LEAGUE OF WOMEN VOTERS®

Overview of Pesticide Management

Definition and History

"Pesticides" is an umbrella term referring to substances that prevent damage from weeds, diseases, or animals. Pesticides are applied to growing crops to maintain crop yields, crop quality, and appearance, as well as post-harvest storage to prevent mold and animal infestation.[1,2,3] They may be applied to livestock to control lice, mites, ticks and flies.[4] Pesticides are also used to control invasive species, contain diseases geographically, and protect wood structures.

Pesticides can be classified by their target organism[5] or by their chemical structure, i.e. inorganic, organic, synthetic, or biological. Some pesticides are broad-spectrum meaning they are toxic to a range of insects or weeds, while others are "restricted use," i.e. the pesticide is approved for use only on a select number of crops and can only be applied by a licensed applicator.

Naturally occurring pesticides such as sulfur and copper, and biological pesticides derived from chrysanthemums (pyrethrum), nicotine, and the roots and stems of tropical plants (rotenone) have been used for hundreds of years. Bacillus thuringiensis (Bt), a non-pathogenic bacterium that is found naturally in the soil, has been used as a pesticide on organic farms for more than 50 years.[6]

Many of these naturally occurring pesticides continue to be used on organic and conventional farms, although synthetic pesticides have dominated conventional agriculture since the 1950s. More recently, seeds containing genetically engineered Plant Incorporated Protectants such as Bt predominate in certain crops (e.g. corn, cotton). As genetic engineering is addressed elsewhere in this Agriculture Update (Regulatory Agencies—EPA; Genetic Engineering), this overview will focus on other aspects of pesticide use.

Pesticide Use Trends

Agriculture accounts for 80% of the pesticide use in the U.S.[7] Estimates on the types and amounts of pesticides used, the crops on which they are placed, and their geographic distribution are available through three government agencies: the EPA,[8] the USDA,[9] and the U.S. Geological Survey (USGS).[10]

The 2011 USEPA report provided data through 2007. That report shows that agricultural pesticide use was down, from 948 million pounds in 2000 to 877 million pounds in 2007; use of organophosphates, among the most toxic class of pesticides and the subject of special scrutiny by

USEPA, had decreased, but the herbicide glyphosate more than doubled in use, from 85-90 million pounds in 2001 to 180-185 million pounds in 2007.[11]

USDA estimates on pesticide use over time are based on its Census of Agriculture conducted every five years, and the National Agricultural Statistics Service's annual Agricultural Chemical Usage data reports on a limited number of surveyed commodities and animal species. USDA estimates suffer from gaps due to suspension of data collection[12] and program differences in what data get reported.

The 2013 USGS report, utilizing proprietary usage data along with USDA acreage information, concluded that pesticide use was higher than that reported by either USEPA or USDA but was still trending downward.[13] Though USGS estimating methodologies were different from the other agencies, the report concludes that overall the results from these three agencies were fairly consistent.

Though pesticide use may be down, there are indications that it will begin trending up due to the emergence of new pests and pesticide tolerant weeds.[14]

Management Practices

A complex set of factors affect the efficacy of pesticides and should be evaluated in order to properly apply them for maximum effect and minimum non-intended damage.[15] It is unknown whether all these factors are taken into consideration before application occurs.

As pesticides are expensive and can harm human health and the environment, many farmers use pesticides as one part of a complex strategy called Integrated Pest Management (IPM) to control pests. IPM is not a single pest control method but, rather, a series of pest management evaluations, decisions, and controls. In practicing IPM, growers follow a four-tiered approach: establishing a threshold when pest control action is necessary; monitoring and identifying pests; preventing impacts through practices such as crop rotation and selection of pesticide-resistant varieties; and evaluating alternative control methods, including but not limited to, the use of pheromones, trap crop planting to lure pests away, and using predator parasites.[16]

Other preventative practices that can be employed include selecting disease-free rootstock, timing planting to avoid pest outbreaks, using tillage practices to remove weeds, planting non-GE "refuge" crops among genetically engineered plants, removing pests mechanically, applying manure to build up soil biota and increase resilience, and using computer modeling to predict pest outbreaks.

While IPM is considered a best management practice, farmers fall all along its continuum of practices. Organic farmers, who by regulation and disposition, have fewer pesticide options available, must rely on many of these strategies.

Integrated weed management (IWM) employs many of the same principles as IPM.[17,18]

Health and Environmental Issues

Concerns over health effects from workplace pesticide exposure, consumption of pesticide residues in our food & water, and effect on biota are three major concerns.

Health Studies

Pesticide applicators, farm workers, and farmers are regularly exposed to pesticides, and 10,000-20,000 workers experience pesticide poisoning annually, according to USEPA estimates. This population is studied by the National Institute for Occupational Safety and Health (NIOSH), a part of the Centers for Disease Control, and the EPA that conduct surveillance for acute events.[19] Chronic exposure is studied through the Agricultural Health Study (AHS) a prospective study of licensed pesticide applicators.[20]

In the broader population, persistent pesticides such as organophosphates have been a particular concern and focus of studies. A recent meta-analysis of 20 studies indicates that long-term low-level exposure can affect neurological and cognitive functioning.[21,22] Other pesticides such as paraquat have been linked to Parkinson's Disease.[23] Additional studies are described in a recent *Science* article[24] "Beyond Pesticides' Pesticide-Induced Diseases Database."[25]

The Centers for Disease Control and Prevention (CDC) conduct a national biomonitoring program on 212 chemicals, some of which are pesticides, through the National Health and Nutrition Examination Survey (NHANES).[26] A 2012 study using NHANES data found an association between dichlorophenols, a widely used pesticide also used in water chlorination, and food allergies.[27] Though studies may show an association between exposure and a health issue, association does not prove causation; but it does warrant further study. However, use of NHANES datasets in particular may not be appropriate in drawing conclusions about the effects of chemicals on chronic or acute disease.[28] The CDC also cautions that more research is needed on many chemicals.[29]

Presence in Food & Water

While pesticides present on a plant's exterior can be washed off, other pesticides are systemic[30] and remain in our food as they cannot be removed by washing or peeling.

