Cultivating Collaborations

Health and Safety in Western Agriculture

September 16-18, 2002

Coeur d'Alene Resort, Coeur d'Alene, Idaho

Preface

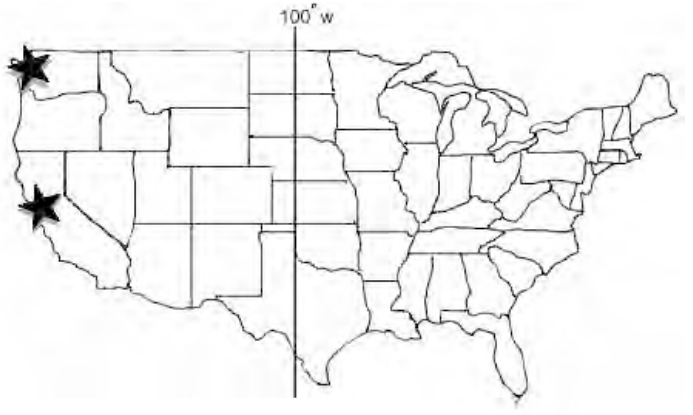
The “Cultivating Collaborations” conference created a forum to exchange thoughts and tools to improve research practices, build research capacity and identify and share ideas for collaborative projects. This first Far West regional conference brought together constituents from varied segments of western agriculture to discuss issues common to the area’s agricultural worker health and safety.

The following material presents a record of that exchange. These proceedings were developed in an un-traditional format in order to offer an engaging, user-friendly reference for presentation concepts and maintaining connections. We hope this booklet successfully captures the attendees’ ideas for collaborative projects and will serve as a reminder, as well as a spring board for getting collaborations off the ground.

The conference was developed by two western NIOSH agricultural centers: The Pacific Northwest Agricultural Safety and Health Center (PNASH), University of Washington, Seattle, and the Western Agricultural Health and Safety Center, University of California, Davis (UC Davis). “Cultivating Collaborations: Health and Safety in Western Agriculture,” was coordinated by the PNASH center and held in September 2002 in Coeur d’Alene, Idaho. The next conference, “Challenges in Agricultural Safety and Health,” will be led by UC Davis -and will take place in San Francisco, September 7-9, 2003.

Contents

Cover photographs: Earl Dotter (orchard worker)
Stacey Holland (Yakima Valley landscape)



WESTERN AGRICULTURE

The continental landscape west of the 100th meridian has occupied a near-mythological place in the American mindset since the days of Lewis and Clark and John Wesley Powell. Its uniqueness has been chronicled in journals, immortalized in literature, analyzed in reports, and transformed by human enterprise on a grand scale. The vast landscape supplys a great range of agricultural products. Labor-intesive crop production in Washington, Oregon, and California shape its workforce and issues.

The Far West Region: An Agricultural and Research Profile

- Richard Fenske

Agriculture in the US Far West, especially in California, can be summed up in one word—*big*. The region hires more farmworkers than any other region in the nation and accounts for nearly a fifth of the country's total cash receipts for agricultural commodities. Farmworkers in the Far West are overwhelmingly Hispanic; 70 percent have less than a complete high school education, 85 percent farm full time, and 60 percent earn less than $300 a week. Of the Far West states, Washington has devoted the largest share of its land (roughly 35 percent) to farming.

The Pacific Northwest (Washington, Oregon, Idaho) is the top US producer of berries, legumes, and nursery products; dairy products ($1.7 billion in 2000), cattle and calves ($2 billion), and potatoes ($1.1 billion) bring in the most dollars. The majority of Northwest farms are smaller than 100 acres and owned by individuals or families.

Through stakeholder consultations and workshops in the late 1990s, PNASH identified three priority areas for its attention: disease and injury, work environment and workforce, and research tools and approaches to improve worker health and safety.

Richard Fenske
Professor & Director
Pacific Northwest
Agricultural Safety &
Health Center University of
Washington

California Agriculture: Characteristics and Health and Safety Issues

- Marc Schenker

California agriculture is not only big, but labor intensive, varied, and hazardous. The state produces more than 250 major commodities, leading the nation in more than 60. Among the principals are milk cows, cut flowers, grapes, almonds, and cotton.

The demography and socioeconomic status of the state's huge farm workforce raise a number of barriers to health care. Most farmwork is done by hired labor; more than 90 percent of the labor force is Hispanic; 26 percent are women. The workforce is young, and the majority have families. Especially among recent immigrants, poverty, little education, and large households create cost, transportation, language, and cultural barriers to health care.

California agriculture is also hazardous. Farmworkers face possible injury, even death, from physical, chemical, biological, and stress-related hazards, including injuries from equipment, respiratory and reproductive ills from chemical exposures, infections, and physiological and psychological stresses. Motor vehicles inflict a big share of nonfatal and fatal injuries. Still, two-thirds of California farmers perceive their occupation as less hazardous than other work.

As elsewhere in the Far West, California is an arid, heavily irrigated state. Dust exposure is chronic and can lead to chronic respiratory symptoms; asthma rates are higher than average among farmworkers. Rates of occupational skin diseases in agriculture are almost double what they are in manufacturing, which ranks second in incidence of occupational dermatitis. The cost of occupational injuries in agriculture is disproportionately high: agriculture accounts for 1.8 percent of US GDP but 3.5 percent of occupational injury costs.

To improve safety and health among California's farmworkers, UC Davis's Western Center for Agricultural Health and Safety has launched a number of research, outreach, and prevention projects. These range from addressing health issues among hired (migrant) farmworkers, to improving exposure monitoring, to assessing children's and young people's safety issues, to extending pesticide and food safety awareness among non-English-speaking workers. Nevertheless, even the best disease and injury prevention efforts won't make agriculture absolutely safe.

Marc Schenker
Professor & Director
Western Center for Agricultural Health and Safety
Unversity of California, Davis

Labor and Productivity: Health and Safety in Western Agriculture

- Don Villarejo

A quarter century ago, livestock, grains, and hay constituted nearly two-thirds of agricultural production; by the late 1990s, the share devoted to table vegetables, nursery and greenhouse products, fruits, nuts, and berries had grown to half. Dairy has tripled, with the West Coast supplying one-third of US production. At the same time, the number of livestock farms, where the work is more dangerous, has gone up.

Despite only rough estimates, we know that farm labor demand has also changed over the past 25 years. It appears that farm labor demand and reliance on hired or contract workers have risen. Farm wage rates, however, have fallen, largely because of what seems to be an infinite supply of laborers from Mexico and Central America.

Rough as the estimates for labor and productivity are, they are even rougher for farmworker injury and illness rates, though recent agricultural censuses suggest that injury rates are lower now than a decade ago. We need more information for different groups of farmworkers, including contract workers, and for farms that employ fewer than 10 workers. One recent, disturbing finding from California indicates that compliance with workplace health and safety regulations is less than 50 percent among chemical handlers as well as field workers.

Don Villarejo
Founder & Director Emeritus
California Institute for
Rural Studies
Davis, California

FARMWORK IN THE WEST: PERSONAL VIEWS

from the Keynote Addresses

The tough ranch hand. The migrant farmworker. The entrepreneurial émigré. The clinician. Four keynote speakers painted vivid pictures from each of these perspectives. Not only do ranchers and farmworkers contend with unique health and safety issues, but their perspectives—and the way their professions are woven into the mythology of the North American West—influence worker well-being.

Brad & Carol Baugh
Farmers
Washington State

Farm owners Bradford and Karyl Baugh made very clear that life on a ranch with cattle and horses brings any number of unexpected hazards, ranging from animals that kick to serious accidents during routine tasks such as ear notching, branding, or castrating. Harsh weather, long winters, remoteness, farmers' and ranchers' tendency to take risks and downplay dangers—these factors complicate and sometimes compromise rural health and safety.

Throughout the past century, migrant farmworker families like Guadalupe Gamboa's have formed the backbone of western agriculture. Often children worked to help support their families instead of attending school. Families endured poor housing, pesticide exposure, and backbreaking work. Cesar Chavez's fight in the 1960s and 1970s for farmworkers' rights led to creation of a labor union, the United Farm Workers of America, but even today in Washington State, Gamboa pointed out, farmworkers do not have collective bargaining rights, "and so the legacy continues."

Yet in their compatriots' eyes, observed Malcolm Butler, medical director of an eastern Washington clinic serving farmworkers, migrant farmworkers are successful entrepreneurs. Many come from stately towns in central Mexico. These émigrés are the ones brave enough to give up home, culture, and family to try to provide a better life for those left behind; to their families, migrant farmworkers are heroes. Often their families at home enjoy a more stable income and better housing than their neighbors. The migrants themselves, in contrast, face the hazards of their work, plus serious anxiety from the cultural disconnect, poverty, isolation, language barrier, and illiteracy. These factors, and a widespread view that "life is a burden to be tolerated with forbearance," prevent many migrant workers from seeking medical help and shorten the lives of many others.

HE DID NOT COMPLAIN

-A Story by Malcolm Butler

He died Sunday morning. He sat up in bed, coughed hard, and slumped over. The paramedics arrived and performed their ritual, but he had gone. It was his time. His baby had just turned two; he had made it into the new millennium and his twenty-seventh year.

José was a friend of mine. Not the friend I went out with after work but the friend who brought a smile to my face whenever I saw him. He was a friend to everyone, as far as I could tell. His ex-wife never forgave him his alcoholism, but everyone else enjoyed him. He never complained. In the morning I would walk in and ask him how he was doing. He would be sitting forward in bed, caught in a paroxysm of coughing. He would finally look up and smile, take a moment to let the oxygen recirculate, then say, "I'm fine." I suppose he had enjoyed the bottom of too many bottles over the years. But it was probably an ordinary little virus that killed him.

