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Pacific Northwest Agricultural Safety and Health (PNASH) Center

RESEARCH FOR

Healthy Workers, Strong Communities & Productive Agriculture

Year End Report

Fiscal Year 2014 (September 30, 2013 to September 29, 2014)

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TABLE OF CONTENTS

| | |
|---|---------|
| PNASH OVERVIEW _____ | 3 |
| PNASH LISTING OF ALL ACTIVE PROJECTS _____ | 4 |
| ADMINISTRATIVE AND PLANNING CORE | |
| Administration & Planning _____ | 5-7 |
| Evaluation Program _____ | 8 |
| | |
| NIOSH SPONSORED PROJECTS - COMPLETED FY 2014 | |
| Feasibility 2: Development of a Work Stress Survey for Farmworkers _____ | 12 |
| Feasibility 3: Parkinsonism among Washington State Agricultural Pesticide Handlers _____ | 11-13 |
| Feasibility 6: Understanding the Effects of Filipino Migrant and Immigrant Workers in the Fishing Industry in the Subarctic _____ | 13 |
| | |
| NIOSH SPONSORED PROJECTS - CONTINUING | |
| Res 1 Measurement of Farmworker Exposure to OP Pesticides through Protein Adducts _____ | 14 |
| Res 2 Biomonitoring of Pyrethroid Pesticide Exposures in Ag Workers _____ | 15 |
| Prev 1 Reducing Pesticide Risks through Technologies _____ | 15-16 |
| Prev 2: Ergonomic Evaluation of Emerging Technologies in the Tree Fruit Industry _____ | 16 - 17 |
| Edu 1 Pesticide Safety in Tree Fruit: Translating Research, Overcoming Barriers _____ | 17 - 18 |
| Feasibility 5: Transmission of Microorganisms in Dairy Farming _____ | 18 |
| Feasibility 7: GRAS ² P Safety Video _____ | 18 |
| | |
| ADDITIONAL ACCOMPLISHMENT | |
| Washington Leaders for Conversations about Climate _____ | 19 |
| Notification of Pesticide Applications to Minimize Workplace Exposures _____ | 19-20 |
| Health and Safety of Women Agricultural Workers _____ | 20 |
| Additional Research Publications _____ | 21 |



PACIFIC NORTHWEST AGRICULTURAL SAFETY & HEALTH CENTER

The Pacific Northwest Agricultural Safety and Health (PNASH) Center, established in 1996, conducts research and promotes best occupational health and safety practices for Northwest farming, fishing and forestry industries. Our goal is to prevent or reduce injury and illness for producers, workers, and their families.



One of ten regional centers, PNASH works throughout the Northwest integrating expertise from multiple disciplines, institutions and community partners. We are housed in the UW Department of Environmental and Occupational Health Sciences, School of Public Health and have formal affiliations with multiple UW programs, Washington State University (WSU), and Oregon State University, among others. Our faculty, staff, and students bring expertise to our agricultural industries in the fields of medicine, nursing, industrial hygiene, epidemiology, engineering, and education.

Principal funding of the PNASH Center is granted through the Agricultural, Forestry and Fishing (AgFF) Program at the National Institute for Occupational Safety and Health (NIOSH)/Centers for Disease Control and Prevention. The NIOSH AgFF program is a non-regulatory approach that addresses region- and industry-specific complexities. PNASH is also competitively awarded project grants from other federal, state, and non-profit organizations.

Relevance

The agricultural industries (farming, fishing, and forestry – or AgFF) consistently rank among the most dangerous jobs, with fatality rates 7-8 times that of the all-industry average for the US. Commercial fishing fatality rates exceed national averages for all occupations 36-fold, and logging fatality rates exceed the national average by 30 times. Farming is a unique workplace in that families frequently live on site. Each year 14,000 children are injured and 100 are killed on US farms.

The 2013 Census of Fatal Occupational Injuries showed AgFF fatalities were 6 percent lower in 2013 at 479 compared to 2012, the third straight year of declines. Yet fatal work injuries in forestry and logging were higher by 25 percent at 81, the highest number since 2008. Overall, AgFF still recorded the highest fatal injury rate of any industry sector at 22.2 fatal injuries per 100,000 FTE workers in 2013.

Agricultural injury statistics often do not include the men, women, and youths at operations with fewer than 11 full-time employees. Nearly 78% of employers fall into this category, even though the AgFF industry as a whole constitutes one of the largest industry sectors in the US. In addition to injuries and fatalities, agricultural, forestry and fishing workers are also at high risk for illnesses such as lung diseases, hearing loss, heat related illness, skin diseases and certain cancers associated with chemical use and prolonged sun exposure. The economic burden in a single year is assessed at 8.3 billion loss in medical costs and lost productivity.

Third Year (FY2014) Activities

This report focuses on high impact activities and accomplishments for PNASH’s Year 3 of it’s 5-year program cycle. Our third year saw progress across all projects, the conclusion of three pilot/feasibility projects, and the funding of four new emerging areas.

PNASH Internal Advisory Committee

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|---|---|--------------|-----------------|
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The Pacific Northwest Agricultural Safety and Health (PNASH) Center, established in 1996 through the NIOSH/CDC Agricultural Initiative, is dedicated to the prevention of illness and injury among agricultural producers, workers and their families. We work toward this goal through partnerships in the Northwest (Alaska, Idaho, Oregon, and Washington). Agricultural businesses, workers, and communities are the foundation of a strong agricultural industry. With this in mind, we partner with industry, health care, government, academic, and community groups to address key hazards and promote safe and sustainable workplaces.

RESEARCH FOR

Healthy Workers, Strong Communities & Productive Agriculture

The following listing describes all active PNASH projects, including those funded outside the NIOSH award.

RESEARCH

Heat Exposure, Injury Risk, and Productivity in Agricultural Workers (NIOSH 2014-2017)

Farmworker OP Exposure through Protein Adducts (NIOSH 2011-2016)

Using IPM to Reduce Pyrethroid Pesticide Exposures in Dairy Workers (NIOSH 2011-2016)

Feasibility: Non-Fatal Injuries among Commercial Fishing Workers in Alaska, Washington, and Oregon
(PNASH Small Grant 2014-2015)

Feasibility: Transmission of Microorganisms in Dairy Farms (PNASH Small Grant 2013-2015)

Feasibility: Fishing Industry Filipino Migrant and Immigrant Work in the Subarctic (PNASH Small Grant 2013-2014)

PREVENTION AND INTERVENTION

Safety and Health of Latino Immigrant Forestry Services Workers in the Pacific Northwest (NIOSH 2014-2017)

Reducing Agricultural Worker Risks through New and Emerging Technologies
(NIOSH 2011-2016, MAAF 2012-2013)

Ergonomic Evaluation and Development of Best Practices for the Use of Mobile Work Platform Technology in Orchards (NIOSH 2011-2016, MAAF 2009-2011)

Impact of Workplace Stress on Health in Farmworker Families (NIOSH 2014-2016)