The USDA's Pesticide Data Program (PDP) is a national pesticide residue database program that operates in collaboration with state agriculture departments and other Federal agencies. Annual testing is conducted on samples of domestic and imported foods with a special focus on commodities highly consumed by infants and children. The data from this program form the basis for consumer group databases.[31]

The 2013 PDP report shows that, similar to previous years, overall pesticide chemical residues found on tested foods are at levels well below the tolerances set by the EPA. Residues exceeding the tolerances were detected in 0.27 percent of the samples tested. Some residues with no established tolerance levels or tolerance exemptions were found, but the EPA has determined the

extremely low levels of those residues are not a food safety risk, and the presence of such residues does not pose a safety concern.[32]

While this is good news, it is an incomplete picture of the quantity or the effect of ingested pesticides. When the EPA establishes a tolerance level, it is based on a risk assessment of a single compound. As there is no limit to the number of different pesticides that can be on food, the risk assessment cannot and does not examine the "body burden," i.e. the additive effect of the pesticide under consideration along with presence of other chemicals to which we have been exposed. Nor does the risk assessment evaluate the possible synergistic, i.e. interactive effect, of those compounds. Moreover, the tolerance level is established on the active ingredient, though the inert ingredients that dilute and help deliver the pesticide may also be toxic.[33]

While NIEHS is working to develop methods to study the real world mixtures of exposures to chemicals (not just pesticides),[34] the EPA has updated its human health benchmarks for 363 food-use pesticides that may be present in drinking water, but for which no drinking water standard has been developed. Advanced test methods permit detection of pesticides in water at very low levels. This improved testing technology along with the latest scientific information is part of the continuing effort to establish thresholds of a potential health risk.[35]

At the same time, the EPA has raised the amount of glyphosate residue allowed in the food supply.[36] Glyphosate is considered to be a low toxicity pesticide.[37] Additional information on the presence of pesticide residues in food, can be found in the consumer databases referenced above.

Environment

As described in a recent review, there is widespread evidence of wildlife ecotoxicity by pesticides. More than 120 endocrine disrupting pesticides are known to affect multiple body systems in birds, amphibians, and fish. In addition, immune system functioning can be impaired and there are indirect effects on the food web and species competition. Despite best efforts to improve the specificity of insecticides in particular, they may harm beneficial or benign insects as well as the targeted organism.[38]

While insects and weeds are known to develop resistance to pesticides over time,[39] resistance to glyphosate has become widespread, with 24 resistant weed species now documented.[40,41] Increased spraying of stronger pesticides and planting of genetically engineered seeds that are stacked with multiple resistance, is anticipated and is discussed in the "Genetic Engineering and Genetically Modified Organisms in the Food System" paper in this Agriculture Update.

Field Application Issues

Because spraying can contaminate water supplies, directly expose farm workers, adversely affect non-target species, and cause economic damage to certified organic operations, great care must be taken during pesticide application. There are multiple application methods. Through precision

technology (using GPS and "smart" sprayers), pesticide use is more precisely directed and the quantity applied can be cut significantly.[42]

However, other methods pose more risk of exposure: Aerial spraying, airblast (as is used in urban mosquito abatement), and chemigation (application of chemicals through irrigation equipment). The Pesticide Action Network (an advocacy group) reports on pesticide levels detected in their drift catcher program.[43] Although there are guidelines for aerial spraying,[44] it is difficult to ensure that ideal conditions are always present. And, based on a laboratory study, spraying may be a method of inadvertently spreading norovirus, the largest cause of foodborne illness.[45]

Regulatory Issues

In order to register a pesticide with the EPA, applicants are required to comply with the requirements of the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) which specifies testing requirements. FIFRA's testing requirements were strengthened in 1972, but the regulated community had difficulty meeting the new data requirement deadline. To address this problem, Congress authorized a fix by creating an alternative procedure called conditional registration. Conditional registration was supposed to be a limited to those pesticides that are brought to market to serve the public interest, or during the time period in which the required data are being developed by the applicant and submitted to the EPA for review.

Consumer protection groups have criticized this practice as not being protective of public health and the environment.[46] In a 2013 report, the Natural Resources Defense Council (NRDC) asserts that 10,000 pesticides used in consumer products and agricultural processes have been given conditional registration, the EPA is not following up to ensure that the required data are being submitted, and some of the conditional registrations have lasted 15 years. The NRDC has recommended six corrective actions, including two related to public transparency in the approval process.

In 1989, the LWVUS Education Fund, in conjunction with the Public Voice for Food and Health, produced a 19 page citizen's guide to pesticides as part of the Food Forum Education Project. That project was initiated because of the need for education on agriculture and food issues in order to affect public policy. Each of the issues identified in that guide continue to pose challenges today.

Recommended Readings

"Smarter Pest Control", Science (Special Section with multiple articles on pesticide use), August 16, 2013, http://www.sciencemag.org/content/341/6147/728.full.pdf, not accessible online without a subscription.

National Pesticide Information Center, http://npic.orst.edu, through a cooperative agreement between USEPA and Oregon State University, is a resource center offering brief summaries and links on a wide variety of topics, and is a good place to being further research.

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