It killed him slowly. On January 1, 1997, we finally got the chest x-ray that revealed a heart as big as his head sitting inside his young chest. We had assumed that his cough was from bronchitis; and then we considered asthma; and when we saw him a third time, looking worse, we took the x-ray. A normal heart is just a little bigger than your fist, with walls as thick as your thumb. When it pumps, two-thirds to three-quarters of the blood within it shoots out to the lungs and body. José's heart was a floppy sack, as big as a volleyball, with walls of paper. Though it was huge, when José's heart pumped, only about 15 percent of the blood went out; the rest just sloshed around inside.

A virus will do that to you—"viral cardiomyopathy" it's called. The virus gets inside the heart muscle and kills it. The weakened muscle slowly thins out, and, like an old inner tube left out in the sun, its elasticity dissolves, and the heart fails. Alcohol does the same thing. Over the years alcohol poisons the heart, insidiously thinning and weakening the only muscle in the body that never rests.

Guadalupe Gamboa
Regional Director
United Farmworkers of
America, Washington & Oregon

Malcolm Butler MD
Medical Director
Columbia Valley
Community Health

That January we realized José was going to die. His blood pressure was so low that his liver was dying from lack of blood. We fiddled with medicines, trying to rest the heart muscle, and realized that his salvation would be in another man's death. He needed a new heart. So to the Medical Center of the Universe he went. At the Medical Center, he was visited by the Hepatologist, who pondered the plight of his liver; and by the Cardiologist, who pondered the plight of his heart; and by the Transplant Surgeons, who relished the plight of his liver and heart; and finally by the Billing Clerks, who realized that he had no money.

José worked in an orchard. He picked fruit. With his earnings he supported his parents in Mexico and his family in the United States. He was young, worked hard, partied hard, and never thought of insuring his health. He had come to this country because he wanted more from life than he could have had at home in Mexico. He stole north to join his brothers in the great adventure that migrants share. He found plenty of work and made steady wages. But he found that life here was much more expensive than at home, and there are many more ways to dispose of one's earnings.

Once struck down by that little virus, José couldn't work to afford insurance. He couldn't work to afford health care. He couldn't work to afford another man's heart. He could only afford to die.

The state does have emergency funds for such situations. Not everyone plans well, and many people have astonishingly bad luck, so the state provides emergency medical coverage for its citizens. But José was not a citizen. He worked hard, he paid taxes, but he was "illegal." The Medical Center of the Universe has an ethics committee for such disturbing times and accountants who direct decisions. So back to our town came José.

That was three years ago. He defied our every effort to convince him that the amount of blood pumped out of his heart was incompatible with human existence. Returning to his home state of Michoacan, José sought out a famed local herbalist. He drank the herbalist's tea three times daily, and he got better. He ran out of the tea, and he got worse. When I visited the state of Michoacan, I found the same herbalist and brought José a three-month supply of the magic tea. José improved to the point where he even returned to work, labeling apple bins in the orchard. He watched the birth of his son, José Junior, and he watched his son learn to walk.

José would come and go from our clinic, sometimes better, sometimes worse. He never complained. He took the medicines we gave him, but he refused to go back to the Medical Center. His disease was a burden to be tolerated with forbearance. He took it as it came and allowed us to worry for him.

Three days before his death, he came into the clinic complaining that he could not see. He looked horrible. His liver and kidneys were both failing, and he was bright yellow with jaundice. An ophthalmologist evaluated José and concluded that he was blind because his heart was too weak to push blood up to his eyes.

I saw José the next day. He was carrying a bottle of day-glow yellow Gatorade. In one of those horribly inappropriate comic moments, I suddenly flashed on a TV commercial with a bunch of athletes all drinking blue Gatorade, their sweat the same color blue. José was the same day-glow yellow as the drink in his hand, and I burst out laughing. José smiled when he understood the likeness. I asked him how he felt, and after another tortured paroxysm of coughing, he swigged his Gatorade and said, "Fine."

I told him that his liver and kidneys were dying and offered to admit him to the hospital to keep him comfortable. He preferred to go home. He had a wife, a child, and his brothers there. I made it plain that if he were at all uncomfortable, we had medicine to comfort him. His brothers' eyes welled up with tears; they nodded and wheeled him out of the clinic.

I wonder now if we actually can savor moments when we know they are scarce and fleeting. Does time pass more quickly or more slowly for someone who's dying? The glances, and smiles, and snuggles—how do we cherish them when they may be our last? Do we ponder our passing, or do we live absolutely in the present, avoiding thoughts that tarnish the moments we have left? José had the answer, but as I stroked his hair in the emergency room Sunday morning, he could not share it with me. He was not yet cold, but he was dead. He died quickly, and he did not complain.

SOCIAL ISSUES

Not least among the unique characteristics of the Far West's agricultural workforce is the mix of long-time farm families and the influx of migrant workers. Different populations of agricultural workers contend with different challenges, and each group's perspectives in turn pose challenges for researchers.

Correlates of Depression among Mexican Migrant Farmworker Mothers and Fathers

- Nora Coronado

Anecdotal evidence has focused attention on the incidence of depression among farmworkers and the effects of parents' mental health on child rearing and well-being. As part of a longitudinal study of migrant farmworkers in South Texas, we examined the correlates of depression among fathers and mothers of children in Head Start programs. The demographics of mothers and fathers were similar: the majority of studied individuals were low-income, married, and Spanish-speaking (roughly 25 percent were bilingual); the proportion of fathers who were married (98 percent) was higher than that of mothers (88 percent). Using a battery of psychological tests, the study examined depression, levels of social support, mastery (control felt over one's life), self-esteem, family stress, and problems in life conditions.

The fathers scored below the norm for the general US population in depression risk; only 3 percent scored in the range of "severe" depression. Factors that might help protect fathers from depression include marriage, spirituality, and a feeling that life in the United States is better than in Mexico. It is also possible that the test we used in this study may not reveal depression among migrant men as well as, perhaps, a measure of anxiety would. Among mothers, a far larger share (23 percent) scored in the range of "severe" depression, and this share was larger than that among the general US population.

Previous research has suggested that children of mothers who are depressed are at risk for social and cognitive delays that may influence later academic achievement. When a parent is depressed, he or she may be more, irritable, angry, or neglectful, attitudes that can erode the parent-child bond. Yet limited research on depression among migrants has hampered development of potential intervention strategies, as well as of policies and funding for mental health services within this population.

Limited research on depression among migrants has hampered development of potential

Nora Coronado
Research Scientist
School of Social Welfare
University of Washington

intervention strategies

Farm Parents' Attitudes toward the North American Guidelines for Children's Agricultural Tasks

- Steven Neufeld

Children typically begin farming at an early age, yet farming ranks as one of the nation's most hazardous occupations. In 1998 children suffered some 15,000 injuries from farmwork, which often involves operating heavy machinery. Working with farm safety and child development experts, the National Farm Medicine Center in Wisconsin has developed guidelines meant to delay children's introduction to farmwork. What do farm parents think of these North American Guidelines for Children's Agricultural Tasks (NAGCAT) and their relevance to real life on the farm?

Many farm parents regarded NAGCAT's age benchmarks for particular tasks as too high. They also questioned their validity and usefulness; "it depends on the child," they said. Factors besides age—experience in particular—also matter. A child who grows up on a farm might be capable of safely driving a tractor at age 13, for example, while a "town" 18-year-old would have to "get up to speed" despite being older. Some parents found the guidelines useful as reminders of particular age-related abilities; many, however, felt the guidelines were "common sense." Parents also appear to differ from the experts in risk perception, believing that the risk of unintentional childhood farm injuries is slight and that farm practices involving children are safer today than in previous generations. Parents limit risk by supervising children; limiting work hours; restricting contact with large animals; and setting rules for when, where, and how to operate machinery.

Parents' values—which in some respects differ from those of safety experts—were also important in shaping their views of the guidelines. Farm parents value early childhood exposure to farm life as the principal way to raise a next farming generation; they also weigh farm safety against farm productivity; and in general, farmers are skep tical of government regulation. Some parents felt the guidelines contradicted these values and practices. Whereas safety experts operate from a risk-averse standpoint, assume that risk results from lack of information, and value scientific methods and knowledge, farmers naturally operate in a high-risk occupation, assume that they can manage risk, and value learning from experience. The contrasts reveal shortcomings in the guidelines and pose challenges to overcome in future revisions.

Steven Neufeld
Research Coordinator
Department of Sociology
Eastern Washington
University

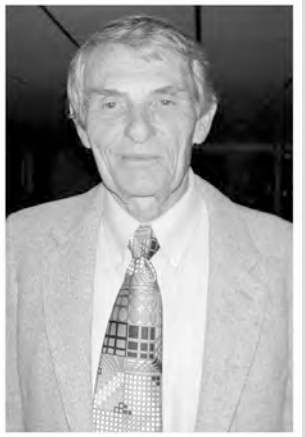
National Issues in Agriculture

- Richard Rominger, guest speaker

Dinner speaker Richard Rominger, farm owner and former deputy secretary of the US Department of Agriculture, outlined some present concerns in US agriculture, ranging from the weather—a spell of optimal weather that has produced surpluses resulting in low commodity prices—to security at national agricultural labs. Fear of catastrophic losses if foot-and-mouth disease should establish itself in the United States has curtailed the import of foreign livestock, and farmers worry about emerging and persistent crop diseases.

Trade tensions continue between the United States and Europe, particularly over Europe's import-export policies and its ban on genetically modified crops. Farmers also blame government policy, not food shortages, for malnutrition at home. They would like to see the government provide more disaster relief for farmers hardest hit by uneven commodity pricing.