Feasibility: Total Worker Health in Salmon Fishermen from Cordova, AK (PNASH Small Grant 2014-2015)

Notification of Pesticide Applications to Minimize Workplace Exposures: A Feasibility Study (MAAF, 2013-2014)

Development of a Surveillance Strategy to Guide Injury Prevention Efforts in the Washington Commercial Fishing Industry (MAAF, 2012-2013)

EDUCATION

Pesticide Safety in Tree Fruit: Translating Research, Overcoming Barriers (NIOSH 2011-2016)

Educational Video For Farmworker Ladder Safety and Heat Illness Prevention (MAAF, 2012-2014)

GRAS²P Food Safety Video (PNASH Small Grant 2013-2014)

Washington Leaders for Conversations about Climate (UW School of Public Health 2012-2014)

COMMUNITY-BASED PARTICIPATORY RESEARCH

El Proyecto Bienestar (or, Well Being Project), is a long standing community health intervention effort guided by a Yakima Valley community advisory board and a partnership of: UW PNASH; Northwest Communities Education Center/Radio KDNA; Heritage University; and the Yakima Valley Farm Workers Clinic. Our current projects:

Home Air in Agriculture - Pediatric Intervention (HAPI) Trial (NIEHS 2014-2019)

Health & Safety of Women Ag Workers (MAAF 20013-2014)



ADMINISTRATIVE AND PLANNING

The Administrative and Planning Core provides an infrastructure for the Center and assists in the implementation of individual project and program objectives. Core programs ensure that activities are well coordinated and integrated within the center, are of high scientific quality, meet their objectives, and work in coordination with community and industry partners to move results into practice.

PNASH PEOPLE



Dr. Jennifer Lincoln

It is our great pleasure to announce that Dr. Jennifer Lincoln, director of the NIOSH Alaska Pacific Office, has been appointed as Affiliate Faculty at the UW Department of Environmental and Occupational Health Sciences. Dr. Lincoln is a member of the Pacific Northwest Agricultural Safety and Health (PNASH) Center's Scientific Advisory Committee and has provided guidance to PNASH faculty and graduate students looking for practical injury epidemiology experiences. PNASH supported the appointment and will facilitate ongoing collaboration to benefit student learning and commercial fishing safety. Carly Miller, MD, and MPH student, commented,

"Working with Jennifer provided me a fantastic example of an injury epidemiologist - she is remarkably effective in her work and has enacted meaningful changes while working for the safety and health of commercial fishermen."

After a national search, Mike Yost, PhD and PNASH Deputy Director has been selected as Chair of the UW Department of Environmental and Occupational Health Sciences. Dr. Yost will be continuing his leadership position and project work at PNASH, with some shifting of responsibilities to co-investigators. Other new appointments include: Ms. Marcy Harrington as facilitator of the NIOSH Evaluation, Communication and Outreach (ECO) Group, a collaborative effort across the 10 Agricultural Centers; and Ms. Stacey Holland as PNASH's Media Specialist.

Students: As an academic program, we conduct higher education at every level. FY2014 projects included 4 PhD student thesis work in exposure sciences, 1 Masters in exposure sciences, 1 Masters in public health interns, and 7 Bachelors in public health/health sciences interns.

NEW PROJECT GRANT AWARDS

Each year, thanks to the nucleus of research expertise and support formed by the Center, our faculty and staff researchers successfully procure additional project grants to help advance the goals and priorities of the PNASH Center. In FY2014 the following projects addressing PNASH's mission were awarded:

Heat Exposure, Injury Risk, and Productivity in Agricultural Workers (NIOSH 2014-2017)

PI: June Spector

This project aims to examine the association between heat exposure and traumatic injury risk in agricultural workers, the relationship between heat stress and productivity, and the feasibility of using a biomarker of heat acclimation to detect workers at risk for heat-related illness (HRI) and injury.

Safety and Health of Latino Immigrant Forestry Services Workers in the Pacific Northwest (NIOSH 2014-2017)

PI: Arnold de Castro

This research-to-practice project identifies and assesses injury and health risks for Latino immigrant forestry services workers in order to create story (case)-based education and prevention materials aimed to reduce risks for workers. The project partnerships include the Northwest Forest Worker Center, Berkeley Labor Center and UW PNASH.



Home Air in Agriculture - Pediatric Intervention (HAPI) Trial (NIEHS 2014-2019)

PI: Catherine Karr

This study is addressing three highly underdeveloped components of asthma and environmental research - the health of children with asthma living in communities with industrial scale agricultural operations, asthma in a particularly vulnerable subpopulation (Latino farm worker children), and evidence based intervention strategies within these populations. HAPI aims to reduce child exposure to inflammatory agents and allergens in the home through the use of high efficiency particulate air cleaners and a home-based education program. This is a project under the community-engaged project, **El Proyecto Bienestar** (or, Well Being Project), a long standing community health intervention effort guided by a Yakima Valley community advisory board and a partnership of: The University of Washington; Northwest Communities Education Center/Radio KDNA; Heritage University; Yakima Valley Farm Workers Clinic.



Impact of Workplace Stress on Health in Farmworker Families (NIOSH 2014-2016)

PIs: Diane Rohlman & Kent Anger, Oregon Health Sciences University

This project addresses stress experienced by agriculture workers and their families. Findings will lead to the development of practical workplace intervention strategies designed to reduce stress. Plans for this project include administering a stress-factor screening questionnaire to 100 farmworkers who have worked in agriculture for the past three years. An intervention program aimed at employees, as well as one aimed at supervisors, will be developed using existing intervention study research.

SMALL GRANT (PILOT/FEASIBILITY) AND EMERGING ISSUES PROGRAM

Every year PNASH sends out a call to Northwest investigators for pilot research or small projects in agricultural safety and health. We are pleased to announce this year's awards for small grants for 2014-2015:

Total Worker Health for Salmon Fishermen from Cordova, AK

PI: Dr. Debra Cherry, University of Washington

Building on partnerships between the UW, NIOSH – Alaska Pacific Office, and University of Alaska Fairbanks Sea Grant program, this pilot project will result in a new health risk appraisal tool and exam protocol that can be transferred to other populations of fishermen. Another product of this project will be a detailed description of the health status and chronic disease risk factors in the participating population. Physical measurements will be used to validate the survey responses. By identifying and describing chronic health risks associated with fishing, we can develop “total worker health” best practices to make work in this vital industry as safe and healthy as possible.

Non-fatal Injuries among commercial fishing workers in AK, WA, OR

PI: Laurel Kincl, Oregon State University

Commercial fishing is the most hazardous occupation in the United States. Although there is a national database that collects fishing industry fatality data, information on non-fatal injuries is limited. Non-fatal injuries constitute the vast majority of workplace injuries and can result in lower productivity, lost wages, lost quality of life, or disability. This descriptive epidemiological study will provide estimates of the reported non-fatal occupational injuries among commercial fishermen, identify high-risk work processes, and identify vulnerable workers, such as young workers. This study will utilize injury data from the United States Coast Guard's (USCG) Marine Information for Safety and Law Enforcement (MISLE) electronic system accessed in collaboration with the National Institute for Occupational Safety and Health (NIOSH) Alaska Pacific Office. Using the injury data, the study will identify high risk work processes by utilizing a Work Process Classification System developed for the commercial fishing industry.



