

WASHINGTON
PACIFIC NORTHWEST AGRICULTURAL
SAFETY AND HEALTH CENTER

ANNUAL REPORT
FISCAL YEAR 2004

(October 1, 2003 to September 30, 2004)

WASHINGTON
PACIFIC NORTHWEST AGRICULTURAL SAFETY AND HEALTH CENTER
Annual Report for Fiscal Year 2004

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WASHINGTON

PACIFIC NORTHWEST AGRICULTURAL SAFETY AND HEALTH CENTER

I. EXECUTIVE SUMMARY

The Pacific Northwest Agriculture Safety and Health (PNASH) Center serves Alaska, Idaho, Oregon, and Washington in reducing occupational disease and injury among agricultural operators, workers, and their families. In recognition of the importance of all agricultural industries to the Northwest, our scope of work includes farming, fishing, and forestry industries. The PNASH Center's emphasis is on injury and illness prevention and health promotion. Our approach is to:

- Work in partnership with employers, workers, agencies and other research and service organizations
- Develop innovative research and intervention programs to find solutions
- Take solutions to the workplace through training, outreach, and participatory research

Calendar Year 2004 was the third year of this five-year program cycle and marked the completion of our small projects.

- **Pilot 2:** Finding Common Ground: Developing, Testing and Evaluating a Narrative Based Model for Presenting Safety Information in Two Socially Diverse Farm Communities
- **Prevention 1:** Development of a Community Theater Troupe: Health and Farm Safety Training for Hispanic Agricultural Workers
- **Education 2:** Document Development for Prevention of Tractor-Related Injuries and Fatalities
- **Feasibility 1:** Wildland Firefighter Injuries in Idaho and Montana
- **Feasibility 3:** Assessment of Farmers' Exposure to Smoke from Ag Burning
- **Feasibility 4:** Evaluation of the Worker Protection Standard Train-the-Trainer Model Curriculum

Each of these projects resulted in information and resources to improve the safety and health for people in agriculture and are described in the following report and accomplishments section.

The two five-year research projects are continuing for another two years:

- **Research 1:** Identification and Prevention of Injuries in NW Orchards
- **Research 2:** Workplace Determinants of Take Home Pesticide Exposure

Each has completed initial investigative activities and development of intervention prototypes, and is now moving to testing and analysis of the effectiveness of the proposed interventions.

Likewise, the project, Pilot 1: Developing, Testing and Objective Tool for Measuring Postural and Vibrational Exposures during Forestry and Agricultural Work, was successful in the evaluation of the Virtual Corset™, a small tool to measure and record upper body posture and movement.

The PNASH Center was also successful in the development of new project ideas and received funds for three two-year projects through NIOSH:

- Large Intervention: An Incentive Intervention Program to Encourage Ergonomic Behavior in Latino Farm Workers
- Small Education: Fluorescent Tracer Component for Hands-on Pesticide Handler Training
- Translation: Communication of Pesticide Health Risks for Children of Agricultural Families

In addition, we received support from other sources for two additional new projects.

The faculty and staff of the PNASH Center are pleased to have fulfilled our Year 3 research project objectives. Equally, we take pride in the leadership role we've taken among other national agricultural centers and the partnerships we've launched in the Northwest and the greater West.

A. CENTER ACCOMPLISHMENTS FOR FY 2004

1. Survey of orchard workers.

R1: Identification and Prevention of Injuries in NW Orchards

In Year 3, investigators completed Phase I of the study, which proposed to collect and compare data on injuries among workers in deciduous tree fruit from three population sources: worker compensation data, key informants, and worker interviews. The data obtained from these three sources are being brought together to identify key issues in orchard work that lead to the high rate of injuries. One clear theme emerges from all three sources of information: ladders are a major source of injuries in orchard work. Investigators were confident from early data returns and preliminary information that engineers were included in the project and methods for improving ladder safety were begun. Information from these sources will guide the development of a larger worker questionnaire designed to prioritize issues and a sensor equipped ladder that will be tested and applied to real life situations to help characterize and control injuries through warning workers about risk situations.

2. Field-testing of pesticide take home pathway interventions.

R2: Workplace Determinants of Take Home Pesticide Exposure

In Year 3, data analysis was conducted for the 2003 baseline study, nine manager/foreman interviews were conducted, the site walkthrough was completed, and three interventions were developed and field tested.

Conclusions from the 2003 baseline study results were that:

- Azinphosmethyl vehicle and house dust results provide additional support for the vehicle as a vector.
- Work clothes and boots are sources of pesticide residues in the home.
- Traditional clothes washing recommendations are not practical given the lack of clothes washers and dryers in worker homes.
- Exposure information is needed to better understand and interpret dust residue results.