The physical as well as political interface between agriculture and conservation poses a number of urgent problems, including a potential loss of farm production capacity as urban sprawl encroaches on more farmland. Increasing forest fires cause smoke, erosion, and problems with fuel removal, especially near streams and urban areas. Public concern is growing over contamination due to pesticide-laden runoff from fields as well as excessive nitrogen from feedlots; dust, diesel fumes, and after-harvest burning of rice fields can produce human disease–causing particulates. On the other hand, legislation that rewards farmers for conserving water, soil, and wildlife is in place; crop fuels can help lessen dependence on oil; and certain agricultural practices increase the amount of carbon stored in plants and soil, mitigating global warming.



Richard Rominger
Farmer and Former
Deputy Secretary
United States Department
of Agriculture

John Reganold
Professor
Department of Crop and Soil Sciences
Washington State University

Is There a Role for Pesticide-Free Crops?

- John Reganold, guest speaker

On the landscape of concerns about modern agriculture—among them, high costs and uncertain availability of energy and chemicals, loss of family farms, soil erosion, and pollution—is there a role for pesticide-free crops? Though organic crops may not be entirely pesticide free, they do have much lower pesticide residues than conventionally grown crops. According to Washington State University Professor John Reganold, the organic food sector has grown by 20 percent every year over the last decade; 5 to 10 percent of European farmers grow organically, 1 or 2 percent in the United States.

Three studies, two in Washington State and one in New Zealand, compared the sustainability of organic and conventional farming. To qualify as "sustainable," a farm has to produce adequate high-quality yields and be economically viable, environmentally safe, resource conserving, and socially responsible. Results from"these studies showed that organic farming lost less topsoil to erosion, resulted in healthier soils, and yielded less or the same as conventional counterparts. Moreover, organic crops were equally profitable (New Zealand) or more profitable (Washington apple farms, after six years) than conventional crops. Organic farms were also the least environmentally harmful and more energy efficient than conventional farms. Overall, organic farms ranked above conventional systems in sustainability. In Reganold's view, organic systems are viable and better for the environment than conventional systems because they offer good yields of high quality, they can profitable, and they benefit soils while detracting minimally from environmental quality.

Organic systems are viable and better for the environment than conventional systems

BUILDING RESEARCH CAPACITY AND PERFORMANCE

As any working scientist will attest, researchers are called upon not only to do research but to raise money, talk to reporters, and account for the effectiveness of their work. Three speakers offered their best advice for doing these things well.

Alternative Funding for Your Center

- Don Villarejo

Private philanthropic foundations got their start early in the twentieth century, at about the same time as the national income tax, when the Rockefellers developed a way to shelter wealth in a respected institution. Today private foundations provide the lion's share of funding for US nonprofits, a.k.a. 501(c)(3)s or nongovernmental organizations (NGOs), like the California Institute for Rural Studies.

The heart of obtaining private foundation funding is telling the story of your project—in three sentences and 30 seconds. Be sure to have a mission statement: What are you trying to do? How will society benefit? What is the minimum level of funding you are willing to accept? Memorize your pitch before you approach a foundation.

Then do your homework. Foundations look for practical, action projects, not basic research. Find out prospective foundations' priorities, their program officers, their past and current grantees. Network. Check Web sites. (The Foundation Center, at *www.foundationcenter.org,* has a variety of resources for grant seekers.) Most important, find a way to meet with the program officer responsible for the foundation's grant making for your field. All successful fund raising is done face to face with the program officer. Be persistent: leave phone messages 20 days in a row if you have to, and be ready to travel to the foundation offices. Writing a grant proposal is often the last steps getting in the door is the crucial first.

Working with the Media

- Sandra Hines

In May 2001 the University of Washington was on the front pages of every major newspaper—but for the wrong reason: arson at the Center for Urban Horticulture. The incident and its media coverage illustrate well the uncertainties of working with the media and kept the news office busy: "When news breaks, we fix it." We did get out the message that the research targeted by the arsonists was traditional cross-breeding, not genetic engineering. But we did not get out the message that using genetically altered trees for research is a legal and useful tool. Even the news office doesn't always have as much control over what's reported as it would like.

Still, working with the media has many benefits; in addition to bringing relevant and important research findings to the public, broad, well-done reporting can catch the attention of funders, motivate changes in behavior (e.g., articles on health), and inspire laypeople and professionals alike.

Key tips include: keep your message simple, be clear and accurate, repeat your key message, mention who supports your research, correct errors right away, and assume that anything you say will show up in tomorrow's newspaper.

Keep your message simple

Sandra Hines
Assistant Director
News and Information
University of Washington

Evaluation throughout the Life of your Project

- Linda M. Goldenhar

To determine how effective a safety and health intervention program is, plan and carry out an evaluation of the intervention right along with the intervention itself. Such intervention research consists of three interdependent phases (developmental studies, implementation studies, and effectiveness studies) and five primary research tasks (assess need for an intervention, develop partnerships, choose methods and designs, do the work, and report and disseminate the results).

In the developmental phase, decide on an intervention strategy and fit it to the context of interest. Ask questions such as, What changes are needed to enhance the health of the target population? What are the best ways to bring about these changes? How much does the target group already know? Are there any occupational safety and health guiding principles?

The implementation phase should systematically document how an intervention is carried out—its quality, comprehensiveness, intensity, frequency, and duration. Who and how many people were reached? How often? Did the content and methods of the intervention meet expectations? Thorough data gathering at this stage allows improvements in the intervention itself and helps in later evaluation of the intervention's effectiveness. Finally, the effectiveness phase answers the question, Did the intervention program do what it was supposed to do? Did it reduce worker exposure to hazards, enhance worker knowledge, have any unintended consequences?

The five research tasks come into play throughout the three intervention and evaluation phases. Assess the needs of the target population; look at the literature to see what's been done before. In partnership with those who might be affected by the intervention's outcome, decide what is the outcome objective or objectives (e.g., reduce exposure to pesticides) and how it will be met. Choose the most feasible, ethical, and legal study design: experimental or not? Then do the research. When your data have been collected and analyzed, don't forget to report the results to the intervention participants, to all interested stakeholders, and to other occupational safety and health researchers.

Linda M. Goldenhar
Senior Research Associate
Institute for Health Policy &
Health Services Research
University of Cincinnati
Medical School

BREAKOUT SESSIONS

Conference participants with similar interests—field studies, evaluation of education and training programs, and respiratory diseases—gathered into three "breakout" groups, which allowed them to meet one another and to discuss topics in a loosely structured setting.

Field Studies: Challenges and Best Practices

- Matthew Keifer

Led by Matthew Keifer of PNASH, this group touched on population-based studies, environmental monitoring studies, quality-assurance/quality-control (QA/QC) studies, and regulatory compliance. Most of the discussion concerned population-based studies, which are the most common, and often the most challenging, type of field study.

In agricultural settings, population-based studies usually center on field workers, their children, or both. Working with either group poses special challenges. Some of these challenges arise in any population-based study; others are specific to the studied group or subject. Gaining access to potential subjects, engaging their willing participation, and retaining them can all present stumbling blocks. Recruitment can start in schools, churches, community events like soccer games, clinics, Head Start programs, and migrant housing centers. But adult field workers, many of whom are undocumented, may be hard to recruit because they fear discovery, so researchers may have to approach employers instead. Agricultural extension agents, who are usually growers' trusted advisors, can greatly help health researchers with access by explaining research benefits to growers and employers. For children, institutional review boards may limit what researchers can study. In one attempt to research child injuries by contacting parents of injured children, participation was low, perhaps because the parents felt guilty over their child's injury. In any event, retention of participants is better in parent-child studies when parents and their children take part together.

Matthew Keifer
AssociateProfessor &
Co-Director for Prevention
& Intervention
Pacific Northwest Agricultural
Safety & Health Center
University of Washington

Evaluation of Educational Programs

- Sonja Brodt & Vickie Buchan

Program evaluation is, or should be, a central component of occupational health education, research, and intervention. Stressing that evaluation ought to be developed right along with the rest of any project, Sonja Brodt of UC Davis and Vickie Buchan of Colorado State University offered their session's attendees practice using a standard evaluation model to assess an agricultural education program. This model starts with development of clearly written, specific, and measurable outcome objectives; next these objectives are organized logically according to long-term and near-term project impacts, project deliverables, and the activities for accomplishing each deliverable. Researchers then establish performance indicators for each objective and identify data sources and evaluation methods. In small group sessions, participants tackled an education program suited to their interests—for example, a train-the-trainers project involving Californian and Mexican stakeholders—and made a start at developing their own evaluations.

Respiratory Disease

- Marc Schenker

Facilitator Marc Schenker from UC Davis began by listing key respiratory issues related to agriculture. These ranged from the rising incidence of diseases such as asthma and tuberculosis; to toxins such as mold-preventing fogs used in greenhouses; to dusts of all kinds, from ammonia to kaolin in apple orchards. Unlike pesticides, these harmful irritants are not generally regulated, and neither are there widely adopted safety practices to protect workers. How to deal with such "off-the-radar" issues? Partnerships across sectors emerged as a promising approach, between agencies including the Environmental Protection Agency, clinics, agricultural centers, and farmers, for example. Surveillance and assessment—identifying the problem—were mentioned, as were fines. But a couple of participants stressed the importance not only of identifying the problem but also of suggesting constructive solutions. Surveillance ought to guide research to bring about solutions, and these solutions would need collaborations across sectors.

Vicky Buchan
Professor
Department of Social Work
High Plains Intermountain Center for Agricultural Health & Saftey (HI-CAHS)
Colorado State University

Sonja Brodt
Program Evaluation Specialist
UC Statewide Integrated Pesticide Management Program
Western Center for Agricultural Health & Safety
University of California, Davis

COLLABORATIVE PARTNERSHIP PANELS AND DISCUSSIONS

Before the Coeur d'Alene gathering, conference organizers set up a framework to bring West Coast agricultural researchers together in collaborations that they hoped would flourish afterward. Five groups—focusing on injury epidemiology, ergonomics, engineering and technologies, risk communication, and interventions to reduce pesticide exposure and illness—were to develop proposals for collaborative research projects, present them to attendees, and solicit feedback. Each panel took its own approach: some groups brainstormed; some stressed forthcoming proposals. The resulting talks spanned the gamut of important issues in agricultural health and safety.