NEW DIRECTIONS

The WA Farm Work Group

In 2014 PNASH was appointed to a new collaborative initiative, the Washington Farm Work Group. The Farm Work Group was formed under the WA Employment Security Commission by the state legislature to find mutual points of interest in the ag community and administrative solutions to agricultural issues. The group is charged to identify these shared issues and solutions by the end of 2014. Overall the workgroup goals are to:

- Educate on regulation, business practices and other ag-labor issues in Washington
- Identify labor-related issues like housing, workplace standards and labor supply
- Foster positive communication among stakeholders in the agricultural industry

The Workgroup is composed of 5 farmworker and 5 industry representatives. Exofficio members are included by agreement of the group. The PNASH Center was voted in as one of several exofficio members, with representation by PNASH's Director of Community Engagement and Education Victoria Breckwich Vásquez and PNASH Director Richard Fenske. Several issue areas have called upon PNASH's expertise and previous research experience, including sexual harassment of women in agriculture and pesticide drift.

NIOSH's NORA for Agriculture, Forestry and Fishing

PNASH served as site-host for the NIOSH National NORA Ag, Forestry and Fishing (AgFF) Sector Council Meeting this August 6-7, 2014. The National Occupational Research Agenda (NORA) is a multi-stakeholder partnership program to stimulate innovative research and improved workplace practices. DEOHS and PNASH assisted NIOSH in launching this effort in 2005 with a Town Hall forum in Seattle to gather stakeholder testimony on safety and health research priorities for agriculture and other high-risk occupations. The current AgFF agenda and council has guided both research and research-to-practice efforts throughout the past decade. In April 2016, a new decade's agenda will be set. At this 2014 AgFF NORA Council meeting, PNASH Center faculty, staff and students were invited to participate and inform the agenda's implementation and evaluation.

ADDITIONAL ADMINISTRATIVE ACCOMPLISHMENTS

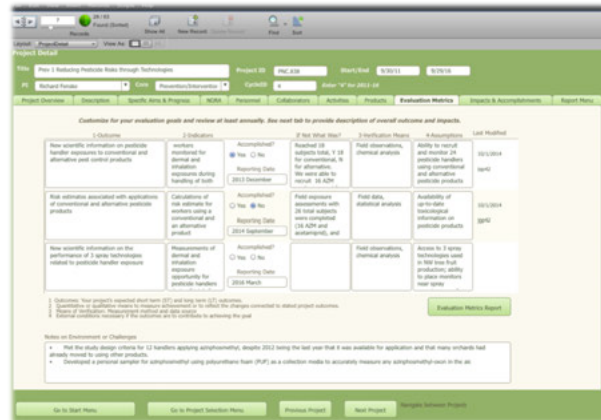
- **New Yakima PNASH Office.** Based at Yakima Medical Center with office, meeting and dry lab/exam rooms.
- **Monthly meetings of PNASH Internal Advisory Committee and PNASH Staff**
- **Oct 3-5, 2013. NIOSH Ag Centers, ERCs, Healthy Workforce Center Meeting,** Denver, CO
- **Oct 10-11, 2013. PNASH Oregon Forest Sector Meetings and Tours,** Salem, OR
- **Feb 3-4, 2014. AUPOHS Meeting,** Washington DC
- **Feb 25-26, 2014. PNASH Scientific Advisory Committee Meeting,** Seattle, WA
A meeting focused on: 1) Progress, Results and Outcomes, and 2) Strategic Planning - Looking Ahead
- **April 17-18, 2014. Latino Health Conference - University of Washington Medicine,** Seattle WA



EVALUATION PROGRAM

As a result of NIOSH’s investment in evaluation, PNASH has developed a rigorous evaluation program with a focus on developmental evaluation, outcomes and impacts. Our goal is to ensure that our efforts are relevant, feasible, sustainable, the best science and practice, and demonstrate efforts consistent with the ultimate goal of reducing injuries and illness. The program focuses at the micro project level and at the macro Center level. On an annual basis, PNASH internally assesses progress and impacts while an external review is conducted by our Scientific Advisory Committee.

Our newly developed **Program Monitoring Database** builds on previous NIOSH and Ag Center evaluation tools, allowing our tracking and analysis of PNASH project outcomes and impacts. Unique to this database is the integration of impact stories, stakeholder anecdotes/quotes, PHS Progress Report fields, and a customizable evaluation matrix to track project-specific indicators of success. The system employs a relational database with a web-hosted platform for any-time, any-where data entry and reference. The database will be introduced to NIOSH/Ag Centers for their potential use.



PNASH's Agricultural Center Evaluation Database

In 2014 Dr. Doug Brock held **Developmental Evaluation Consultations** with leadership for each PNASH project.

Through two consecutive consultations, Brock, Marcy Harrington, and project teams evaluated successes, unanticipated challenges, plans for navigating challenges, alternative ways success can be defined and evaluated, current and future project impacts, and how stakeholders can become more positively engaged. The Developmental Evaluation approach is described by Michael Patton as “The evaluator is part of a team whose members collaborate to conceptualize, design and test new approaches in a long-term, on-going process of continuous improvement, adaptation and intentional change.” The approach seeks to identify and understand how project successes (some anticipated, others emergent) can be used to inform future investigations and support Center operations. In conjunction with the consultations, PNASH Center personnel received training in evaluation theory and methods.

PNASH continues to collaborate across all NIOSH AFF Regional Centers through the Agricultural Center Evaluation, Communication and Outreach (ECO) group. The ECO group's goals are to share resources and knowledge, collaborate on Center-wide communications and evaluation efforts, and enhance intra-extramural dialogue with the NIOSH Ag Centers and NIOSH program offices. Call-in meetings take place every other month with working groups focused on Legislative Education, YouTube Channel, Awareness Events, and the National Ag Safety Database.



OUTREACH AND EDUCATION PROGRAM

The Agricultural Community Outreach and Education Program (ACOEP) is the Center's foundation for building relationships and sharing information with our agricultural community. This small program has an infusion of supplemental funding in FY2014, enabling PNASH to respond to regional needs for PNASH training and educational products. Through our combined education programs, we directly reached 3,300 individuals throughout the Northwest and across the country in FY2014. Additionally, 31 collaborators/partners representing over two dozen different businesses and organizations were or continue to be actively engaged through our projects and programs.