Using the results of the baseline study as a starting point, three interventions were developed to minimize the possibility of pesticides being carried from the workplace into vehicles and then into the home:

- Thinners were given a work boot storage box and sandals so that they had an alternative to wearing their boots into their home.
- Thinners vacuumed their cars once a week using vacuums (equipped with high efficiency particulate air filters) located at a central location.
- Applicators used a locker room that was cleaned daily and had separate lockers for PPE and work clothes. Workers also washed off their boots before entering the locker room.

Approximately four weeks after implementing the interventions, subjects were interviewed and house and vehicle dust samples were collected. This project continues with sample and result analysis.

3. Completion of story telling project.

Pilot 2: Finding Common Ground: Developing, Testing and Evaluating a Narrative Based Model for Presenting Safety Information in Two Socially Diverse Farm Communities.

Year 3 marks the completion of this pilot study. This project defined and contrasted two narrative genres that communicate safety information to agricultural workers. It documented the appeal of informal stories and formalized narratives based on the responses of farmers with varying agricultural experience and knowledge. Results indicated the highly generative quality of informal stories; they usually stimulated further storytelling or higher level thinking about safety. When safety information was packaged in informal, unscripted narrative, receivers of the information added their own comments and evaluation to match or build upon the previous story. In contrast, pre-planned formal safety narratives may have given the impression of being official, complete, and beyond questioning. The informal stories, by their very nature, invited participation and engagement.

Based on preliminary findings, we suggest three hypotheses for future research:

- Informal stories are an effective tool in safety training.
- Stories need to have sensory impact.
- Stories must accommodate differences among learners, taking into account such factors as age, experience, type of farm, interests, and cognitive styles.

One of the tangible results of this preliminary study was the collection of 88 informal stories that are now available for use in safety interventions. The next step is to incorporate the informal stories into formal intervention strategies. A new intervention strategy that incorporates informal stories with more direct formats of safety instruction combines the best of both worlds of discourse.

4. Completion of Hispanic theater project.

Prevention 1: Development of a Community Theater Troupe: Health and Farm Safety Training for Hispanic Agricultural Workers.

The Hispanic theater project was previously successful in using theater to educate farm workers on safety concerns and health promotion strategies. In consultation with area producers and other educators, it was decided that theater troupes were too expensive to find sustaining support, so instead, plays were filmed and marketed in VHS and DVD format with a questionnaire to use in training.

In 2004 two videos in Spanish with English subtitles were completed and marketed on pesticide safety and reducing musculoskeletal injuries (ergonomics). They were marketed through press releases and direct contact and streamed on the Farm Center Web page. By the end of this year, orders were in from four grower associations, ten individual farms, and 11 other service organizations. A total of 52 videos were ordered, 30 of the pesticide safety video and 22 of the ergonomics video.

Overall, feedback from the grower associations, farm operators, and the organizations was positive. Of those who provide worker training, approximately 1,860 workers are expected to be trained. We will continue marketing and expect further orders for these videos. In addition to the videos, this project developed a duplication kit, enabling other organizations to produce the plays.

5. Completion of the National Agricultural Tractor Safety Initiative publication and launching the initiative.

Education 2: Document Development for Prevention of Tractor-Related Injuries and Fatalities.

This project brought together all the NIOSH Agricultural Centers in their first joint project to address a known problem area. The Centers worked together to develop an informed solution to the high fatality and injury rates from tractors. While this initiative is still underway, the development and launching of the initiative to national partners is a first step to implementing a plan that will reduce farmer injuries and deaths.

The National Agricultural Tractor Safety Initiative publication (See Appendix B) was a major focus of the PNASH Center in Year 3. From the period of October to March, activities revolved around the development of the document. March to July was the development of the final electronic and printed document, distribution, and launching to interested parties at the National Symposium on Agricultural Health and Safety in June 2004.

6. Completion of feasibility project on wildland firefighter injuries.

Feasibility1: Wildland Firefighter Injuries in Idaho and Montana.

This study looked at the two largest Northwest fires that burned in 2000: the Clear Creek fire in Idaho, and the Valley Complex fire in Montana. Our purpose was to review injuries that were documented on these fires, to determine if types of individuals, environmental factors, fatigue and/or fitness levels impacted the numbers and types of injuries.

We found that, while several of our hypotheses were difficult or impossible to validate with the available data, there was an elevated injury frequency rate for the T-1 “Hotshot” crews assigned to the Clear Creek fire. Injuries in the fire camp setting were a significant number, and offer opportunities to reduce injuries on future fires.

