AgConnections

AGRICULTURAL SAFETY AND HEALTH

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NIOSH Agricultural Research Centers Update for Spring, 2003

Pesticide Registration

by Jack Arthur, M.En., CIH, Health Effects Division, Office of Pesticide Programs; Environmental Protection Agency

EPA's Office of Pesticide Programs (OPP) is responsible for registering and establishing maximum allowable residue levels for all pesticides used in the United States, in order to safeguard the nation's food supply.

The registration process includes: examination of the ingredients; the site or crop on which it is to be used; the amount, frequency and timing of its use; storage and disposal practices. The OPP evaluates whether a pesticide has the potential to cause adverse effects on humans, wildlife, fish and plants, including endangered species and non-target organisms, as well as possible contamination of surface water or ground water from leaching, runoff and spray drift.

The Food Quality Protection Act (FQPA) of 1996 establishes stringent and consistent health-based standards to assess the risks of pesticide residues in food or feed. Under the FQPA, before a tolerance can be established, and the pesticide

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Pesticides and Farming: Are Children in Harm's Way?

Farming is a healthy occupation, and the farm can be a great place to raise kids. But we also know that the farm is a complex workplace that contains a broad spectrum of hazards, and that the boundary between work-place and home is often hard to draw. Agricultural chemicals represent one such hazard. Insecticides, fungicides, and herbicides are common features of modern agricultural production in the United States. Over the past three decades substantial efforts have been made to protect farmers and farm workers from the hazards posed by overexposure to pesticides. Toxicity testing, strict labeling procedures, certification and training, improved application equipment, and personal protective gear are all parts of an elaborate program of risk management designed to minimize this hazard. As the rules governing occupational pesticide exposures have been strengthened, it has been generally assumed that, so long as chemicals were handled and stored properly, children would not be placed in harm's way.

Richard Fenske, PhD, MPH
PNASH Center Director

In the past decade, however, new insights into more subtle mechanisms of toxicity, and concerns regarding the special vulnerability of children to environmental pollutants have led to a new focus on children's environmental health. An important wake-up call was a 1996 Executive Order directing all federal agencies to develop an explicit strategy for including children's health in their evaluations. Passage of the Food Quality Protection Act of 1996 pointed the spotlight directly at pesticide health risks and children. This law, approved by a unanimous vote of Congress, requires the Environmental Protection Agency to review the toxicity of every pesticide, and to determine both the acute and chronic health risks these chemicals pose to children. This increased scrutiny has led to new questions about children and pesticides. What do children eat and how does it differ from adult diets? Where do children spend their time and how do they interact with their environment?

When we turn our attention to the farm environment, a new set of questions can be posed. Are workplace chemicals entering the home? Can washing work clothes with the family laundry transfer pesticide residues to children's clothing? When pesticides are sprayed, do the chemicals move off-target to residential areas?

Our efforts at the Pacific Northwest Agricultural Safety and Health Center have tried to answer these questions, and have investigated new approaches to minimize children's exposure to pesticides. Our early studies in the agricultural region of Washington State demonstrated that agricultural pesticides measured in house dust were elevated in the homes of agricultural workers compared to other homes in the same community. A follow-up study collected urine samples from pre-school children, and found that children of pesticide applicators had higher levels of pesticide metabolites than did children of non-agricultural workers. These studies led us to hypothesize a para-occupational or "take home" pathway for children of agricultural producers and workers. Our most recent study of this pathway sampled the dust in commuter vehicles of more than 200 farm workers, together with dust from their residences. We found a strong association between home and vehicle dust for a number of pesticides, providing further support for the take home exposure pathway. Current efforts have focused on an intervention to improve hygienic practices in these communities to reduce pesticide residue levels in homes.