COMMUNITY ENGAGEMENT & NEEDS ASSESSMENT

El Proyecto Bienestar (or, Well Being Project) is a long-standing community based participatory research project and partnership between the UW PNASH Center, Northwest Communities Education Center/Radio Cadena, Heritage University, and the Yakima Valley Farm Workers Clinic. In FY2014 El Proyecto Bienestar (EPB) was reinvigorated with the introduction of a new community advisory board (CAB). Topics addressed included sexual harassment prevention, AFARE asthma project findings and presentations, nitrates in groundwater, anencephaly, and new grant development. EPB's most important new direction responds to a community priority of workplace abuse: Health &

Safety of Women Ag Workers – Sexual Harassment (see pages 19 for project results). In addition to this regional project, PNASH contributes to national efforts working to curb sexual violence in agricultural workplaces. Dr. Breckwich Vásquez joined the National Working Group hosted by Oxfam U.S. that brings together stakeholders from the legal, regulatory, industry and labor sectors to develop a national plan of action. This collaboration has been well-received by the Working Group. An increased understanding of sexual harassment in agriculture as an occupational health concern has emerged due to our active participation. A key future plan for the project is the development of funding applications aimed at production of a training video on sexual harassment prevention for the agricultural industry (in collaboration with WA Grower's League).

"I have enjoyed being a part of research with PNASH and feel our joint work has resulted in positive impacts in the community. There are exciting opportunities to continue working together, especially given the enormous need that exists."

- PNASH Community Partner

Northwest Forestry Sector Outreach and Partner Meetings

In FY2014, PNASH leadership pursued the development of partnerships and assessed needs to address forestry and logging safety. The following partner meetings laid the groundwork for a new NIOSH funding opportunity, with forestry industries safety as a top priority. Topics of regional interest included resources for Latino immigrant forest service workers and training for contract loggers. Meetings took place with:

- ❖ **Portland State Univ, Oregon Law Center, Pineros y Campesinos Unidos Noroeste (PCUN)**, Portland, OR
- ❖ **OR OSHA Logging Code Committee, Salem, OR (and field tour)**. Representatives from OR OSHA, Association of Oregon Loggers and multiple logging and forest service contract companies.
- ❖ **Northwest Forest Worker Center, Promotoras de Salud**, Ashland, OR
- ❖ **Lomakatsi Restoration Project (and field tour)**, Ashland, OR

In addition, Dr. John Garland, PNASH Advisor and DEOHS Affiliate Professor, serves as advisor to the Associated Oregon Loggers and Oregon OSHA Code Committee, and presented "the Limiting Factor in North American Forest Operations. A Skilled Workforce" at forums: Council on Forest Engineering Meeting, Illinois, May 2014; Fifth International Forest Engineering Conference, Sept 2014; and Oregon Logging Conference, February 2014.



EDUCATION & TRAINING

January – March. Pesticide Applicator Recertification Training with Washington State Department of Agriculture.

Dr. Breckwich Vásquez collaborated with Washington State Department of Agriculture (WSDA) to provide hands-on training to Spanish-speaking pesticide handlers and agricultural workers throughout Washington State as part of the Farmworker Education Program. PNASH participated in 5 trainings and trained 250 workers on respirators, PPE, decontamination, and mixing and loading. These educational opportunities aided PNASH research translation and Center-prioritized messages, such as evaluation activities for PNASH’s Practical Solutions for Pesticide Safety.

Feb 26-28. Western Forum for Migrant and Community Health, Seattle, WA

PNASH Participation: Sponsor of Poster Research Reception, Planning Committee, Exhibit

The Community & Migrant Stream Conference is an annual meeting of health professionals and community health workers that serve underserved, diverse populations throughout the Western states region. PNASH offered several activities at this 2-day conference:

- Hosted a research poster session, presenting over 25 poster presentations to over 200 conference participants
- Presented the workshop, "Health and Safety of Women Agricultural Workers in Yakima Valley: Key Prevention Messages and Next Steps in a Community-Campus Partnership Project on Sexual Harassment"
- Presented on research and practice results of a student-led climate change education project featuring a "Climate Change Loteria Game"

Feb 19. Ag Safety Day, Yakima, WA

PNASH Participants: Victoria Breckwich Vásquez, Pablo Palmandez, Kit Galvin

The conference is co-sponsored by the Department of Labor & Industries and the Governor’s Industrial Safety and Health Advisory Board. The conference, with programs in English and Spanish, is designed for employers, supervisors, workers and safety and health professionals – reaching 300 people annually. PNASH served on the planning committee and presented, integrating our research on heat related illness and pesticide safety. In conjunction with the event, PNASH co-sponsored an ammonia safety short course with the Northwest Center for Occupational Safety and Health (Northwest’s NIOSH Education and Research Center).

The screenshot shows a webpage from the University of Washington's Pacific Northwest Agricultural Safety and Health Center. The main heading is "NEW Spanish language Heat Illness & Ladder Injury Prevention Videos" with a sub-heading "AVAILABLE NOW!". Below this, there is a paragraph explaining that the videos were created for training workers on injury and illness prevention. It mentions that the videos are based on a previous audio story-telling project and a previous PNASH work. A green checkmark icon indicates that both videos will be available on the collective U.S. Ag Centers' YouTube Channel. A yellow banner with the text "Available NOW! Safety Videos in Spanish with English subtitles" is prominently displayed. Below the banner, two video titles are listed: "Novelas sobre trabajo en el calor" (Novels about work in the heat) and "Working in the Heat: Awareness, Response & Prevention of Heat Illness". Another section lists "Escaleras de las huertas" (Orchard Ladders) and "Orchard Ladders: Life-Changing Injury Stories Real workers - Real Events". At the bottom, there is a list of other noteworthy heat-illness items, including Washington State's new heat-related illnesses in agriculture, forestry, and CDC's heat acclimatization link.

PNASH Center Mass Communications

We continued our strategic development of the PNASH Mass Communications Plan. We reviewed mass media and social network options, developed a communications dissemination database, and are currently piloting new social media approaches. PNASH also enhanced its mass communications approach, releasing a monthly E-newsletter to over 700 PNASH stakeholders who have been added at their request to our mailing and news lists over the years. Our Center website was accessed by 6,516 unique visitors, with the top visited pages being our educational websites: Northwest Forest Worker Safety Review (newsletter) and Heat Related Illness.

PNASH promotes new Safety Videos through our stakeholder e-news. During National Farm Safety Week PNASH sent out daily communications to keep stakeholders engaged with the event all week long.