The study finishes by making recommendations to improve firefighter safety and reduce injuries, both on the fireline and among fire support personnel in the fire camp setting. It also proposes future research needs to better define the types of injuries, the resources affected, and the need to look at fire illnesses as another component of the wildland fire Health and Safety program.

7. Completion of feasibility project on agricultural burning.

Feasibility3: Assessment of Farmers’ Exposure to Smoke from Ag Burning.

In Year 3 this feasibility study was successfully completed with the target number of Ag burning activities. With the assistance from the Washington Wheat Growers’ Association, the Eastern Department of Ecology, and the Columbia Conservation District, 9 farmers participated in the study for a total of 10 burns. The results showed acute exposure at levels far higher than the EPA's National Ambient Air Quality Standard and the occupational standards for respiratory dust.

The study found that farmers' average exposure to respirable particulate matter (PM2.5) during typical field burning ranged between 111 and 7,949 micrograms/cubic meter over 0.6-3.0 hours. (The EPA considers exposure above 65 micrograms/cubic meter within 24 hours to be unhealthy, especially over extended periods.) Farmers with the highest PM2.5 exposure also showed high levels of biomass burning markers in their urine. Note that farmers did try to get out the smoke's way.

Study results have been communicated to the community through town meetings in Pullman and Spokane, Washington, June 7 and June 10, 2004, involving the Washington Ag Burning Task Force, the Washington Department of Ecology, and the public.

8. Conferences and continuing education courses.

Educ1: Agricultural Health and Safety Communication and Education Project. Pesticide Issues Conference, Yakima, Washington, February 18, 2004

Co-sponsored by the Washington State University Pesticide Education Program, Northwest Center for Occupational Safety & Health, this 2nd annual conference focused on the new Washington state pesticide monitoring regulations. This course brought together producers, workers/applicators, and health care providers. Plenary sessions

reviewed issues of pesticide toxicity and exposure. During concurrent breakout sessions, growers/managers, applicators/handlers, and medical providers were given information and materials on how best to comply. One hundred and forty people attended and the participant evaluation showed a high level of interest and the applicability of the program.

Western Regional Conference: Cultivating a Sustainable Agricultural Workplace, Troutdale, Oregon, September 12-14, 2004. This conference brought the latest research and practices to sustain workers' health and safety. The conference was designed such that the participants addressed how occupational safety and health can be integrated into sustainable agriculture practices and how research and outreach can contribute to that effort. The 110 participants were academics, producers, safety professionals, health care providers, worker advocates, and other service providers. Participant evaluation comments showed that many came away with project ideas, partnerships, and practical means to improve worker's social conditions.

B. REGIONAL ACTIVITIES

1. States Served by Center:

Alaska, Idaho, Oregon, Washington

2. States with Center Activity for FY 2004:

Alaska, Idaho, Oregon, Washington, Montana, Arizona, California, Hawaii

II. REPORT ON THE OUTREACH PROGRAM

In Year 3, the PNASH Center outreach program was conducted under the final year of project, Educ1: Agricultural Health and Safety Communication and Education. See pages 26 – 47 for this report. In Years 4 and 5, these activities will be continued under the Agricultural Communication, Outreach, and Education Program (ACOEP).

B. CENTER PROJECT REPORTS

ONGOING PROJECTS

No	Project Title	Project Investigators	Page
R1	Identification and Prevention of Injuries in NW Orchards	M. Keifer, M. Salazar, K. Kapur, K. Snyder, M. Negrete	8-14
R2	Workplace Determinants of Take Home Pesticide Exposure	R. Fenske, K. Galvin, C. Lu, M. Negrete	14-18
Pilot1	Developing, Testing and Objective Tool for Measuring Postural and Vibrational Exposures during Forestry and Agricultural Work	P. Johnson	19-21

CONCLUDED PROJECTS

Pilot2	Finding Common Ground: Developing, Testing and Evaluating a Narrative Based Model for Presenting Safety Information in Two Socially Diverse Farm Communities	M. Landa, P. Elkind, C. Woodruff, J. Safford	21-23
Prev1	Development of a Community Theater Troupe: Health and Farm Safety Training for Hispanic Agricultural Workers	P. Elkind, K. Pitts, C. Woodruff	23-25
Educ1	Agricultural Health and Safety Communication and Education Project	H. Murphy, P. Boiko, M. Harrington, S. Holland, E. Swenson	26-47
Educ2	Document Development for Prevention of Tractor-Related Injuries and Fatalities	R. Fenske, E. Swenson, M. Harrington, K. Galvin, S. Holland	47-49

A. PROJECT TITLE

R1: Identification and Prevention of Injuries in NW Orchards

B. PROJECT OFFICER(s)

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C. PROJECT DESCRIPTION

The primary goal of this study is to reduce occupational injuries among workers in the tree fruit industry. This project explores and characterizes the array of factors that contribute to the occurrence of injury of orchard workers and will develop, implement, and evaluate several technical interventions that are based on these identified factors. Specific aims are to:

