Overview/theory



This graphic depicts the impact of pesticides on the delicate balance of life. Porter, et al. 1999. Toxicol. & Indust. Health. 15 (1-2): 133-150.

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The Secret History of the War on Cancer

Devra Davis, Ph.D. New York: Basic Books. 2007. 453pp. Cancer has become commonplace in modern life. One out of every two men and one out of every three women contracts cancer in this country. It is the second biggest killer of children, after accidents. While *The Secret History of the War on Cancer* is centrally a history of the science and politics of cancer causing substances and technology, the author, Devra Davis, PhD, weaves a book that includes her insights, travels and travails, spirituality, and sense of humor.

Introducing uncertainty

Dr. Davis, an epidemiologist, director of the Center for Environmental Oncology at the University of Pittsburgh and former director of the National Academy of Sciences Board on Environmental Studies and Toxicology, gives us an historical context for her conclusion that the producers of toxic chemicals and dangerous technologies hide the facts and deceptively (mis)use science to proffer confusion and delay restrictions while the public is exposed to hazards. Dr. Davis explains that while the evidence of harm is ample years or decades before action is taken (citing benzene, tobacco and asbestos), the courts are loathe to act in the face of uncertainty. Industry is positioned to introduce uncertainty at every turn. Dr. Davis concludes:

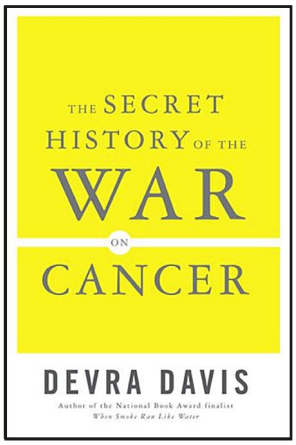
The absence of extensive information confirming that human health is endangered by any one of these technologies and medications lulls most of us into assuming that no such hazard exists. The lesson of this book is that we should all question this presumption. A lack of definitive evidence regarding human harm is not proof that no such harm occurs. Rather it shows the difficulties and roadblocks that surround efforts to develop information on the health effects of modern technologies and chemicals.

While recognition of cancer can be traced to the Middle Ages with medical recognition of hazardous industries, Dr. Davis cites an international meeting in Brussels in 1936, the *Second International Congress of Scientific and Social Campaigns Against Cancer*, of preeminent scientists on environmental causes of cancer as a turning point and historical marker. And then nothing. A report in 1949 in *Scientific American* cites the growth of cancer and its connection to the environment.

Dr. Davis recounts the experience of researcher Wilhelm Hueper, Ph.D. who joined the fledgling U.S. National Cancer Institute (NCI), founded in 1940, in the late 1940's and published a cancer pamphlet which cited the occupational causes of cancer and recommended a cancer control program to eliminate carcinogenic agents from industrial, civilian and military use whenever practical. By 1959, the industry had quashed a reprinting of the pamphlet and Dr. Hueper's views were characterized as anti-business and potentially communistic.

Focus on the cure

History indicates that early detection and research for a cancer cure has been the major focus of industry, government and cancer organizations. However, it took the American Cancer Society (ACS) 15 years after the Pap smear was shown to be successful and 45 years after it was developed to get behind this effective early detection tool for cervical cancer.



The revolving door between government and industry is pervasive, with, for example, the head of ACS becoming head of NCI and then founding director of the Tobacco Industry Research Council. After reviewing the history of tobacco restrictions, Dr. Davis concludes, "In the end, the tobacco story is not just about tobacco. Rather, it is a lesson in how public access to information about any suspect hazard can be skewed, bent and twisted to suit other interests. Here we learn that the same tactics that delayed public action against tobacco also played a role in laying down the foundations of what is considered proof in epidemiological research."