ADDITIONAL OUTREACH AND EDUCATION ACCOMPLISHMENTS

- **Evaluation Communication Outreach (ECO) Group's subcommittees:**
YouTube Channel, Ag Awareness, Legislative Communications
- **Washington State Department of Agriculture Stakeholder Advisory Committee Participation**
- **Oregon Law Center Indigenous Workers Project Advisor**
- **November 20-22. Pacific Marine Expo, Seattle, WA.**
- **January 21, 2014. Wilbur Ellis Pesticide Safety Training, Yakima Convention Center, WA**
PNASH Presenter: Pablo Palmandez on Pesticide Safety and Heat Illness
- **March 3, 2014. Oxfam Stakeholder Meeting, PA**
Participant: Victoria Breckwich Vásquez represented PNASH and Sexual Harassment Prevention Program.
- **Dec 2-4, 2014. Washington State Horticultural Association Annual Meeting, Wenatchee, WA**
PNASH and Exhibit: Participants: Victoria Breckwich Vásquez and Kit Galvin
- **June 20, 2014. Washington Dairy Federation Meeting**
Participants: Victoria Breckwich Vásquez, Catherine Karr, Mike Yost, Peter Rabinowitz
- **September 25, 2014. CME - Recognition and Diagnosis of Pesticide Poisoning, September 25. Columbia Valley Community Health, WA.**
Presenters: Catherine Karr and Deborah Cherry
- **September 25, 2014. CME - Pesticides and Nitrates Health Risks, Toppenish Hospital, WA.**
Presenter: Catherine Karr and Maggie Willis

PRODUCTS & RESOURCES DEVELOPED

Motivational Videos for Farmworker Ladder Safety and Heat Illness Prevention

(NIOSH Supplement 2014, MAAF, 2012-2014)

This project has expanded the use of two recently PNASH-produced Spanish radio programs into educational videos for farmworker training. The program topics: to prevent ladder injuries; and heat-related illness, are in-demand and timely. <http://www.youtube.com/user/USagCenters>

Northwest Forest Worker Safety Review, April 2014

http://depts.washington.edu/pnash/forest_safety

New PNASH Center website resource pages:

- ❖ Northwest Forest Worker Safety, http://depts.washington.edu/pnash/forest_safety
- ❖ Sexual Harassment Prevention, http://depts.washington.edu/pnash/sexual_harassment
- ❖ Orchard Injuries, http://depts.washington.edu/pnash/orchard_injuries



NIOSH SPONSORED PROJECTS - COMPLETED FY2014

Feasibility 2: Development of a Work Stress Survey for Farmworkers (PNASH Small Grant 2012-2014)

PI: Diane Rohlman, Oregon Health Sciences University

Many factors impact the health of agricultural workers, including job demands, workplace hazards, limited resources, and access to medical care. Seasonal variations in work demand can also lower workers’ control over the work environment. These factors can increase the risk for adverse health effects in workers.

Although recent reports indicate that agricultural-related injuries and fatalities are declining, there has been an increase in stress-related behavioral health problems including suicide, depression, and substance abuse. Immigrant farmworkers, a large part of the U.S. agricultural labor force, may bear an undue share of these problems.

The goal of this project is to develop methods to assess workplace stress in agricultural workers and to identify the key stressors faced by agricultural families. This project builds upon the work begun in the PNASH project

“Neurobehavioral Assessment of Pesticide Exposure in Children” by continuing to study its cohort of agricultural workers and families. We have created a culturally appropriate questionnaire designed to evaluate stressors during high and low work demand times.

I would need to go back to school to get different work, but all the time I am working and then I am too tired. I tell my kids that they need to study.
- Project Participant

Both men and women reported experiencing depressive symptoms. During harvest, both men and women report increased stress and an increase in unhealthy habits, such as consuming more fast food and drinks with added sugar. However, their overall physical health remained

constant across work seasons. This could be due to increased physical activity during harvest, which could help to mitigate stress. Women reported lower support and control over their job compared to men. They also report experiencing more stress associated with conflicts between work and home and these conflicts increase during high work demand times.

The results of this study will help us to better understand the causes and impacts of occupational stress during times of high and low work demand for a unique population of Latino agricultural workers. We hope to create culturally appropriate interventions based upon the results of this study.

Resources

Diane Rohlman, Survey of psychosocial stressors faced by immigrant agricultural workers, 2014

Feasibility 3: Parkinsonism among Washington State Agricultural Pesticide Handlers (PNASH Small Grant 2012-2014)

PIs: Susan Neilson and Christopher Simpson

Previous human and animal studies suggest that some pesticides, including those typically applied by agricultural pesticide handlers, may increase the risk of parkinsonism (PS). Some epidemiological studies have indicated a 49% increase in parkinsonism in individuals who have had chronic occupational exposure to pesticides. However, evidence of a direct correlation between occupational exposure to pesticides and parkinsonism is still inconclusive and most human studies have solely looked at Parkinson’s disease. This study assessed feasibility of conducting neurological exams on active pesticide handlers, to determine



Screen shots from the recruitment video played at medical clinics.



the prevalence PS symptoms among this population, and to identify any correlation between PS symptoms and chronic occupational OP pesticide exposure. Recruitment for this study took place at two clinics in the Yakima Valley, interest among the community was so high that the number of interested parties surpassed the number of available clinic appointments.

This study is the largest assessment of parkinsonism signs and symptoms in agricultural workers to date, and the only one among workers with predominant exposures to organophosphorus/carbamate insecticides as opposed to manganese-containing fungicides. We were able to demonstrate the feasibility of conducting movement disorder exams among actively working agricultural pesticide handlers. In addition, we generated important new knowledge on human health effects of these classes of pesticides, in that our study provided minimal evidence that these classes of pesticides contribute to parkinsonism, and no evidence that parkinsonism is as prevalent in this group of workers as it is in selected other occupational groups (welders, manganese miners). We plan to seek funding to conduct follow up exams with these same workers, as well as to conduct other neurological assessments that may provide more objective and sensitive measures of potential neurological health effects of pesticides.

Feasibility 6: Understanding the Effects of Filipino Migrant and Immigrant Workers in the Fishing Industry in the Subarctic (PNASH Small Grant 2013-2014)

PI: Gabriel Garcia, University of Alaska

Migrant and Immigrant workers from the tropics working in Alaska face unique occupational health risks that had not been extensively studied before this pilot. This current research study was conducted to address this specific need. We aimed to establish relationships and trust among principal stakeholders in the fishing industry in Unalaska/Dutch Harbor; develop preliminary data to support subsequent research; support a new investigator to develop a line of research focused on migrant workers, and immigrants in commercial fishing; and expansion of PNASH's work in commercial fishing in Alaska.

Thank you for coming here to talk to us. I hope that the stories we've shared can help improve our working conditions

- Project Participant

A total of 30 in-depth interviews were conducted among Filipinos working in fish processing in two of the largest fishing industries stationed in Dutch Harbor area. Almost all of the interviews were conducted in Filipino (Tagalog). The average length of each interview was about 45 minutes. All interviews were digitally recorded, and transcription of the interviews was recently completed.

Through this study, relationships were formed with both formal and informal leaders in two major fishing industries as well as the Filipino community of Dutch Harbor/Unalaska. Moreover, relationships were established with three community-based organizations, including the local community health center.



Dutch Harbor, AK



NIOSH SPONSORED PROJECTS - CONTINUING

Res 1: Measurement of Farmworker Exposure to OP Pesticides through Protein Adducts

(NIOSH 2011-2016, UW Royalty Research Fund 2012)

PI: Christopher Simpson, University of Washington

Organophosphorus (OP) pesticides cause illness through inhibition of cholinesterase, a critical enzyme in the nervous system. Our previous work developed an assay that provides greater sensitivity and specificity as compared to traditional cholinesterase monitoring. The overall goal of this project is to improve methods for detecting overexposure to organophosphorus pesticides (OPs). Currently in Washington State, cholinesterase (ChE) activity is measured in farmworkers who are expected to have high exposures to OPs.