1. Determine the most common types of reported and unreported injuries and near misses among orchard workers through interviews with orchard managers, orchard owners, health and safety personnel, and an examination of worker compensation data.
2. Prioritize the injuries and risk conditions that lead to injuries among orchard workers.
3. Use this information to develop targeted interventions aimed at reducing the frequency of risk conditions that lead to injury.
4. Develop sensor-based devices for ladders that can both monitor the occurrence of risk conditions and be adapted to warn workers of the condition.
5. Use sensor devices to evaluate the effectiveness and the cost-benefit of the interventions.

D. PROJECT START AND END DATES: October 1, 2001 – September 30, 2006

E. PROJECT ACTIVITIES / ACCOMPLISHMENTS

This project is designed to collect and compare data on deciduous tree fruit injuries from three population sources: worker compensation data, key informants, and worker interviews. Information from these sources will guide the development of a larger worker questionnaire which is designed to prioritize issues related to injuries in the deciduous tree fruit workplace. Guided by information from these sources, a sensor-equipped ladder will be designed tested and applied to real life situations to help characterize and control injuries by warning workers about risk situations. Phase 1: worker compensation, key informant, and worker interviews have been completed. Ladder design is underway and should be completed in February 2005. Testing of the instrumented ladder will follow and should be complete by June 2005. The project is largely on track to be completed as planned. Some delay has been encountered in adapting some sensors to the typical orchard ladder. Work continues as described below.

Worker Compensation Data

Data analysis of the Washington Worker Compensation data system for Region V (the main agricultural area of the state) was completed. 15,102 workers' compensation claims were extracted from L&I's database for years 1996-2001. The study sample consisted of all Region V claims classified as risk class 4803-02 (Orchards: Fruit Tree Crops) that were not rejected by L&I or filed with self-insured employers. While the original plan was to use SIC code 0175 (deciduous tree fruit), purveyors of the worker compensation system in Washington recommended that using the risk class would be a more efficient way to focus on the appropriate workforce.

Claims were categorized by key word search on several data fields and the data were analyzed by cause of injury in terms of frequency, severity, and cost. Of the 13,068 claims reviewed from this time period, 4,020 (30.8%) were found to have been ladder-related injuries. Additionally ladder-related claims accounted for nearly half (48%) of all compensable claims (e.g. claims involving time loss, disability, or loss of earning power, in addition to medical expenses). Claims related to ladders were not only the most frequent, but were also the most expensive as a group in terms of medical aid, time loss, and other costs. On a per claim basis, ladder-related injuries were among the most severe and costly reported injuries. Other common causes of injury among claims were branches and vegetation, structure and material, and ground-related injuries.

Data from claims were insufficient to identify the exact mechanism of injury, that is to say, how exactly the injury came about. Broader statements of cause were included with claims which suggested mechanisms such as “fell from,” “fell upon,” “struck by,” etc. but could not allow sufficient detail to focus on a specific engineering-based intervention. Based on the information collected from the summarized ladder injuries, we believe that continued work on interventions which focus on ladder safety is justified.

Worker Interviews

During the past year, data analyses on the orchard worker interviews has been completed. This qualitative study was designed to examine the factors that contribute to occupational risks related to orchard work. Twenty-five Hispanic orchard workers were interviewed. The most common type of accident (reported by 60 percent of participants) was falling from a ladder. An additional 12.0% reported a near miss that involved a ladder. Thus a total of 72.0 percent of participants reported either an accident or near miss involving a ladder. Ladder falls were related to the shifting weight of produce causing the workers to be unbalanced; slippery steps from rain, snow, or fruit residue; ladder being hit by a tractor; and catching feet in the wrungs of the ladder. The second most common type of accident was getting poked by branches and other objects. Other types of accidents included falling on slippery ground, getting hit by falling debris, being cut with shears, and tripping over wires or other objects in the orchard.

A total of 20 participants (80.0%) indicated that they sustained an injury while working in the orchards. The nature of these injuries varied, but the most common were strains and sprains, broken bones, eye injuries, and cuts and abrasions. Some workers reported “slicing their skin” on the sharp steps of ladder. Eye injuries often resulted from falling debris or protruding or rebounding branches.