Injury Epidemiology

This panel touched on three aspects of epidemiological research: the role of the studied community, collaboration along the West Coast, and the pluses and minuses of using existing databases of worker diseases and injuries. According to Steve McCurdy, community advisory boards can smooth the way for epidemiological research by providing ideas, clarifying community perceptions and possible differences with those of researchers, and helping to avert misunderstandings if a study reveals results that the community doesn't expect. In collaborative ventures, panel member Matt Keifer noted, evaluation of interventions is particularly important, and any controls that are developed should be shared for replication or evaluation in other regions. Session participants also mentioned benefits of closer links between epidemiological studies and compliance systems and the importance of looking at gender differences in the occurrence of disease and injuries.

Discussion centered on the value of using existing administrative databases—such as Washington State's Department of Labor and Industries' compilation of workers compensation claims—for research. But although available and comprising a tremendous amount of information, administrative databases are not designed for research and so may not meet researchers' needs. Data quality can be uneven; researchers may need approval from the parent agency or insurance company for access; and help from an expert user may be required to navigate the database.

If researchers show agencies and insurance companies that good data, and research access to good data, can help reduce injuries and claims costs, then existing databases might become more compatible with research. Commented one participant, "This is the beginning, not the end." Indeed, McCurdy is planning injury epidemiology studies using California's agricultural statistics database and its hospital discharge database.

Panel: *Stephen A. McCurdy (leader, University of California, Davis), David Bonauto (Washington Department of Labor and Industries), Matthew Keifer (University of Washington), Reuel "Monty" Paradis (Washington Department of Labor and Industries), Hal Stockbridge (Washington Department of Labor and Industries)*

Ergonomics

Few people fully understand what it takes to bring food from farms to their tables, much less what's needed to get it from the fields to trucks. A short video in this session opened many attendees' eyes: agricultural workers harvest food fast, and musculoskeletal injuries often result. Yet the risks of such injuries have not been adequately quantified.

Peter Johnson reported on some of the hardware and software used to assess exposure to repetitive musculoskeletal strain. He noted that exposure outcomes are a function not only of particular activities but also of activity patterns throughout the day: can work patterns be optimized to minimize injury? Remarking that safety and productivity are essentially synonymous, Kailash Kapur described a six-step method drawing on epidemiology, nursing, and engineering interventions to identify and prevent injuries in Northwest orchards. Steve Russell and Lori Winnemuller have applied Washington State's ergonomics rule to assess musculoskeletal exposures among fruit packers and to identify' research opportunities and validate ergonomic interventions; they stress the importance of looking first to change the ergonomics of a situation rather than workers' behavior. Jeffrey Woldstad has used biomechanical modeling of the neck and shoulder to examine how handwork develops into cervical injuries. And Fadi Fathallah and his University of California colleagues have developed a number of engineering interventions to reduce musculoskeletal disorders among workers at plant nurseries and vineyards.

The panel proposed—and is now working on—a collaborative project involving Oregon State, UC Davis, and the University of Washington to identify and record musculoskeletal disorders in the West Coast migrant worker population and to assess exposure using a commodity- and task-based approach. The project aims to develop and implement a unified exposure assessment in the West's top labor-intensive commodity industries and to set priorities for interventions. Anticipated results include a ranking of high-risk commodities; clarifying the relationships among exposure, symptoms, insurance records, and OSHA's and others' records; information that could help determine, by commodity, the cost of injuries; and priorities and justifications for interventions.

Panel: *Patrick O'Connor-Marer (leader, University of California, Davis), Patricia Boiko (University of Washington), William Krycia (California Occupational Safety and Health Administration), Karen Snyder (University of Washington), Jennifer Weber (University of California, Davis)*

Engineering and Technologies to Aid the Researcher

When it comes to agricultural health and safety, technology can help both workers and researchers: it can enhance worker productivity or solve some ergonomic problems, and it can open up new research topics. But technology can also create new problems, and it has limits in field situations.

Agricultural safety and health research can make use of technology for information management, as through handheld devices or bar coding. Technology can help detect and measure everything from physical force or position to biological endpoints such as urinary metabolites of pesticides. It can ease process change and control by means of "smart" equipment and fault-tolerant designs or improved biomechanical interfaces. And new technologies can improve protective equipment.

Even in the field, new devices promise some reduction in paperwork. Digital data entered directly into a database are more easily shared, tracked, organized, and stored than paper records. New personal digital assistants, or PDAs, like Palm Pilots or Pocket PCs now have many of the advantages of full computer systems contained in pocket-sized boxes, which stand up in harsh weather as well as many researchers. Using such devices in the field can reduce damp (and heavy) paperwork and eliminate some data entry steps back in the lab; with add-ons like GPS receivers, digital voice recorders, or digital cameras, PDAs can be powerful portable research centers. But widespread adoption of new devices may be hampered by barriers such as costs, perceived researcher interference or imposition of some "newfangled thing" on familiar routines, and the inevitable learning curves for specific applications.

Panel: *Michael Yost (leader, University of Washington), Bradford Baugh (Washington farm owner), Rebecca Domingo-Neuman (University of California, Davis), Kiyoung Lee (University of California, Davis), Rick Neitzel (University of Washington)*

Some collaborative project ideas to develop technological usefulness in agricultural safety and health research include adoption of a standard framework for job hazard analysis in the West; sharing of information management tools, such as Palm-based questionnaires or inspection forms (a collaboration now under way between the University of Washington and UC Davis); and using the Web for sharing research technology. Panel members left the audience with food for thought: What incentives can be offered to increase adoption of useful technologies? How can researchers best engage growers and workers? How can they identify new and useful technologies? And how should researchers select "appropriate technologies," as opposed to the "best available" or "preferred uses"?

Interventions to Reduce Pesticide Exposure and Illness

Panel members presented a number of innovative projects, aimed at health care providers as well as workers, to reduce pesticide exposure and illness among agricultural workers and their families. Tim Stock described a learning-by-doing program, held at three locations in Washington, designed to improve farmworkers' pesticide-handling techniques. Workers practiced safe techniques using props and equipment; they learned how to mix and load pesticides safely, how to clean and care for equipment, how to use personal protective equipment, and so on. Cheryl Hanks approaches pesticide exposure from the health care provider side, with outreach to emergency rooms, clinics, schools, and licensed daycare providers. The goal is to help these groups recognize pesticide-caused symptoms and the potential for exposure, for example, in schools or with particular crops.

Kathy Pitts presented a unique way to reach Hispanic farmworkers in eastern Washington: a theater project begun in 1998. Researchers first assessed workers' most urgent health and safety needs and developed plays' covering those issues. They tested workers' health and safety knowledge before and after performances and found that workers scored higher after the performances. Although agricultural safety theater would not be easy to mount and sustain long term, it is a promising and effective communication tool for low-literacy populations.

Panel: *Gloria Coronado (leader, Fred Hutchinson Cancer Research Center), Cheryl Hanks (Washington Department of Health), William Lambert (Oregon Health Sciences University), Helen Murphy (United Nations Food and Agricultural Organization), Kathy Pitts (Eastern Washington University), Tim Stock (UC Davis)*

Pesticide exposure interventions can benefit not only workers but also their families; conversely, interventions can be more effective when they involve the families as well as workers. According to Helen Murphy, schoolchildren in Southeast Asia learned to survey their communities on pesticide hazards and health effects and to report the results to their families; the same people who were surveyed had to come up with ideas for reducing risk. William Lambert has worked on projects in eastern Oregon to reduce pesticide exposure in preschool children of farmworkers and in teenage workers. Videos shown to parents and children, plus deep carpet cleaning, shoe boxes, and mats, proved effective interventions among Migrant Head Start families. Similarly, age-appropriate tools, such as computer programs and peer trainers, have helped raise awareness among teens of pesticide risks.

These success stories led panel members to propose a number of collaborative projects. A "signs and symptoms" project might target workers and physicians. For workers, training might involve reading pesticide labels and English-as-a-second-language classes; for physicians, more outreach highlighting symptoms of exposure. A student-produced video project could assess pesticide sources and levels within a community and generate community-identified ways to reduce risks, something like the work in Southeast Asia. Drama clubs might even be encouraged to produce a play or two about exposure risks.

POSTER BRIEFS

The Effect of Data Quality on Case Determination for Pesticide-Related Illness among Agricultural Workers

- Judith A. Bardin, Washington State Department of Health

Suspected cases of occupational and non-occupational pesticide illnesses are referred to the Washington Department of Health Pesticide Illness Monitoring System. Of cases reported for agricultural workers in 2000, only 16 percent received an initial diagnosis indicating pesticide exposure; diagnoses of eye and skin conditions were more common. After case-by-case departmental investigation, however, the share of pesticide-related cases rose to 52 percent. In 34 percent of cases, the department could not determine whether pesticide exposure played a role. Successful determination was most likely when cases were reported in a timely manner. These findings underscore the need to report suspected cases quickly and to educate health care providers continually in how to recognize pesticide-related injuries.

Work-Related Fatalities in Washington State

- Martin A. Cohen, Safety and Health Assessment and Research for Prevention (SHARP) Program, Washington State Department of Labor and Industries

The Washington State Fatality Assessment and Control Evaluation (FACE) Program tracks work-related fatalities, investigates selected fatal incidents, and develops and disseminates prevention activities. Each year approximately 100 workers are killed on the job in Washington, approximately 10 each year in agriculture. The fatality rate for agriculture, forestry, and fishing collectively (17 fatalities per 100,000 workers) is five times the statewide average. The majority of these incidents stem from motor vehicle collisions, machinery, and drowning.