Our studies have also found that children who live in homes in close proximity to pesticide-treated farmland may have higher exposures than children living further away from spray activities. The most striking finding in this regard came from a study of 44 pre-school children living in the tree fruit region of the state. We collected urine samples from these children over the course of a year, and found that levels of pesticide metabolites in the urine increased during periods of active spraying, and returned to normal levels when the spraying ended. It appears from these results that agricultural spraying can have a community-wide effect on children's pesticide

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FRESH FROM THE FIELD
CENTER RESEARCH PROJECTS

SOUTHEAST CENTER

Multi-Center Pesticide Surveillance in the Mississippi River Delta Region

by Robert McKnight, MPH, ScD

The Southeast and Southwest centers are cooperating with 9 poison control centers that serve the Lower Mississippi River Delta Region in order to improve surveillance of pesticide and other agricultural chemical exposures. This region, which is Congressionally defined, contains 240 counties in Alabama, Arkansas, Illinois, Kentucky, Louisiana, Mississippi, Missouri, and Tennessee. Currently, data analysis is underway on approximately 2,400 reported exposures occurring in 2001, with a similar analysis of cases occurring in 2002 to begin this spring. Later this summer, a selected group of new pesticide exposures occurring over a 12-month period will be followed-up by a ten minute telephone questionnaire that probes the circumstances of the exposure.

WESTERN CENTER

Pyrethroid & Paraquat Immunoassays

by Shirley Gee, PhD

The main goals of this project are to develop immunoassays for pyrethroid insecticides and the herbicide paraquat. An immunoassay is a rapid, simple and sensitive measurement method that is based on using antibodies as detectors. These assays are tools that will be used by researchers to analyze the urine of humans as a measure of exposure to these compounds and to analyze other types of exposure samples (air filters, patches, etc.). Major progress has been made in developing and using immunoassays for pyrethroid insecticides that are rapidly replacing organophosphate insecticides as the major U.S. insecticides. Assays for permethrin, esfenvalerate and deltamethrin have been published by this laboratory. Although less toxic to mammals than some organophosphate insecticides, pyrethroids are toxic to non-target organisms like fish and aquatic invertebrates, therefore, the assay is also useful for environmental monitoring. Since some monitoring efforts will involve detection of different pyrethroids, we have developed assays for both specific pyrethroids, and groups of pyrethroids. We have published assays selective for Type I pyrethroids. Manuscripts are in preparation for the Type II pyrethroids and for 3-phenoxybenzoic acid, a common breakdown product of several major pyrethroids. We are currently developing assays to the reputed human metabolites of pyrethroid insecticides. Since pyrethroids are used to control mosquito adults spreading the West Nile Virus, assays will come at a time in which monitoring will be critical to assessing the impact on human health.

A previously developed immunoassay for the herbicide paraquat has been used in an extensive epidemiology study to monitor exposure of farmworkers in Costa Rica. Exposure levels are being correlated to lung function and general health with the goal of probing the relationship between long term low-level exposure and health effects.

MIDWEST CENTER

Pesticide Exposure, Host Susceptibility Factors and Risk of Parkinson's Disease

by Ann Greenlee, PhD

Parkinson's Disease (PD) is a common neurological disorder (second only to Alzheimer's Disease) and affects close to 1 million Americans. Progressive disability results from tremor, muscular rigidity, slowing of movements and impairment of gait and balance. It occurs in all ethnic groups with an average prevalence of about 150 per 100,000 in North America and Western European countries. Both genetic and environmental factors are thought to influence the course of PD. Prevalence of PD in the U.S. is highest in five mid-western states (IA, MN, NE, ND, SD) in which agrochemicals are intensively used suggesting that pesticide exposure may contribute to disease etiology.

Despite considerable research, the precise causal factors of PD remain elusive. Epidemiology and animal studies suggest that exposure to environmental agents (pesticides, heavy metals, and solvents) and aging are likely to play roles in the disease process. Few studies have merged genetics with environmental epidemiology to determine if individuals harboring gene mutations may be more susceptible to effects of environmental exposures.