Three broad categories of factors that contribute to the occurrence of injury were:

- Knowledge, attitudes, and behaviors, which included the following themes: having choices; feeling disrespected, behavioral influences (experience and training, assigning blame), and feelings of vulnerability
- Work-related factors included: relationship with boss (being treated fairly, employer demands, communication styles), quality and availability of equipment, accessing resources (water, sanitation facilities) and pay and pace of work

- Factors external to work included: environmental conditions (weather, condition of terrain) and regulatory issues (worker protection standard, ladder regulation, immigration laws)

When an injury occurs, workers often do not report it; and even if they do report it, they may not get compensated. Misunderstandings and misinformation often affects workers' actions following an injury. For example, some workers indicated that there were challenges related to *being believed* (i.e., “If no one sees you, they don't believe you” and “Out of shame, one doesn't even go get it looked at.”) and *delayed symptoms*: “Sometimes one can get hurt badly, but it's not until the next day that it starts to hurt.” More details about these issues are included in a manuscript which has been submitted for publication.

The findings from this study provide a poignant though troubling glimpse into the day-to-day lives of Hispanic orchard workers. The candid responses of the participants reveal that, for the most part, they are aware that risks are associated with their work; however, for the reasons stated, they have limited ability to avoid occupational injuries and illnesses. It is clear from these workers' comments that a multitude of factors increase worker's risk for injury; and that accidents in the orchards cannot be attributed to any single cause.

Although numerous factors affecting the occurrence of work-related injuries were identified in this study, the full contribution of these factors needs further exploration. The next phase of this study consists of a detailed survey which is intended to quantify and prioritize the factors that workers identified in this study. Additionally, it asks detailed questions about ladder incidents. The survey was used to guide a structured interview with nearly 200 Hispanic orchard workers. We are currently in the process of completing data entry and analyzing the data from these interviews. It is anticipated that this phase of the study will provide much more detailed information about injuries and their contributing factors. This information can then be used to develop more appropriate interventions.

Key Informant Analysis

An analysis of key informant interviews has been completed and a draft manuscript has been developed. The data point out the professionals who frequently deal with farm workers and farm worker injuries identify musculoskeletal and eye injuries as the major group of problems faced by workers. Ladders were consistently identified as a major cause of injuries. Lack of protective equipment was also identified as important. Several other factors identified as having an important bearing on the frequency of injuries included:

- Worker characteristics and responsibilities
- Employer factors
- “Inevitable nature” of agricultural injuries
- Economic, cultural and political factors

The key informant analysis also identified important contradictions within and between key information reports. These contradictions potentially represent important points of access for safety teaching through attempts at resolution of dissonance.

Triangulation

The data obtained from these three sources are presently being brought together to identify

key issues in orchard work that lead to the high rate of injuries. One clear theme emerges from all three sources of information. Ladders appear to be a major source of injuries in orchard work. This was an expected outcome and became apparent early on in this project. The investigators were confident enough from early data returns and preliminary information that engineers were included in the project and exploration of methods for improving ladder safety were begun in the first year of the study.

One task that remains to be accomplished is a method for data triangulation. This project has obtained the information from key informant interviews, worker compensation data and worker interviews. Based on this input we designed a questionnaire and will be analyzing the response of the working population of concern, the farm workers, to the issues raised in the previous components of the study. We have asked workers to prioritize these issues. The data collection for this process has been completed. Data analysis is underway. The project will also be exploring other methods for triangulating this information in the next year. At least one manuscript will come of these efforts before the project's end.

Making Orchard Ladders Safer

Work on the engineering aspects of improving the safety of orchard ladders continued. The first cause (not necessarily the most common but among the most important) of ladder injuries identified by the respondents was weight shifting causing the worker to lose balance and fall. We continue to work on designing an orchard ladder that can sense the position, weight, center of gravity and weight shift of the worker. Dr Kal Kapur (professor, Engineering) and graduate student Qiangmei Feng (Ph.D candidate, Engineering) and Heather Barr (masters candidate, Environmental and Occupational Health Sciences) continued their work on assembling components and adapting them to an orchard ladder. Assistance regarding design component options, such as data loggers and load cell choices, was provided by Dr. Peter Johnson, Department of Environmental and Occupational Health Sciences. The modifications envisioned included three primary instrumentation options:

- Sensors attached to ladder rungs to indicate location of the worker on the ladder.
- Load cells on ladder feet to determine total weight, changes in weight, and direction of shift.
- Goniometer (angle meter) to determine ladder leg spread and ladder base dimensions.

Strain sensors were attached to ladder rungs and were able to detect the presence of a person on the individual steps. Testing of the assembled equipment demonstrated that the sensors were able to detect the presence of workers, but preamplifiers were necessary to increase signal strength and a “tattle-tail” data logger was purchased for data logging from the various sensors. Some difficulty in isolating signals to single steps has been encountered. Some modifications in the strain gauge placement or the inclusion of specific mechanical activators are planned. Assistance from the University of Washington Marine Engineering Consulting Service has been obtained with the intention of exploring designs which can isolate worker position more effectively.