New System for Laboratory Dust Generation Using Soils

- Rebecca Domingo-Neumann, University of California, Davis

Soil dust is a major factor in respiratory problems among agricultural workers, but sampling of soil dust in the field can be difficult. To provide laboratory dust samples for chemical characterization and for experiments with inhalation exposure, we developed a dust generator consisting of a rotating chamber, where soil samples were loaded, and a settling chamber, where airborne soil dust samples were collected. X-ray diffractometry and energy-dispersive x-ray analyses showed that mineralogical and chemical composition were similar in field and laboratory dusts derived from the same agricultural field, suggesting that this laboratory dust generator provides reliable soil-derived dust samples.

Integration of GPS/GIS with Biological and Environmental Monitoring in a Sampling Plan to Characterize Children's Exposure to Methamidophos

- Kai Elgethun, Department of Environmental Health, University of Washington

Predicting pesticide exposure in children requires tracking where they go and what they do throughout the day. We are constructing an exposure profile of children during and after an aerial pesticide spraying of the organophosphate pesticide methamidophos on russet potato fields in eastern Washington. GPS personal acquisition loggers (GPS-PALs) successfully tracked children's movements within their community, and global information system (GIS) software enables us to map their positions in relation to sequence and location of exposure events. Further data from a survey; hand, surface, and object wipes; urine monitoring; and air and deposition sampling provide estimates of exposure levels and pesticide metabolites. Our goal is to delineate the amount of pesticide drift and potential areas of exposure during and after spraying and to locate children in space and time relative to contaminated areas.

Evaluating the Communication of Farm Safety Information through Community Theater

- Pamela Elkind, Center for Farm Health and Safety, Eastern Washington University

We evaluated the effectiveness of a theater project in educating Hispanic agricultural workers and their families about urgent farm health and safety issues. The workers' community was involved in developing plays, performed in Spanish, at festivals or fairs or in mandatory safety training for employees. Analysis of quantitative and qualitative data before and after the plays suggests that workers do retain the health and safety information the plays present and that this new knowledge can change behavior. Responses from workers, growers, community members, and community groups indicate that the program responded successfully to the farmworkers' health and safety needs. Live theater thus offers another safety training tool specifically designed for the Hispanic agricultural workforce.

Pacific Northwest Agricultural Safety and Health Center

- Richard Fenske, Pacific Northwest Agricultural Safety and Health Center, University of Washington

The PNASH Center aims to improve the health and safety of workers in farming, forestry, and fishing throughout Alaska, Idaho, Oregon, and Washington. The center's work emphasizes injury and illness prevention, health promotion, and integration of health and safety activities across the Northwest. The growing center continues to build an infrastructure and networks for research, education, and evaluation of model programs to prevent illness and injury among agricultural workers and their families. These efforts are undertaken with special emphasis on populations such as hired farm laborers, other ethnic minority workers, women, and children.

A Fast-Response Inclinometer for Use in Characterizing Posture and Movement during Agricultural Work

- Peter W. Johnson, Pacific Northwest Agricultural Safety and Health Center, University of Washington

Measuring fast movements accurately is key to assessing the risk of occupational musculoskeletal injury. This study tested and characterized the performance of a prototype device consisting of two accelerometers (inclinometers) and one piezo-ceramic gyro, called a Flexion Angle Sensor with Gyro (FAS-G). The prototype performed accurately in tests of static angle measurement and outperformed conventional inclinometers in tests of dynamic swing. The dynamic response of FAS-G will allow measurement of movement velocities and accelerations and may have applications in agricultural ergonomics.

National Institute for Farm Safety

- Tom Karsky, Biological and Agricultural Engineering Department, University of Idaho

The National Institute for Farm Safety (NIFS) is a nonprofit, voluntary organization dedicated to reducing the rates of death, injury, and illness in agriculture. Comprising safety and health professionals and interested organizations, NIFS was formed in 1962 to provide a structure for the professional development of its members. The organization also initiates safety directions and reviews safety issues.

Behavioral Risk Factors among Female Hispanic Agricultural Workers in California

- Olivia Kasirye, Center for Health and the Environment, University of California, Davis

Among Hispanic women receiving prenatal care in California, we evaluated behavioral factors that might raise the women's risk of adverse reproductive health outcomes. Our study compared the demographics, occupations, and behavioral risk factors among agricultural workers, workers employed in nonagricultural jobs, and women who had never worked. Farmworkers were less likely to be born in the United States than non-farmworkers or nonworkers. Farmworkers were also less likely to continue working during pregnancy than non-farmworkers. In addition, female Hispanic farmworkers were less likely to have ever drunk alcohol, smoked, or used drugs and less likely to drink or smoke while pregnant. Overall, they thus had better profiles for reproductive-health-related behavioral risk factors than non-farmworkers.

Biomonitoring of Concurrent Carbaryl & Guthion Exposures during Apple Thinning and Suckering in California & Washington

- Robert Krieger, Department of Entomology, University of California, Riverside

Workers were monitored for pesticide exposure during apple tree thinning and suckering. Absorbed daily dosages of carbaryl and guthion were five to seven times higher among California workers than among Washington workers doing the same tasks. Dry, hot California field conditions were associated with the higher worker exposures.

Urinary Creatinine Measurements Minimize Differences between Children and Adults in Exposure to Organophosphate Insecticide

- Robert Krieger, Department of Entomology, University of California, Riverside

Concentrations of urinary creatinine have long been used to estimate absorbed daily dosages of short-lived chemicals, such as organophosphate insecticides, from metabolite biomarkers in spot urine samples. Urinary biomarker concentrations are compared against norms of excreted creatinine: 1.7 grams creatinine per day for males and 1.0 gram creatinine per day for females. But because of their much smaller muscle mass, children excrete much less creatinine than adults. Consequently, studies that do not take children's smaller muscle mass into account overestimate their pesticide exposures. This finding has important implications for risk assessment, health policy, and regulation but is of little significance to the health of the exposed persons.

Occupational Exposure of Agricultural Workers in Costa Rica

- Kiyoung Lee, Epidemiology and Preventive Medicine, University of California, Davis

In a cross-sectional epidemiological study, we examined the association between exposure to the herbicide paraquat and respiratory health effects among agricultural workers on Costa Rican banana, coffee, and palm oil farms. We used questionnaires and exposure assessment, including measurement of inhalable dust. Paraquat levels were very low in the urine of workers who did not handle the herbicide. Among paraquat handlers, urinary concentrations of the chemical were significantly higher on spray days than either before or after spray days. Personal protective equipment was used on banana and palm oil farms, and rarely on coffee farms; dust exposure on banana and palm oil farms was slightly higher than on coffee farms. Exposures were about two times higher on sunny days than on rainy days.

Hands-On Pesticide Handler Training

- Karen M. Lewis, Cooperative Extension, Washington State University

A partnership of the Washington State Department of Agriculture, Washington State University, and the Washington Grower's League held three hands-on training events for pesticide handlers— workers who mix, load and apply pesticides—employed in Washington's tree fruit industry. The training, in English and Spanish, covered personal protective equipment, mixing and loading, leaks and spills, clean-up and disposal, and worker protection standards. All participants indicated that the training increased their previous skills or knowledge in all topics, with the greatest increase in skill reported for managing leaks and spills.

Free National Library of Medicine Resources for Agricultural Health and Safety

- Sarah McCord, Health Sciences Library, Washington State University

This exhibit showcased the many free databases and other resources available from the National Library of Medicine, including old favorites like MEDLINE and TOXNET, as well as new resources such as MEDLINEplus and HazMap. On display were handouts, bookmarks, and other educational materials for providers and consumers, including material in English and Spanish.

Agricultural Injury among Rural California High-School Students

- Stephen A. McCurdy, Western Center for Agricultural Health and Safety, University of California, Davis

We are observing patterns of work and injury over time among rural California high school students (predominantly white males) attending schools with programs in agricultural studies. Thirty-six percent live on a farm. More than 90 percent agreed or strongly agreed that safety precautions were important and necessary, even if they slowed tasks. Fifteen percent reported an agricultural injury within the preceding year that required medical attention or led to missed or restricted work or school time. Injury was associated with living on a farm, current smoking, and chewing tobacco. Machinery and animal work were the most common activities associated with injury; seatbelt wearers had lower injury rates. These results suggest that prevention programs should center on males, smokers, and tasks involving machinery or animals.

Farmer and School Children Epidemiologists:
Self-Studies on the Health Effects of Pesticides as a Health Education Strategy

- Helen H. Murphy, Programme for Community IPM, United Nations Food and Agricultural Organization

Farmers and school children in Southeast Asia learn how to conduct surveys within their own communities on the hazards and health effects of pesticides. They interview and observe fellow farmers or parents in pesticides in use, which they classify by World Health Organization health hazard levels and chemical family; amounts of pesticide solution used per farmer per year; exposure routes; household pesticide storage and disposal hazards; and signs and symptoms of pesticide poisoning before and after sprayings. The results are subsequently presented back to the community for discussion of risk reduction. Such strategies have helped to improve the safety of pesticide spraying, storage, and handling (Thailand); to document unreported cases of pesticide poisoning (Vietnam, Sri Lanka, Thailand, and India); and to reduce the incidence of moderate poisoning (Vietnam). These community-based studies create a tremendous demand for pesticide alternatives and, via such alternatives, have a dramatic impact on hazardous pesticide handling.

Pulmonary Effects of Inhaled Concentrated Fine or Coarse Particulate Matter in Rats

- Kent E. Pinkerton, Center for Health and the Environment, University of California, Davis

Particulate matter (PM) smaller than 10 mm (PM_{10}) is associated with increased respiratory disease. We exposed rats for several days to filtered air or to particulates smaller than 2.5 mm (fine PM) and to particles between 2.5 and 10 mm (coarse PM) at up to 40 times the ambient levels in Fresno, California. Such exposures to fine and coarse particles led to mild, but statistically significant, cellular effects in the lungs of healthy adult rats, including lowered viability of cells recovered by bronchoalveolar lavage in rats exposed to fine PM and increases in the number of these cells in rats exposed to coarse PM. These findings have significant implications for dry farming techniques used in California's Central Valley, which generate significant amounts of dust and combustion particles that workers inhale.