The Midwest Center at Marshfield Medical Research Foundation is conducting a population-based, case-control study to examine host susceptibility factors (age, genes) and environmental exposures on the risk for "idiopathic" PD in rural areas of Wisconsin. The long-term goal of this study is to link exposure information with biomarker data to provide a clearer understanding of the mechanisms by which agrochemical exposures influence the occurrence of PD. The findings may assist with reducing incidence by improving strategies for disease prevention.

SOUTHERN COASTAL CENTER

Human Metabolism of New and Emerging Pesticides

by Randy L. Rose, PhD and Ernest Hodgson, PhD

In the past, human risk assessment of pesticide hazards has relied primarily upon extrapolation from experimental animals. In the absence of human data, pesticide risk assessment relies upon use of several uncertainty factors to account for species differences, inter-individual differences and differences between adults and children. Human studies can begin to address some aspects of human risk assessment, which cannot be accomplished using animal models. The relative paucity of human data involving pesticide exposure, metabolism, or effects stands in marked contrast to pharmaceutical studies, where product efficacy and possible negative metabolic interactions with other pharmaceuticals are routinely evaluated. Although humans do not generally purposely expose themselves to pesticides, occupational and incidental exposure to pesticides do occur. The result of such exposure must be fully understood to evaluate the potential risks involved.

The proposed studies are evaluating the human metabolism of fipronil, deltamethrin, and one of the chloronicotinoid pesticides. The purpose of these studies is to identify metabolic routes of high-use pesticides and the enzymes that are involved in their metabolism. Specific enzyme identification will enable subsequent studies which will explore potential interactions of pesticide metabolizing enzymes with the metabolism of other pesticides or pharmaceuticals. Individuals or populations with increased risks to pesticide exposure as a result of enzyme polymorphisms may also be identified once metabolic pathways are fully understood. Some of our preliminary studies suggest that some pesticides can significantly inhibit metabolism of other pesticides as well as endogenous substrates. We have also demonstrated, using human hepatocytes, that pesticides may induce several important cytochrome P450-metabolizing enzymes.

HI-CAHS

Biomarkers to Detect Organophosphates

by John Tessari, PhD

Organophosphate pesticides (OPs) are generally much more toxic to vertebrates than are the organochlorine insecticides. The OPs are currently being used, and have been used for many years for pest control. The parent compounds are metabolized to dialkylphosphate urinary metabolites, which can be used to estimate dose in exposed populations including adults and children. These biomarkers of exposure are particularly of interest since these compounds are most frequently causes of pesticide related illness. The analytical methods for measuring these urinary biomarkers are very difficult and time-consuming.

The focus of this project is to develop a method that is fast, reliable, sensitive and simple that does not require expensive, specialized equipment affordable by only a few large laboratories. This method for the analysis of urine alkyl phosphate metabolites uses disposable solid phase extraction cartridges, injector block derivatization, and final determination with Gas Chromatography using a pulsed Flame Photometric Detector.

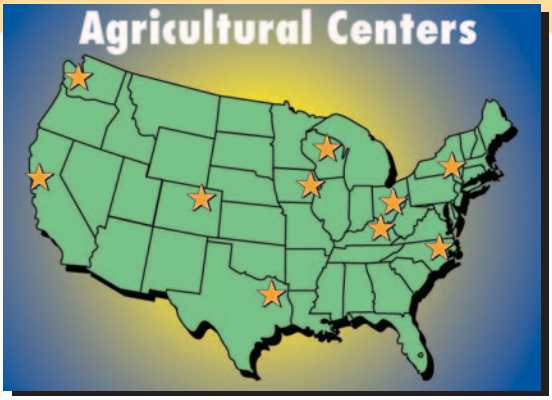
Results using this method show promise as an excellent tool for monitoring human exposure to parent organophosphate pesticides.