An outside consultant assisted us in developing stability models for three legged ladders. Charles Nordstrom (a naval consulting engineer) was contracted to develop the mathematical stability model (see attached appendix). Mr. Nordstrom worked with Drs

Kapur, Keifer and graduate students Barr and Feng. This led to the development of the white paper (See Appendix B), which characterizes the forces on the ladder which could lead to instability. With this model in hand we can determine the sensor data that would be needed to identify activities and conditions which would lead to unstable situations. Heather Barr will be testing the theoretical model against the sensor measurements once the fully instrumented ladder is assembled and functioning. Ms Barr is presently working on developing a working spreadsheet in which parameters such as weight, height and ladder base width can be changed and vectors for various ladder activities can be calculated.

By February 2005 we will have a completed working model of a sensing ladder. Tests of the ladder will first take place in a laboratory situation. Ms Heather Barr will take on the task of modeling worker ladder behavior and using sensor output in order to establish the sensor output profile of various activities.

F. PROJECT PRODUCTS

1. Presentations:

Barr H. Identification and Prevention of Injuries in NW Orchards: Analysis of Survey-based Worker Interviews on Risks and Hazards. Poster presentation at Western Migrant Stream Forum, January 30 - February 1, 2004, Seattle, WA.

Feng Q. Smart Engineered Ladders for Targeted Interventions to Prevent Injuries. Poster presentation at Western Migrant Stream Forum, January 30 - February 1, 2004, Seattle, WA.

Keifer M. Snyder K, Salazar M, Negrete M. Injuries and Other Occupational Health Issues of Northwest Orchard Workers. Panel presentation at Western Migrant Stream Forum, January 30 - February 1, 2004, Seattle, WA.

Salazar M, Negrete M. Perceptions of Occupational Health and Safety among Orchard Workers: A Descriptive Study, Western Migrant Stream Forum. Poster presentation at Western Migrant Stream Forum, January 30 - February 1, 2004, Seattle, WA.

Hoffman J. A Descriptive Study of Workers' Compensation Claims in Washington State Orchards. Poster presentation at the NIOSH Site Visit and Western Centers' Showcase, Davis, California, May 13, 2004.

Keifer M. Identification and Prevention of Injuries in NW Orchards. NIOSH Site Visit and Western Centers' Showcase, Davis, California, May 13, 2004.

Keifer M. Injuries in Northwest Orchards. Cultivating a Sustainable Agricultural Workplace. Troutdale, Oregon, September 12–14, 2004.

Barr H. Identification and Prevention of Injuries in NW Orchards: Analysis of Survey-based Worker Interviews on Risks and Hazards. Poster presentation at Cultivating a Sustainable Agricultural Workplace. Troutdale, Oregon, September 12–14, 2004.

Feng Q. Smart Engineered Ladders for Targeted Interventions to Prevent Injuries. Poster presentation at Cultivating a Sustainable Agricultural Workplace. Troutdale, Oregon, September 12–14, 2004.

Hofmann J. A Descriptive Study of Workers' Compensation Claims in Washington

State Orchards. National Symposium on Agricultural Health and Safety and Tractor Safety Initiative meetings, Keystone Resort, Colorado, June 20-24, 2004.

2. Publications

a. Peer Reviewed Journal:

Occupational Risk among Orchard Workers: A Descriptive Study. Submitted to Family & Community Health.

c. Fact Sheets / Brochures / Technical Publications:

Nordstrom C. Ladder Stability Model. Final Report. September 2004.

d. Other Publications:

Salazar M. Identification and Prevention of Injuries in NW Orchards. *Connections*, UW School of Nursing.

5. Other Products:

Consent Form: Worker Interviews (English and Spanish)

Questionnaire: Worker Interviews (English and Spanish)

Flyer: Recruitment for Worker Interviews (English and Spanish)

G. STATES THE PROJECT WAS ACTIVE IN

Washington

A. PROJECT TITLE

R2: Workplace Determinants of Take Home Pesticide Exposure

B. PROJECT OFFICER(s)

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C. PROJECT DESCRIPTION

Children of agricultural producers and workers can be exposed to pesticides and other agricultural chemicals if workplace chemicals are inadvertently brought into the residential environment. The purpose of this research is to prevent or reduce take home pesticide exposure among agricultural workers and their families in Northwest farming communities. This project will also result in new methods for the characterization of the take home exposure pathway, and for interventions to reduce children's exposures to pesticides. The specific aims of the project are to:

- Conduct vehicle and household dust sampling in a group of orchard workers and a reference group to determine the extent to which the take home exposure pathway contributes to residential pesticide residue levels.
- Conduct interviews with workers and managers, and conduct worksite walkthrough evaluations to identify the primary workplace determinants of the take home exposure pathway.
- Conduct an intervention at all study sites for which take home exposure is determined to be a significant contributor to residential pesticide residues.
- Evaluate the intervention by re-sampling vehicle and house dust of workers, and by review of worksite facilities and procedures.