University of California, Davis, Farmer Health Study: The First Ten Years

- Marc B. Schenker, Western Center for Agricultural Health and Safety, University of California, Davis

UC Davis's Farmer Health Study was established in 1993 to determine the prevalence of and risk factors for acute and chronic disease in this cohort of California farm operators. The study also documents changes in work practices and occupational risk factors and identifies how these affect the cohort's health as it ages. In 1993, 1,947 (73.8%) of randomly contacted, eligible farm operators from a sample frame of 55,000 California farms completed a computer-assisted telephone interview. A subset of 374 farmers completed lung function and immunologic tests in the field in 1995–96. A nested case-base sample of farmers, and 802 spouses (81%), completed a computer-assisted telephone interview in 1998. In 2002–03 members of the 1995–96 respiratory subset will undergo a more intensive respiratory evaluation, including lung visualization using high-resolution computed tomography. A second follow-up questionnaire is planned for 2003–04, covering the entire cohort, including spouses and new wave of enrollment from the current sample frame of California farms. Among its findings, the study has identified risk factors for respiratory disease, such as exposure to inorganic dust; farmworker risks for injury; and risks for musculoskeletal symptoms. The study has also examined perceptions of farmers about the hazardousness of their work and their use of protective equipment known to reduce health hazards.

Western Center for Agricultural Health and Safety

- Marc B. Schenker, Western Center for Agricultural Health and Safety, University of California, Davis

The major goal of the Western Center for Agricultural Health and Safety is to improve the health and safety of farmers, farm family members, and farmworkers in western agriculture, in which practices and workforce differ from its better-studied counterpart in the Midwest. The center is organized into research, intervention and prevention, education, and administrative cores. Areas of specific interest include respiratory disease in dry-climate farming, ergonomic hazards of farm labor work, acute and cumulative trauma injuries, biomarkers and neurotoxicity of pesticide exposure, health status of hired farm workers, and economic and policy issues pertinent to agricultural health and safety. A team of 13 scientists plus co-investigators and support staff has been assembled. Center collaborations exist in Arizona and Hawaii, and an annual conference rotates between Davis and the PNASH Center in Seattle.

Transfer of Pesticide Surrogates to Skin Following Contact with Contaminated Surfaces

- René M. Showlund, Department of Environmental Health, University of Washington

Under the US Food Quality Protection Act, aggregate exposure assessments must be done for pesticides proposed for registration. To assess surface-to-skin transfers relevant to this law, adult volunteers in a series of trials touched their fingertips to surfaces loaded with fluorescent tracers as surrogates for pesticides. The trials investigated contact duration, contact pressure, surface tracer loading, surface type, contact scenario, skin moisture, and tracer solubility in water. Skin moisture and surface type most influenced the transfer of surface residues to the fingertips. Interaction between tracer solubility and surface type was also important, suggesting that more attention should be given to these variables in future analyses of surface-to-skin transfer.

Characterization of Workers' Exposure to Mixed Dust at a Vineyard

- Jodi L. Smith, Western Center for Agricultural Health and Safety, University of California, Davis

Agricultural work is inherently varied and cyclic. Errors in chronic exposure estimates may result when dust exposure assessments are made during one set of activities, such as harvesting, then extrapolated to other tasks and conditions. This study links activities with exposure levels during a complete cycle of vineyard operations, producing a task-exposure matrix that can be used to estimate yearly dust exposure and identify the factors playing an important role. So far, exposures appear to vary significantly with task as well as with temperature and humidity. Respirable dust is not significantly associated with inhalable dust. Harvest leads to the highest exposure to respirable dust; training young vines produces the highest exposure to inhalable dust. Dust exposure is higher in summer than spring.

Labor and Productivity

- Don Villarejo, California Institute for Rural Studies, Davis, California

Despite disproportionate declines in the amount of land devoted to agriculture in the eight states covered by PNASH and the Western Center for Agricultural Health and Safety, the Northwest and California are now responsible for a larger share of national farm production than they were 25 years ago. Most notable are large increases in fruit and vegetable production, a slowdown in the rise of ornamental nursery output, and the remarkable growth of dairy output. Some traditionally important commodities, such as sugar crops, grains, and cow-calf operations, have declined. Overall labor demand has also increased slightly. Worker compensation, for farm operators and for hired farmworkers, has failed to keep up with increases in productivity. Careful documentation of current practices in a dozen or so of the most important commodities would improve assessment accuracy for contemporary occupational risks.

Farm Exposures to Deposited Arsenic and Lead on Vashon/Maury Island, Washington

- Sarah G. Weppner, Department of Environmental Health, University of Washington

In response to requests from the local grower community, a small study was done of farm exposures to soil contaminants on Vashon/Maury Island. Urine samples were collected and tested for arsenic, and environmental samples, including soil, house dust, and root and leaf crop samples from nine farms, were collected and tested for lead and arsenic. Soil lead and arsenic were significantly associated, suggesting a common source consistent with airborne contamination from smelter emissions. No seasonal trends appeared in environmental levels of arsenic and lead or in biological levels of arsenic. Island-grown produce showed no higher levels of arsenic or lead in comparison with controls, and the island's soil, produce, and house dust did not seem to be dominant sources of exposure. Moreover, no clear evidence of elevated exposure to soil contaminants was found among island farmers and their families.

Standardization of Clinical Cholinesterase Measurements

- Barry W. Wilson, Departments of Environmental Toxicology and Animal Science, UC Davis

Blood cholinesterases are important enzymes for monitoring exposures to agricultural chemicals and nerve agents, but results from commonly used cholinesterase-monitoring assays are not consistently reproducible from one clinical laboratory to another. Our laboratory has developed assays that reduce such variability. In one split-sample study, for example, we compared our lab's assay results for red blood cell acetylcholinesterase (AchE) and plasma non-specific cholinesterase (BChE) with those from nine participating clinical labs and found that the results correlated poorly across laboratories (0.88 or above for four of five laboratories for BChE and 0.9 or above for only two of seven laboratories for AchE). To minimize this variability, we then devised and validated a red blood cell ghost AchE "standard." Our work helped to refine regulations under a California law requiring clinical laboratories to standardize their results, and we continue to work with selected clinical labs to demonstrate their regulatory compliance.

Dan Arrieta
Research Associate
Department of
Environmental Toxicology
University of California
One Shields Avenue
4209 Meyer Hall
Davis CA 95616
530-752-3531/530-752-3394
dearrieta@ucdavis.edu

Brad Baugh PhD
Farmer
Environmental Protection Service
USDA Agricultural Research Service
Box 209
9 Mile Falls WA 99026-0209
509-468-7607
conquest@sisna.com
Interest: farming, health care, toxicology

Karyl Baugh BSN
Farmer
Box 209
Mile Falls WA 99026-0209
509-4687607
conquest@sisna.com
Interest: farming, access to and effective use of heath care services, especially in the elderly farm population

Patricia Boiko MD MPH
Director of Research-Outreach
Core Leader, Outreach and Education
PNASH Center
Department of Environmental and
Occupational Health Sciences
University of Washington
Box 357234
Seattle WA 98195-7234
206-406-7012/206-616-2687
peb5@u.washington.edu
Interest: outreach, skin disorders, mental illness, health care, migrant farmworkers

David Bonauto MD MPH
Occupational Medicine Physician
WA Dept of Labor & Industries SHARP
PO Box 44330
Olympia WA 98504
360-902-5664
bone235@lni.wa.gov
Interest: injury epidemiology

Ofelio Borges
Farmworker Education Specialist
Washington Department of Agriculture
21 North First Ave, Suite 103
Yakima WA 98902
509-225-2625/509-575-2210
oborges@agr.wa.gov
Interest: farmworker education, pesticide exposures, risk communication

Sonja Brodt PhD
Program Evaluation Specialist
UC Statewide Integrated Pesticide
Management Program
Western Center for Agricultural
Health and Safety
University of California
One Shields Avenue
Davis CA 95616
530-754-9297
sbbrodt@ucdavis.edu
Interest: evaluation, integrated pesticide management, farmworker safety training

Vicky Buchan PhD
Professor
Department of Social Work
High Plains Intermountain Center for
Agricultural Health & Safety
(HI-CAHS)
Colorado State University
134 Education Building
Fort Collins CO 80523-1586
970-491-5211/970-491-7280
buchan@cahs.colostate.edu
Interest: evaluation, assessment in higher education, application of human behavior theory to health and safety in agriculture

Malcolm Butler MD
Medical Director
Columbia Valley Community Health
600 Orondo Ave, Suite 1
Wenatchee WA 98801
509-664-4575
mbutler@cvch.org
Interest: health care, migrant and seasonal farmworkers

Marty Cohen ScD CIH
Industrial Hygienist
Washington Department of Labor
& Industries SHARP
PO Box 44330
Olympia WA 98504-4330
360-902-4957/360-902-5672
cohm235@lni.wa.gov
Interest: work-related dermatitis, fatalities & other occupational injuries & illnesses

Kathleen DeMaria
5603 1/2 12th Ave NE
Seattle WA 98105
206-523-3233

Kai Elgethun PhC
Department of Environmental and Occupational Health Sciences
University of Washington
Box 357234
Seattle WA 98195-7234
206-685-6629
elgethun@u.washington.edu
Interest: agricultural exposure assessment, pesticide spray drift research, GPS & GIS technology

Gloria Coronado PhD
Staff Scientist
Fred Hutchinson Cancer Research Center
100 Fairview Ave N
MP-702
Seattle WA 98109-1024
206-667-4216
gcoronad@fhcrc.org
Interest: pesticide, community interventions