However, the ChE assay lacks sensitivity and specificity, resulting in a substantial number of false positives and false negatives. To improve

this assessment, we have developed an assay based on the compared measurements of OP-adducts to butyryl cholinesterase. The OP-adduct assay provides greater sensitivity and specificity as compared to traditional ChE monitoring, and it eliminates the need for collection of a baseline pre-exposure blood sample from each worker.



Washington State Pesticide Handlers Loading Pesticides for Spraying

During FY2014 we measured OP-BChE adducts and BChE activity in samples from cotton farmers and pesticide manufacturers in Pakistan. Analysis of this population of workers showed the adduct method to have good correlation with cholinesterase depression at high exposures as well as low. It also identified a group of workers who are at risk for pesticide poisoning. Further, we have begun to use the adduct method to identify risk factors associated with overexposure to OPs and susceptibility to the effects of OP exposure. Ultimately, we believe that this new assay will help to ensure that workers are adequately protected against overexposure to OP pesticides and the associated adverse health outcomes, by providing rapid feedback on exposure to workers and physicians.

Supplemental funding from the UW Royalty Research Fund enabled the evaluation of the association between OP exposure and alpha-synuclein (-syn) – a biomarker for Parkinson’s disease. Although the sample size was small, preliminary findings indicate that OP exposure was not associated with changes in -syn. However, there was a suggestion that a genetic polymorphism associated with low physiological levels of paraoxonase 1 – a gene involved in detoxification of OPs- was associated with higher risk for OP poisoning.

Publications

Marsillach J, Costa LG, Furlong CE. Protein adducts as biomarkers of exposure to organophosphorus compounds. *Toxicology* 2013. 307: 46-54. PMC3747771

Marsillach J, Hsieh EJ, Richter RJ, Maccoss MJ, Furlong CE. Proteomic analysis of adducted butyrylcholinesterase for biomonitoring organophosphorus exposures. *Chem Biol Interact* 2013. 203: 85-90.

Krenz JE, Hofmann JN, Smith T, Cunningham RN, Fenske RA, Simpson CD, Keifer MC. Determinants of butyrylcholinesterase inhibition among agricultural pesticide handlers in Washington State, 2006-2011. *Annals Occup Hyg*. 2014. 1-16.

Nielsen SS, Checkoway H, Zhang J, Hofmann JN, Keifer MC, Michael Paulsen, Farin FM, Cook TJ, Simpson CD. Blood α -Synuclein in Agricultural Pesticide Handlers in Central Washington State. *Environmental Research*. In Press.



Res 2: Using IPM to Reduce Pyrethroid Pesticide Exposures in Dairy Workers (NIOSH 2011-2016)

PI: Michael Yost, University of Washington

This project partners with Washington State University to reduce pyrethroid pesticide use in dairy operations by introducing Integrated Pest Management (IPM) practices in these workplaces. Since 2001, pyrethroid-related illnesses documented by the WS-DOH have quadrupled, suggesting that exposures to pyrethroid insecticides have been increasing both at home and in the workplace. Not only are pyrethroids harmful to workers, but they are also expensive to purchase and store. This project aims to evaluate new IPM strategies that reduce worker exposure as well as costs.

In FY2014 we expanded our network of partners in this study to include, local private practice large animal veterinarians, state veterinarians, dairy nutritionists, dairy producers, and an additional WSU Agricultural Extension Specialist. These new partners, along with the Dairy Federation and WSU co-investigator, expanded our ability to



reach out to dairy producers. This year we compared two IPM strategies at collaborating dairies: special animal feed (feed-through) and predatory wasps. The feed-through product is a feed supplement that prevents various types of adult flies from developing in and emerging from the manure of treated cows. Over the summer of 2014 project staff and students made weekly visits to participating dairies to collect fly traps, surface wipes, and worker urine samples. The comparison analysis is currently underway. Preliminary results show the feed-through product was

effective in controlling flies (based on fly counts) within one month after it was started and therefore pyrethroid use ceased. The dairy producer informed us that the feed supplement was easy to use and was overall happy with feed supplement's effectiveness. These are positive indicators for feed-through as a solution to reduce dependence on pyrethroids.

In addition, we continued our outreach to the dairy farm community and maintain a close collaboration with the PNASH Team members of the "One-health" dairy feasibility project to coordinate our work in this industry, share resources and support each other's project activities.

Prev 1: Reducing Agricultural Worker Risks through New and Emerging Technologies

(NIOSH 2011-2016, MAAF 2012-2013)

PI: Richard Fenske, University of Washington

Agricultural worker pesticide exposure and pesticide drift continue to be serious public health concerns in Northwest tree fruit production. Tree fruit production currently involves the use of high volumes of toxic pesticides, such as the OP pesticide azinphos-methyl. Personal protective equipment is the most commonly used form of protection among agricultural workers, however previous PNASH research has found that the use of personal protective equipment is no longer sufficient for protecting workers. The purpose of this project is to analyze the effectiveness of new pest control practices and application technologies in reducing worker exposure and drift.



Jane Pouzou and Pablo Palmandez in the field.



To evaluate the impact of a product substitution intervention, in FY2014 we developed a suite of laboratory methods for analysis of personal exposure samples for acetamiprid, a relatively new alternative pesticide with few published human exposure studies. PhD student, Jane Pouzou presented the results of our methods development work at the Semiahmoo Annual Occupational, Environmental and Public Health Conference in January 2014. During the past year we also completed dermal and exposure monitoring during field application for both azinphos-methyl and acetamiprid. Currently, due to an indication of a decline in acetamiprid use, we expanded our focus to include comparative risk analysis of nine different alternatives to azinphos-methyl. Data from the occupational exposure databases used for EPA exposure assessments obtained from AHETF/ARTF will be used in addition to the personal pesticide exposure data collected for handlers that applied azinphos-methyl and acetamiprid in Washington state.

For our second aim to evaluate new pesticide application technologies for drift reduction, we have continued our collaboration with WSU and will be piloting protocols in the field in Fall 2014. These new technologies will also be evaluated for pest control efficacy, allowing us the opportunity to evaluate how these might reduce worker exposures and pesticide drift. Orchard friendly tracers were identified for use during field studies investigating the off-target movement of pesticides during applications. PhD students job-shadowed a crop protection specialist during his rounds, learning about the tools used to make recommendations about fertility and chemical applications. This relationship provided the foundation for selecting the micronutrients, zinc, copper, and molybdenum for tracers. A pilot study using these micronutrients with different sampling methods will be conducted this fall.

We are working directly with industry, producers, and workers to ensure that the decision matrix used for adopting new pesticide products and spray technologies includes explicit recognition of worker health and safety concerns. Interviews with orchard managers and worker supervisors, show there is a willingness to participate in an orchard-to-to orchard notification system of pesticide applications. Such a system would allow proactive measures to be taken to protect agricultural workers and neighbors in nearby orchards from exposure to potential off-target movement of pesticides during an application.