D. PROJECT START AND END DATES: October 1, 2001 – September 30, 2006

E. PROJECT ACTIVITIES / ACCOMPLISHMENTS

Baseline Study (data collected summer 2003)

Data collection was completed for the baseline study after the harvest was over. Nine manager/foreman interviews were conducted and the site walkthrough was completed. The manager interviews covered workplace practices and included questions on pesticide safety training, personal protective equipment, changing areas, storage facilities for work clothes, laundry facilities, and pesticide use for the 2003 season.

Forty-four subjects participated in the 2003 baseline study. From a conventional orchard there were 16 applicator and 15 thinner subjects. Thirteen farm workers employed at an organic orchard served as controls. Preliminary results for house and vehicle dust residues showed relative geometric mean concentrations of azinphosmethyl in vehicle and house dust residues highest for applicators and lowest for the controls. For both applicators and thinners the geometric mean concentrations of dust residues were higher in vehicles than homes. Similar trends were shown for phosmet except that higher concentrations of phosmet were found in the homes of thinners than in homes of applicators. Chlorpyrifos pesticide residue results were lower than those for azinphosmethyl and phosmet. Residues in applicators' vehicles were higher than in their homes.

Results of the walkthrough checklist showed several differences between the applicators and the thinners. Applicators park their personal vehicles near the locker room and do not take them into the orchards. They have a personal locker in which they can store both their work clothes and their PPE. Facilities are available for washing the PPE. Applicators have hand washing facilities and hygiene facilities in the orchards and near the locker room. Thinners, however, park their personal vehicles in the orchards where they work for the day, have no locker facilities, and have access to hygiene facilities only in the orchard.

Farm worker responses to interview questions about work clothes and boots showed that about one-half of the applicators store their work boots and clothes (not PPE) in their homes. Two-thirds of the thinners store their boots and all of them store their work clothes in their homes. When subjects were asked if they usually wear their work clothes and boots into the house after work, 69% of the applicators and 87% of the thinners said they

wore their work boots. The responses for work clothes were 75% for applicators and 93% for thinners. Only 12% of the applicators and 47% of the thinners had clothes washers and dryers in their homes.

Conclusions from the 2003 baseline study results indicate that

- Azinphosmethyl vehicle and house dust results provide additional support for the vehicle as a vector.
- Work clothes and boots are sources of pesticide residues in the home.
- Traditional clothes washing recommendations are not practical given the lack of clothes washers and dryers in worker homes.
- Exposure information is needed to better understand and interpret dust residue results.

Intervention Study (data collected summer 2004)

Intervention design

Using the results of the baseline study as a starting point, three interventions were developed to minimize the possibility of pesticides being carried from the workplace into vehicles and then into the home. Members of the research team met with orchard managers, foremen, and members of the workplace health and safety committee to present the preliminary 2003 baseline data and discuss options for the intervention study. Criteria for the selecting the intervention were that the intervention eliminate or reduce pesticide use, be as close to the source as possible, be feasible and practical, and acceptable to both the employer and employees. Details of the interventions were finalized with the orchard staff and research after the meeting.

Key to selecting the interventions was that they take place at the workplace and not involve activities at home, such as clothes washing practices. While elimination at the source is the most desirable intervention, it was not feasible to eliminate the use of pesticides within context of 2004 intervention study. However, orchard management discussed steps currently in place in the orchard to reduce overall pesticide usage. Documentation of these steps will take place during 2005.

Three interventions were selected, two for the apple thinners and one for applicators. Thinners participating in the boot storage box intervention were instructed to put their work boots in a plastic box before leaving the orchard each day. These subjects were also provided with a pair of sandals so that they had an alternative to wearing their boots into their home. Thinners participating in the vacuum intervention vacuumed their cars once a week using vacuums (equipped with high efficiency particulate air filters) located at a central location they passed each day as they left the orchard.

The intervention for the applicators focused on keeping the locker room clean. A thorough cleaning of the locker room prior to application of azinphosmethyl and phosmet for the season and a daily cleaning was implemented along with separate lockers for PPE and work clothes. Workers were also to wash off their boots before entering the locker room. Interventions were implemented in May and June 2004.