Rebecca Domingo-Neumann PhC
Graduate Student
Land Air Water Resource
Social Science Graduate Group
University of California
One Shields Ave
Davis CA 95616
530-752-0144/750-1103
rdneumann@ucdavis.edu
Interest: soil science, dust inhalation

Pamela Elkind PhD
Professor, Director & Investigator
Center for Farm Health and Safety
Department of Sociology
Eastern Washington University
314 Patterson Hall
Cheney WA 99004-2429
509-359-6447/509-359-6583
pelkind@ewu.edu
Interest: sociology, community-based interventions, farm family decision-making, agricultural stressors

Nora Coronado PhD ABD
Research Scientist
School of Social Welfare
University of Washington
126 NW 101 Street
Seattle WA 98177
206-782-0642
ncorona@u.washington.edu
Interest: health/mental health of parents & developmental issues in children, migrant & seasonal farmworkers

Janet Ehlers RN MSN
Occupational Nurse Epidemiologist
CDC/NIOSH
4676 Columbia Parkway, MS-R21
Cincinnati OH 45226
513-841-4205/513-841-4489
jehlers@cdc.gov
Interest: agricultural safety and health

Fabiola Estrada
Graduate Student
Department of Environmental and Occupational Health Sciences
University of Washington
6017 35th Ave NE
Seattle WA 98115
206-351-5506
fabi@u.washington.edu
Interest: farmworker health issues

Fadi Fathallah PhD
Assistant Professor & Investigator
Biological and Agricultural
Engineering Department
Western Center for Agricultural
Health and Safety
University of California
One Shields Ave
Davis CA 95616-8757
530-752-1612/530-752-2640
fathallah@ucdavis.edu
Interest: occupational biomechanics & ergonomics, with special emphasis on agricultural environments

Linda Goldenhar PhD
Senior Research Associate
Institute for Health Policy &
Health Service Research
University of Cincinnati Medical Center
PO Box 670840
Cincinnati OH 45267
513-558-6936
goldenla@ucmail.uc.edu
Interest: racial & ethnic health disparities, oral health, women's health, work organization, & health service reearch in the aging Appalachian population

Jessie Ham
Undergraduate Student
Pacific Lutheran University
903 Edgewater Lane
Moses Lake WA 98837
509-765-9524
hamje@plu.edu
Interest: agricultural methods, reproductive health & exposure to pesticides

Richard Fenske PhD MPH
Professor & Director
PNASH Center
Department of Environmental and
Occupational Health Sciences
University of Washington
Box 357234
Seattle WA 98195-7234
206-543-0916/206-616-2687
rfenske@u.washington.edu
Interest: risk assessment, pesticides, dermal exposure, children's exposure to pesticides in agricultural communities

Susan Gustke MD
Director
Southern Coastal Agromedicine Center
East Carolina University
W Research Bldg,
1157 VOA Site C RD
Greenville NC 27858
252-744-1000/252-744-1009
gustkes@mail.ecu.edu
Interest: agricultural health and safety

Cheryl Hanks
Public Health Advisor
Washington Department of Health
PO Box 47825
Olympia WA 98504-7825
360-236-2261
cheryl.hanks@doh.wa.gov
Interest: pesticide surveillance, community outreach & education, intervention effectiveness, quality assurance

Guadalupe Gamboa
Regional Director
United Farmworkers of America
for Washington and Oregon
PO Box 1056
Sunnyside WA 98944
509-839-4903
gamboaufw@yahoo.com
Interest: farm worker labor concerns

Robert Haas
California EPA, CEHHA
1515 Clay Street, 16th Floor
Oakland CA 94612
510-622-3172/510-622-3210
rhaas@oehha.ca.gov

Marcy Harrington
Communications Coordinator
PNASH Center
Department of Environmental and
Occupational Health Sciences
University of Washington
Box 357234
Seattle WA 98195-7234
206-685-8962/206-616-2687
Interest: communication strategies, paticipatory research methods, community based research

Maria Hernandez-Peck PhD
Associate Professor
Department of Social Work
Eastern Washington University
526 5th St MS-19
Cheney WA 99004-2431
509-359-6479/509-359-6475
MariaPeck@aol.com
Interest: aging, social work

Sandra Hines
Assistant Director
UW News and Information
Box 351207
Seattle WA 98195206-543-2580
shines@u.washington.edu
Interest: media communication

Kailash Kapur PhD
Professor & Investigator
UW Industrial Engineering Dept
PNASH Center
Box 352650
Seattle WA 98195
206-543-4604/206-685-3072
kkapur@u.washington.edu
Interest: engineering, system safety, reliability analysis & its application in agricultural safety

Adrienne Hidy MA
Manager
PNASH Center
Department of Environmental and Occupational Health Sciences
University of Washington
Box 357234
Seattle WA 98195-7234
ahidy@u.washington.edu

Stacey Holland BFA
Program Coordinator/Designer
PNASH Center
Department of Environmental and Occupational Health Sciences
University of Washington
Box 357234
206-616-1958/206-616-2687
sh3@u.washington.edu
Interest: information technology, graphic design

Tom Karsky MS
Ext Agent
University of ID
Biological and Agricultural Engineering Dept
Moscow ID 83844-0904
208-885-7627/208-885-7908
tkarsky@uidaho.edu
Interest: agricultural injuries

Kathy Himes MS
Graduate Student
Department of Environmental and Occupational Health Sciences
University of Washington
Box 357234
Seattle WA 98195-7234
klhimes@u.washington.edu
Interest: pesticide exposure

Peter Johnson PhD
Assistant Professor & Investigator
PNASH Center
Department of Environmental and Occupational Health Sciences
University of Washington
Box 357234
Seattle WA 98195-7234
206-221-5240/206-616s-2687
petej@u.washington.edu
Interest: ergonomics

Olivia Kasirye MD
UC Davis
Center for Health and the Environment
Building 3792 Old Davis Rd
Davis CA 95616-8615
530-754-9729/530-752-5300
ockasirye@ucdavis.edu
Interest: health disparities, environmental health

Alex Lu PhD
Research Scientist & Investigator
PNASH Center
Department of Environmental and Occupational Health Sciences
University of Washington
Box 357234
Seattle WA 98195-7234
206-685-9299/206-616-2687
calu@u.washington.edu
Interest: exposure assessment & dose estimates of pesticides in agricultural workers & general populations, interventions to minimize exposure

Stephen McCurdy MD
Assoc Professor & Deputy Director for Research
Epidemiology & Preventive Medicine Department
Western Center for Ag Safety and Health
University of California
One Shields Ave
Davis CA 95616-8638
530-752-8051/530-752-3239
samccurdy@ucdavis.edu
Interest: occupational & environmental medicine, agricultural injuries, epidemiology, & occupational hazards for agricultural populations

Diane Mitchell
Study Coordinator
Western Center for Ag Health and Safety
University of California
One Shields Ave.
Davis CA 95616-8757
530-752-1810/530-752-5047
dcmitchell@ucdavis.edu
Interest: farmer and spouse health issues

Lewis Martin
Mechanical Engineer
NIOSH Spokane Research Lab
315 E Montgomery
Spokane WA 99207
509-354-8000/509-354-8099
ljm8@cdc.gov
Interest: engineering

Sara McKinnon MPH
ASPH Fellow
NIOSH
Division of Respiratory Disease
1095 Willowdale
Morgantown WV 26505
304-285-6382/304-285-5861
smckinnon@cdc.gov
Interest: migrant farmworker pesticide safety

Barbara Morrissey MS
Toxicologist
WA DOH
Pesticide Section
PO Box 47825
Olympia WA 98504-7825
360-236-3368
barbara.morrissey@doh.wa.gov
Interest: prevention of pesticide illness, development effects of chronic pesticide exposure

Sarah McCord
Health Science Resources Librarian
Washington State University
Health Sciences Library
170D Wegner Hall
Pullman WA 99164-6512
509-335-1460/509-335-5158
mccord@wsu.edu
Interest: outreach to under-served comm, evidence-based practice & library assessment models

Tom McMonagle MS
Director-Safety Products Division
Banner Engineering Corporation
9714 10th Ave N
Minneapolis MN 55441
763-593-3940
tmcmonagle@baneng.com
Interest: safety engineering development of occupational sensory devices to be used with and near machinery

Helen Murphy FNP/MHS
Epidemiologist
UN Food & Agricultural Organization IPM
2228 Eastlake Ave E #2
Seattle WA 98102
206-325-4848/206-325-4848
hmurf@attglobal.net
Interest: health effects of pesticides, health education, farm worker self-surveillance systems for behavior change, incidence of unreported pesticide poisoning

Maria Negrete BS
Research Coordinator
PNASH Center
Department of Environmental
and Occupational Health Sciences
University of Washington
1121 S 7th St
Yakima WA 98901
509-457-5227/509-575-4649
mnegrete@u.washington.edu
Interest: farmworker health
& interviewing

Patrick O'Connor-Marer PhD
Pesticide Safety Education Coordinator
& Deputry Director for Education &
Outreach
IPM Education & Publications
Western Center for Agricultural
Health and Safety
University of California
One Shields Ave
Davis CA 95616-8620
530-752-7694/530-752-9336
pjmarer@ucdavis.edu
Interest: pesticide safety training, train-the-trainer
methods, & materials development for diverse
cultural, language, & educational backgrounds

Reuel Paradis
Regional Administrator
Washington Department of
Labor & Industries
15 W Yakima Ave, Suite 100
Yakima WA 98902-3480
509-454-3707/509-454-3792
rpar235@lni.wa.gov
Interest: eye injuries, injuries resulting from
ladder falls in tree fruit industry, employer
& worker behavior modification to improve
workplace safety

Rick Neitzel MS
Research Scientist
Department of Environmental and
Occupational Health Sciences
University of Washington
Box 357234
Seattle WA 98195
206-541-5445/206-616-2687
rneitzel@u.washington.edu
Interest: industrial hygiene, noise
& vibration exposure