SOUTHWEST CENTER

Reporter Genes Systems to Detect Endocrine Disruptive Chemicals

by David L. Busbee, PhD

This research will develop a series of biological reporter genes that will detect steroid hormones and chemicals that mimic the gene expression-regulating activities of steroid hormones, in addition to hydrocarbons that interact with the Ah receptor to induce cytochrome P450 expression. This work has implications for environmental influences affecting diabetes.



The NIOSH sponsored agriculture safety and health research centers engage in research, intervention/prevention, and education/outreach projects designed to respond to regional priorities, investigate issues with potential worker safety/health impact, and document effectiveness of measures to reduce risks and prevent injuries and disease among the agricultural worker population.

Other Center Projects

GREAT LAKES CENTER

- Dr. Jay Wilkins, Deputy Director of the Great Lakes Center, is PI of an on-going EPA grant to study biomarkers and neurobehavioral effects of perinatal exposure to Chlorpyrifos and other organophosphate insecticides. *Wilkins.2@osu.edu*.

GREAT PLAINS CENTER

- The Country Adventures of "Pat the Environmental Rat" in The Pesticide Incident Episode, 4 sets available on loan free. Each set complete with 5 puppets, audiotape, coloring/activity book, placemat, and leader's guide. For children & adults. Call toll-free 877-611-4971.

LOGGING IN VALUABLE RESOURCES

Medical & Nursing Environmental Education and Practice Guidelines

Issued by the National Environmental Education & Training Foundation (NEETF), pesticides@neetf.org

The Future Role of Pesticides in Agriculture, National Research Council

http://www.nap.edu

The National Pesticide Medical Monitoring Program *(NPMMP) pesticide toxicology resources, library, and investigation of select cases of human exposures. Daniel L. Sudakin, M.D., MPH, (541) 737-8969 or sudakind@ace.orst.edu*

Websites for Pesticide Information

http://www.aenews.wsu.edu
http://depts.washington.edu/pnash/news/webmedia.htm
http://ehp.niehs.nih.gov/
http://npi.corst.edu
http://www.cdc.gov/nasd

National Poison Center Number

Effective January 1, 2002, ***anyone in the nation can access a poison center by dialing one number***. The call is automatically routed to the nearest center 24 hours a day, 7 days a week, 365 days a year.

The number is: 1-800-222-1222.

Pesticide Registration

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registered for use on food or feed, EPA must find that a pesticide poses a "reasonable certainty of no harm," by addressing a number of factors, including:

1) the aggregate, non-occupational exposure from the pesticide
2) the cumulative effects from exposure to different pesticides that produce similar effects in the human body;
3) whether there is increased susceptibility to infants and children, or other sensitive subpopulations,
4) whether the pesticide produces an effect in humans similar to an effect produced by a naturally-occurring estrogen or produces other endocrine-disruption effects.

These factors have resulted in improved methods for aggregate exposure assessments and calculations of risk. When applied to organophosphates for example, the results led pesticide producers to drop many residential uses of these pesticides. Work is also underway to incorporate endocrine-disruptor effects into the risk assessment equation. For more information on OPP's registration process, including the implementation of the FQPA, visit the EPA website: http://epa.gov/pesticides.

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National Institute for Occupational Safety and Health

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Pesticides and Farming *from page 1*

exposures. Our current studies are looking more carefully at the dynamics of pesticide spray drift, and practical methods that can reduce exposures in residential environments.

We hope this work will lead to new pesticide risk management approaches that place high priority on the health of children of farmers and farm workers, and that can strike a proper balance between the risks and benefits of agricultural pesticide use. ■

LATEST CATCH

Challenges in Agricultural Health & Safety–Sept. 7-9, 2003

Holiday Inn Golden Gateway
San Francisco, CA

Sponsored by the Western Center for Agricultural Health & Safety and The Pacific Northwest Center for Agricultural Safety & Health

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or go to: http://agcenter.ucdavis.edu

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