War on cancer

It was 1971 when the war of cancer in the U.S. began and was embraced by President Nixon with the signing of the *National Cancer Act*. Some of the promise of new agencies that were created during the 1970's, such as EPA, and the Occupational Safety and Health Administration, and new laws like the *Superfund Act*, have been undercut by industry interests. Dr. Davis cites a critical work that captures this undue influence, *Documentation of the Corporate Influence in the Setting of Threshold Limit Values*, published by Barry Castleman, Ph.D. and Grace Ziem, M.D. in 1988. Dr. Davis also cites other authors that have written important books on this subject, Larry Agran, Samuel Epstein, M.D., and Sandra Steingraber, Ph.D.

The reader's travels with the author through contaminated communities in Alabama, Louisiana, Texas and Virginia illustrate the failure of cancer policy. Today, government infatuation with the risk assessment process, which it rejected in the early days of the war on cancer, further fuels the influence of industry and the skewed calculations that implicitly force an unnecessary reliance on carcinogenic chemicals. Moreover, Dr. Davis says, "If we cannot. . .prevent exposures to suspected cancer causes based on solid experimental reasoning, and if we insist on proof that humans have already been harmed, then we are treating people like experimental animals in a vast and largely uncontrolled study." When talking about cancer policy, it should be noted that Congress in 1958 adopted the *Delaney Clause*, named for its sponsor Rep. James Delaney (D-NY), which sought to prohibit cancer causing pesticides in food. While just beginning to be implemented in the 1990's, the provision was repealed in part with the adoption of risk assessment language in the 1996 *Food Quality Protection Act*. Grassroots advocates argued that advances in regulating neurotoxic and other non-cancer endpoints should not have to be traded for efforts that would give teeth to carcinogenic chemical phase-outs in the war on cancer. Now it is the growth of organic practices and products that is outpacing regulation in shifting us away from cancer causing chemicals and pesticides.

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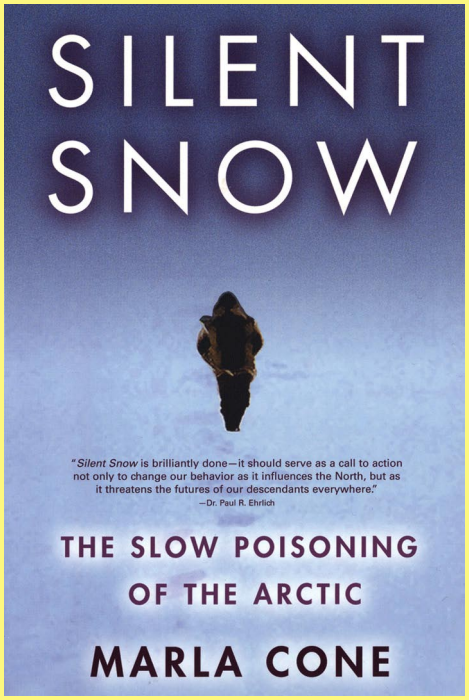

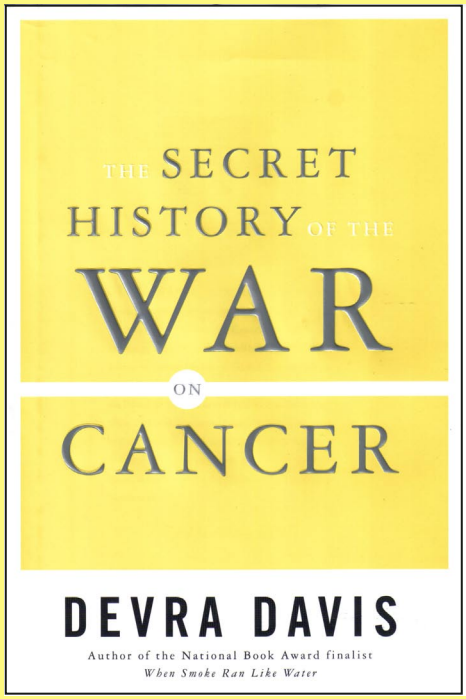

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