Publications

Fenske RA, Lu C, Negrete M, Galvin K. Breaking the take home pesticide exposure pathway for agricultural families: workplace predictors of residential contamination. *Am J Ind Med* 2013. 56(9): 1063-71.

Prev 2: Ergonomic Evaluation of Emerging Technologies in the Tree Fruit Industry (MAAF 2009-2011, NIOSH 2012-2016)

PI: Peter Johnson, University of Washington

Tree fruit production activities, such as pruning and structural cutting, green fruit thinning, and fruit harvesting require high-intensity physical labor.. Traditionally, these activities are performed from the ground or from ladders. Now, new interventions are being introduced: innovations in hand-held tools (pruners), apple collection systems (vacuums and conveyors), and ladder replacements (mobile platforms). This project aims to perform ergonomic evaluations of these interventions, integrating productivity and safety evaluations into the process of developing new agricultural technologies.

"I appreciate you are worried about our safety at work and are doing something about it"
- Project Participant

In Fall 2013, we conducted the first ergonomic evaluation of a harvest-assist mobile platform compared to the conventional equipment, the orchard ladder. This harvest-assist equipment, the Bandit Xpress by Automated Ag



Systems, was named as one of the 2014 Top-10 New Product Winners the World Ag Expo 2014 in Tulare, California. Our partnership with the manufacturer and grower is critical. This study took place during the 1st year of manufacture and we were able to provide prompt feedback, with results that workers harvesting apples from the



Mobile Harvest-Assist Platform

platform had less impact on their bodies (shoulders and backs) and lower exertion than those harvesting apples using ladders. The harvest-assist technology eliminated several ladder related risks, including heavy full apple bags, long walks to the apple bin to empty the bags, climbing up and down ladders with heavy bags, and falls associated with ladder use.

Another accomplishment this year was the development and validation of a new method to measure repetitive arm motion. Repetition is a concern that arises from the workers' increased picking productivity when on harvest-assist platforms compared to ladders.

The project's Agricultural Ergonomic Advisory (AEA) group, provided guidance on assessing productivity and efficacy in a manner relevant to growers. Based on our discussion, we incorporated other ergonomic measures, such as muscle activity and the standardized Nordic Questionnaire into October 2014 study design and data collection. The AEA group is composed of representatives of growers and workers, extension faculty specialists, an ergonomist, a physical therapist, and manufacturers all with the interest in reducing injuries in the tree fruit industry.

Edu 1: Pesticide Safety in Tree Fruit: Translating Research, Overcoming Barriers (NIOSH 2011-2016)

PI: Nadine Lehrer, Chatham University, and Kit Galvin, University of Washington

The overall goal of this project is to minimize agricultural worker and family pesticide exposure in the tree fruit industry by translating and disseminating research results and overcoming barriers to pesticide safety practices, particularly those that affect the large Hispanic workforce in the Pacific Northwest. By translating research into an accessible and relatable form, orchard owners, managers, and handlers will be better equipped to protect workers and their families from potential pesticide exposure and illness. This project capitalizes on the expertise of two institutions, the University of Washington PNASH Center and the Washington State University Tree Fruit Research and Extension Center.

The Practical Solutions for Pesticide Safety handbook, developed by PNASH, incorporates the expertise of local growers to create an approachable "farmer-to-farmer" educational tool. The farm-tested, research based solutions included in the guide are designed to be simple to use and implement, yet highly effective in reducing exposure. In FY2014 we reached 161 Spanish and 169 English workers with training on the solutions. During follow-up phone interviews with 36 randomly selected participants, we asked about resulting changes made in their practice. Overall, participants reported changes to better protect themselves and others "Tell people around [close to me] when I'll spray." Also decontaminating PPE was mentioned frequently. Several of the

Practical Solutions for Pesticide Safety had been adopted or adapted including the mixing table, cement pad for scrubbing PPE, elevated PPE scrubbing surface, scrub brushes instead of a pressure washers for cleaning, lockers for everyday clothes (not just PPE), locked chemical storage area, and checking the local wind speed.

We often did not use the respirator because it was hot, and now we use it, we are more careful to keep it on.

"I told all the workers I supervise, 'notify neighbors when spraying.'"

"I learned about pesticides, and safety, and it was better explained than at my workplace."

- Training Participants



The handbook has become so popular that during FY2014 we applied for, and received, supplemental funding to produce 1000 handbook copies as well as training kits. Each kit contains a large poster featuring a photograph and/or illustration of the solution and the two associated key safety messages, a hands-on example of the solution, and curriculum for the educator. Testing of the kits took place during four WSDA Farmworker Education Program Workshops and kits are now ready for promotion among pesticide educators.

For the project aim to identify and address barriers in pesticide safety education, Dr. Lehrer completed data analysis of the three major views found in the Q-sort interview study of 49 stakeholders. Building on these results, four stakeholder working group (SWG) meetings were held with representatives of each of these views to examine results and hone in on projects that could be supported by all to improve health and safety in the tree fruit industry. The SWG decided to focus efforts on a training gap – farm supervisor training. Members developed a preliminary proposal, contacted partners, and began looking into existing trainings and remaining potential needs. The SWG is pursuing a sustainable solution for supervisor pesticide safety training in the next year.

Feasibility 5: Transmission of Microorganisms in Dairy Farms (PNASH Small Grant 2013-2015)

PI: Peter Rabinowitz, University of Washington

Dairy farming involves close contact between workers and animals, and exposure of both to environments including organic dusts that can be a source of microbial exposures. There is evidence that such microbial transmission can be a source of zoonotic disease in workers due to pathogens, but also evidence that some exposures may have positive health effects for dairy farming families and workers. Despite this, there has been little study of the task-based risk of microbial transmission in dairy farming, nor of work practice and other control measures to manage such exposures. This study addressed a number of priority areas for the Pacific Northwest Center for Agricultural Health. The emphasis of this study on microbial transmission practices in agriculture is aligned with the "safe and sustainable agricultural workplaces and communities" priority of PNASH. This ongoing project explores and stresses the mutually beneficial effect of measures to enhance human, animal, and environmental health in a "One Health" model. Sampling on dairy farms is near complete and we will begin to further explore and analyze the data in the coming year. We then plan to extend this pilot study into a more comprehensive study of biosafety on dairy farms, with task-based exposure assessment of microbial transmission risk, and creation of evidence based best practices for dairy farming.

GRAS²P Food Safety Video (PNASH Small Grant 2013-2014)

PI: Nicole Brunner, Washington State Horticultural Association

This project is integrating current pesticide safety standards into the video: Fieldworker Orientation and Food Safety/Orientation para el Trabajador Agrícola y Seguridad Alimenticia. The project period has been extended in order to integrate the new pesticide safety standards in the UW EPA's Worker Protection Standard (WPS). The new WPS rulemaking is expected in 2015.

Food safety has become a pressing interest for Tree Fruit industry with new FDA regulations and retailer standards. The cross-over between occupational safety and food safety standards is not well understood and there are few training resources available to employers and workers. This bilingual video will be used by growers and workers in WA and across the US to insure effective food safety practices. This product is being developed by the Washington State Horticultural Association and local partners under the program GRAS²P (Growers Response to Agriculture, Safe and Sustainable Practices).