Gwen Oliver
Manager
Western Center for Agricultural
Health and Safety
University of California
One Shields Ave
Davis CA 95616-8757
530-752-5253/530-752-5047
gaoliver@ucdavis.edu

Kent Pinkerton PhD
Professor & Investigator
Anatomy, Physiology and Cell Biology
Western Center for Ag Health & Safety
University of California
One Shields Ave
Davis CA 95616-8615
530-752-8334/530-752-5300
kepinkerton@ucdavis.edu
Interest: pulmonary effects of inhaled fine or
coarse particulate matter in rats

Steven Neufeld PhD
Research Coordinator
Center for Farm Health and Safety
Department of Sociology
Eastern Washington University
314 Patterson Hall
Cheney WA 99004-2429
509-359-6027/509-359-6583
sneufeld@ewu.edu
Interest: community, the family,
& research methods

Teri Palermo RN
Public Health Advisor
NIOSH
Division of Respiratory Disease Studies
1095 Willowdale Rd, MS-128
Morgantown WV 26505-2888
304-285-5836/304-285-5861
tpalermo@cdc.gov
Interest: evaluation, agricultural health & safety

Kathy Pitts MSW
Project Coordinator
Center for Farm Health and Safety
Eastern Western University
314 Patterson Hall
Cheney WA 99004-2429
509-359-6813/509-359-6583
kpitts@u.washington.edu
Interest: Hispanic theater, health science
communication, safety issues impacting Hispanic
agricultural workers & their families

Julie Postma
School of Nursing
University of Washington
560 31/2 12th Ave NE
Seattle WA 98105
206-523-3233

Richard Rominger BS
Farmer &
Former Deputy Secretary
USDA
28681 Road 29
Winters CA 95694
530-662-3515/
rerominger@ucdavis.edu
Interest: agricultural policy development, farming

Mary Salazar EdD, RN, COHN-S
Professor & Investigator
PNASH Center
School of Nursing
University of Washington
Box 357263
Seattle, WA 98195-7263
206-685-0857/206-685-9551
msalazar@u.washington.edu
Interest: occupational health nursing, injuries among farmworkers, pesticide exposure among adolescent Hispanic farmworkers

John Reganold PhD
Professor
Dept of Crop and Soil Sciences
Washington State University
Johnson 255
Pullman WA 99164-6420
509-335-8856/
reganold@wsu.edu
Interest: introductory soils, organic gardening & farming, land use & soil management, research with alternative agricultural systems

Steve Russell
Ergonomist
Field Research and Consultation Group
Department of Environmental and Occupational Health Sciences
University of Washington
Box 354695
Seattle WA 98195
206-543-9711/206-616-6240
ergoguy@u.washington.edu
Interest: musculoskeletal disorders in the fruit packing industry, ergonomics policy & compliance issues

Marc Schenker MD
Professor and Director
Departmentt of Epidemiology & Preventive Medicine
Western Agricultural
Health and Safety Center
University of California
One Shields Ave
Davis CA 95616-8757
530-752-5676/530-752-3239
mbschenker@ucdavis.edu
Interest: environmental & occupational risk factors respiratory disease & lung cancer, biological monitoring of occupational exposure, health hazards of agricultural exposure, respiratory & pesticide risks

Tito Rodriguez
Public Health Advisor
Washington Department of Health
104 N First St
Yakima WA 98901
509-576-3064/509-575-7894
tito.rodriguez@co.yakima.wa.us
Interest: pesticide education, train-the-trainer

John Sabella PhD
Assistant Director
Southern Coastal Agromedicine Center
Easter Carolina University
W Res Building, 1157 VOA Site C RD
Greenville NC 27858
252-744-1005/252-744-1009
sabellaj@mail.ecu.edu
Interest: occupational education & agricultural extension, organic/sustainable agriculture

Rene Showlund MS
Research Scientist
PNASH Center
Department of Environmental & Occupational Health Sciences
University of Washington
Box 357234
Seattle WA 98195-7234
206-685-6728/206-616-2687
rshowlun@u.washington.edu
Interest: pesticide exposure

Tracy Skaer Pharm D
Professor & Assistant Dean
College of Pharmacy
Washington State University
PO Box 646510
Pullman WA 99164-6510
509-335-5045/509-335-4775
skaer@mail.wsu.edu
Interest: migrant health, pediatrics,internal medicine, psychiatry, & woman's health

Tim Stock
Pesticide Safety Educator
University of California Statewide
IPM Program
One Shields Ave.
Davis CA 95616-8620
530-752-6841/530-752-9336
twstock@ucdavis.edu
Interest: community-based safety education, combining IPM & pesticide safety education

Margaret Tucker
Branch Manager
Washington State Department of Agriculture:
Pesticide Management Division
PO Box 42560
Olympia WA 98504-2560
360-902-2015/360-902-2093
mtucker@agr.wa.gov
Interest: farmworker education, pesticide exposures, risk communication

Jodi Smith
Graduate Student
University of California
Western Center for Agricultural Health and Safety
One Shields Ave
Davis CA 95616
530-754-8164
jlsmith@ucdavis.edu
Interest: dust exposure in agricultural industries, specifically CA vineyards

Hal Stockbridge MD MPH
Associate Medical Director
WA Dept of Labor & Industries
Olympia WA
stoh235@lni.wa.gov
Interest: health care

Don Villarejo PhD
Consultant
PO Box 381
Davis CA 95617
530-756-6545
donfarm@pacbell.net
Interest: hired farm labor & western state agriculture

Karen Snyder PhD, MPH
Research Scientist
PNASH Center
Department of Environmental & Occupational Health Sciences
University of Washington
Box 357234
Seattle WA 98195-7234
206-616-3976/206-616-2687
ksnyder@u.washington.edu
Interest: anthropology, risk communication, packing houses, farmworker injuries

Flor Tovar
Farmworker Education Specialist
Washington State
Department of Agriculture
Farmworker Education
1505 N Miller STE 140
Wenatchee WA 98801-1569
509-662-0590/509-664-3170
ftovar@agr.wa.gov
Interest: farmworker education, pesticide exposures, risk communication

Jennifer Weber
Pesticide Safety Educator
University of California
Statewide IPM Project
IPM Education & Publications
Davis CA 95616
530-752-5930/530-752-9336
jlweber@ucdavis.edu
Interest: integrated pesticide management

Sarah Weppner MS
Research Scientist
PNASH Center
Department of Environmental and
Occupational Health Sciences
University of Washington
Box 357234
Seattle WA 98195-7234
206-685-6728/206-616-2687
sweppner@u.washington.edu
Interest: pesticide and soil contaminant exposure

Jeffrey Wolstad PhD
Industrial and Manufacturing Engineering
Oregon State University
133 Covell Hall
Corvallis OR 97331-2407
541-737-8272/541-737-5241
jeff.woldstad@orst.edu
Interest: engineering

Barry Wilson PhD
Professor & Investigator
Western Center for Agricultural
Health and Safety
Department of Animal Science
University of California
One Shields Ave
4209 Meyer Hall
Davis CA 95616-8521
530-752-3519/530-752-0175
bwwilson@ucdavis.edu
Interest: cholinesterase testing & monitoring
methods, neurotoxicology, pesiticide exposure

Chris Woodruff BS
Program Assistant
Center for Farm Health and Safety
Eastern Washington University
314 Patterson Hall
Cheney WA
99004-2429
509-359-7995/509-359-6583cwoodruff@
ewu.edu
Interest: community-based interventions,
family farming

Lori Winnemuller
Research Ergonomist
Department of Environmental &
Occupational Health Sciences
Field Research & Consultation Group
University of Washington
Box 354595
Seattle WA 98195-469
5206-543-9711/206-616-6240
lwinnemu@u.washington.edu
Interest: ergonomics

Michael Yost PhD
Associate Professor &
Core Leader for Research
PNASH Center
Department of Environmental &
Occupational Health Sciences
University of Washington
Box 357234
Seattle WA 98195-7234
206-685-7243/
airion@u.washington.edu
Interest: vibration & noise exposure, develop novel tools
for environmental & occupational exposure assessment

ACKNOWLEDGMENTS

The Cultivating Collaborations conference was a joint enterprise of the two western NIOSH agricultural centers: the Pacific Northwest Agricultural Safety and Health Center (PNASH) at the University of Washington and the Western Center for Agricultural Health and Safety at the University of California, Davis (UC Davis).

The centers thank the conference planing committee: Patricia Boiko, PNASH Director of Outreach; Marcy Harrington, PNASH Manager; Adrienne Hidy, former PNASH Manager, Stacey Holland, PNASH Program Coordinator and Graphic Designer; Patrick O'Connor-Marer, UC Davis center Acting Director; and Gwen Oliver, UC Davis center Manager. Writer-editor Ellen W. Chu wishes to thank all the attendees for their abstracts and slides, and conference notetakers for their notes; any errors or omissions in this volume must be considered the writer's fault, not the attendees'.

Most important, the centers wish to thank all the individuals who participated in this conference. The collaborative spirit brought by the speakers, panel members, discussion leaders, and poster presenters enlivened every session.

Funding provided by the National Institute for Occupational Safety and Health Centers for Disease Control and Prevention, under grants #5U50OH07544-01, #1U50OH07550-01, and R13CCR021178, and from the Washington State Medical Aid and Accident Funds administered through the University of Washington, Department of Environmental and Occupational Health Sciences.

PACIFIC NORTHWEST AGRICUTURAL SAFETY & HEALTH CENTER

Western Center for Agricultural Health and Safety

University of Washington
School of Public Health
and Community Medicine

Contact Information:
PNASH Center
University of Washington
Box 357234
Seattle, Washington 98195-7234
pnash@u.washington.edu
1-800-330-0827