OTHER FY2014 PNASH ACCOMPLISHMENTS

Additional accomplishments based on long-term outcomes from previous cycles or other, non-NIOSH sponsorship.

Washington Leaders for Conversations about Climate (UW School of Public Health 2012-2014)

PIs: Richard Fenske and Victoria Breckwich Vásquez, University of Washington

This project used a student/local champion and community-based participatory research model to launch conversations in rural parts of Washington State on the complex topic of climate change. The goal of these inter-generational teams was to develop a local understanding of the science and issues, including impacts specific to their communities. Five undergraduate students, from underrepresented minority and migrant farmworker families, worked as a team and within their own home communities - four distinct rural counties in Washington State. The students learned about climate change research, conducted community needs assessments, identified a community leader and developed a volunteer base to join them on this project. Public community education forums were held in three Hispanic farmworker communities and one mixed rural/urban community: Maple Valley (King County), Royal City (Grant County) and Granger (Yakima County).

There were 87 total participants engaged by these forums, and 54 of the adults completed a pre-post evaluation, querying their knowledge, attitudes and behavioral intentions concerning climate change. Among all the participants, most had a high school education or less (83%), were born in Mexico (85%), spoke Spanish at home (79%), and identified themselves as Latino/Hispanic (88%), and as Catholic (77%).

Overall, the results indicate that participants in these forums learned some basic information about climate change, that the forum affected their attitudes regarding climate change, and that most were ready to take action on climate change

Resources

Climate Change Lotería (Spanish)

Notification of Pesticide Applications to Minimize Workplace Exposures: A Feasibility Study (MAAF, 2012-2014)

PI: Richard Fenske, University of Washington

In May 2014, the Washington Department of Health (WA DOH) alerted state agencies and growers of spike in pesticide spray drift illness cases among tree fruit orchard workers. Over a two-month period, approximately 60 individuals were exposed to pesticides in 15 drift events, which is equal to the number of cases that the agency normally sees over the course of an entire year. Although specific active ingredient names are currently unavailable, reported health effects were eye and dermal irritation, nausea, and labored breathing. In response, WA DOH has renewed its call for improved communication between farms, sprayers, and crew members with



Pesticide Spraying in Eastern WA

“priority for prevention.” The overall goal of this project was to minimize pesticide exposures of work crews adjacent to orchards where applications take place. We evaluated the feasibility of a notification system that would allow supervisors to ensure workers are not located in areas where pesticide drift could likely occur. Detailed interviews with agriculture supervisors demonstrated that most orchard supervisory personnel are willing to participate in an orchard-to-orchard notification system that harnesses the capabilities of mobile technology. Because similar systems are already being used in the agricultural sector, only a worker-specific component would need to be added. We plan to continue working with the Washington tree fruit industry and Washington State University to seek a simple and cost-effective notification system that provides a feasible means by which to reduce



pesticide exposures at the workplace. A current proposal is the use of smart phones - users could indicate their intention to spray specific land and neighboring property owners could be automatically notified. This type of notification would permit neighbors to alter work patterns so that workers and families would not be in orchards adjacent to the areas at the time of pesticide applications.

Health and Safety of Women Agricultural Workers (MAAF 20013-2014)

PIs: Catherine Karr, Victoria Breckwich Vásquez and Elizabeth Torres, University of Washington and Radio Cadena El Proyecto Bienestar (EPB) partnership has addressed an important new community priority and a newly recognized issue in the field of occupational health: Sexual Harassment. The hidden nature of this issue profoundly impacts women’s ability to work safely. Because of the urgent nature of the issue, PNASH and Radio Cadena launched a one-year prevention campaign in eastern Washington with the primary goal to increase public awareness of the problem and to provide information on workers’ rights and training resources for workers and employers. Our partnership, along with a community advisory board, and focus groups of farmworker women, assessed the interrelationship between sexual harassment and worker health and developed audience-tested prevention strategies. Over the summer of 2014, community and industry education and outreach included: the development and distribution of 18,000 resource cards, broadcasting a 4-minute radionovela with a call-in show at Radio Cadena, delivery of a popular education play for male farmworker allies in partnership with the WA Department of Agriculture, and script development for a future workplace training video.



Worker Resource Card

This small project served as one step toward more comprehensive efforts to address sexual harassment. PNASH is working with regional and national partners in a proposed research-to-practice project, Research Young, New Agricultural Workers (REYNA) with the goals to: reduce sexual violence in agriculture and improve knowledge and resources, 2) strengthen the educational pipeline for young women in agriculture of low socio-economic status. The number of Latina women and girls entering agriculture (as migrant and seasonal workers) is increasing in Washington and the nation. The problem is timely, urgent and in need of a sustained response.

Resources

- WA Sexual Harassment Resource Cards (Spanish)
- Radio novella and call-in show (Spanish)



ADDITIONAL RESEARCH PUBLICATIONS

Additional publications based on PNASH projects funded in previous cycles or other, non-NIOSH sponsorship.

Adetona O, Simpson CD, Onstad G, Naeher LP. Exposure of wildland firefighters to carbon monoxide, fine particles, and levoglucosan. *Ann Occup Hyg.* 2013 Oct;57(8):979-91.

Armstrong JL, Dills RL, Yu J, Yost MG, Fenske RA. A sensitive LC-MS/MS method for measurement of organophosphorus pesticides and their oxygen analogs in air sampling matrices. *J Environ Sci Health B.* 2014 48(2):102-8.

Armstrong JL, Yost MG, Fenske RA. Development of a passive air sampler to measure airborne organophosphorus pesticides and oxygen analogs in an agricultural community. *Chemosphere.* 2014 Sep;111: 135-43.

Armstrong JL, Fitzpatrick CF, Loftus CT, Yost MG, Tchong-French M, Karr CJ. Development of a unique multi-contaminant air sampling device for a childhood asthma cohort in an agricultural environment. *Environ Sci Process Impacts.* 2013 Sep;15(9):1760-7.

Neitzel R, Krenz J, de Castro A. Safety and health hazard observations in Hmong farming operations. *J Agromedicine.* 2014 19(2):130-49.

Perla M, Rue T, Allen C, Krieger J, Karr CJ. Biomarkers of Insecticide Exposure and Asthma in Children: An NHANES 1999-2008 Analysis. *Arch Environ Occup Health.* 2014 Aug 22:0. [Epub ahead of print].

Perla ME, Rue T, Cheadle A, Krieger J, Karr CJ. Erratum to: Population-Based Comparison of Biomarker Concentrations for Chemicals of Concern Among Latino-American and Non-Hispanic White Children. *J Immigr Minor Health.* 2014 Jul 3. [Epub ahead of print]

Naeher LP, Barr DB, Adetona O, Simpson CD. Urinary levoglucosan as a biomarker for woodsmoke exposure in wildland firefighters. *Int J Occup Environ Health.* 2013 Oct-Dec;19(4):304-10.