Data collection instruments and methods were reviewed and modified for evaluation of the interventions. Supplemental questions were added to the 2003 questionnaire for each of the three interventions. These questions covered frequency and ease of following intervention procedures and questions as to what the subject did and did not like about the intervention procedures. Subjects' crew numbers were recorded so that an exposure metric could be determined based on crew work assignments and pesticide application records. Surface wipe sampling was added for the boot bins and locker rooms surfaces as an additional measure of evaluating the interventions.

Data collection and analysis

Approximately four weeks after implementing the interventions, subjects were interviewed and house and vehicle dust samples were collected. Eighty-four subjects participated in the 2004 intervention study. Subjects were interviewed and dust samples collected from their homes and cars. In addition, 23 surface wipe samples were collected from boot storage boxes and 22 from the applicator locker rooms. Wipe samples have been analyzed for five, azinphosmethyl (guthion), phosmet, clorpyrifos, malathion, and m-parathion.

Samples were processed (sieved for dust fines) and are currently being analyzed for five organophosphorus pesticides, azinphosmethyl, phosmet, chlorpyrifos, malathion, and methyl parathion. Questionnaires are being prepared for data entry. The 2004 management interviews, site evaluations, and records review (pesticide application and work crew assignments) are scheduled for after the harvest was completed to accommodate the managers' work schedules.

F. PROJECT PRODUCTS

1. Presentations:

Fenske R. Workplace Determinants of Take Home Pesticide Exposure. the NIOSH Site Visit and Western Center Showcase. Davis, California, May 13, 2004.

Galvin K. Pesticide Pathway Take Home Interventions. Cultivating a Sustainable Agricultural Workplace. Troutdale, Oregon, September 12–14, 2004.

2. Publications

a. Peer Reviewed Journal:

Preparing manuscript for 2003 baseline study.

c. Fact Sheets / Brochures / Technical Publications:

Fact Sheet: Worker recruitment (English and Spanish)

Fact Sheet: Intervention descriptions

d. Other Publications:

Fenske R. Protecting Kids from Pesticides. Pesticide Notes (newsletter), Washington Department of Agriculture, July 2004.

4. Conferences / Meetings Sponsored:

Fenske R, Galvin K, Lu C. Negrete M. Met with employer and stakeholders at site to present preliminary results and develop interventions, April 20, 2004.

5. Other Products:

Procedures: Interviewer instructions

Procedures: SOP 5: Surface Wipe Sampling Procedures

Consent Form: Agricultural Workers – Intervention (English and Spanish)

Questionnaire: Updated questionnaire with intervention evaluation questions

Questionnaire: Screening questions (English)

Intervention: Work Boot Box Intervention and Instructions (English and Spanish)

Intervention: Car Vacuuming Intervention and Instructions (English and Spanish) and Vacuum Check Out card (Spanish)

G. STATES THE PROJECT WAS ACTIVE IN

Washington

A. PROJECT TITLE

Pilot 1: Developing, Testing an Objective Tool for Measuring Postural and Vibrational Exposures during Forestry and Agricultural Work

B. PROJECT OFFICER(s)

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C. PROJECT DESCRIPTION

The long term objectives of this two-year pilot study were to develop, test and validate a portable, ambulatory exposure assessment system for the simultaneous measurement of upper extremity postural and vibrational exposures in agricultural and forestry workers. These were completed in the second year.

Goals for the third year of the project were to:

- 1) Resolve the data logger's resetting problem.
- 2) Completing programming of T-HAVS system.
- 3) Announcing the Virtual Corset tool to the occupational research community.
- 4) Field-testing the Virtual Corset on an agricultural population.

D. PROJECT START AND END DATES

October 1, 2001 – September 30, 2005 (proposed end date)

E. PROJECT ACTIVITIES / ACCOMPLISHMENTS

The development of the Virtual Corset was accomplished by Year 2, so the goals for Year 3 were the last stages of the project.

Minor data collection problems were identified during pilot tests with the Virtual Corsets conducted in Year 2. Periodically the data loggers reset themselves and stopped. This was resolved in Year 3 through reprogramming the firmware. The T-HAVS system was built in Year 2, but contained a microprocessor whose programming was completed in Year 3.

With the final Virtual Corset in place, promotion activities took place in Year 3. Dr. Pete Johnson forwarded the tool to colleagues and currently, investigators the University of British Columbia are using the tool to collect ergonomic data in the workplace. For articles and announcements please see the product listings below.

Plans were pursued for field-testing the Virtual Corset on asparagus workers in the Spring of 2004. This was in coordination with the SHARP Program at Washington State Labor and Industries and the Washington Asparagus Commission. Despite the interest of the Washington Asparagus Commission, we were unable to recruit employers to participate in

time to test during the asparagus harvest season. This aim has not been met and we would like to continue into Year 4 to field test on an agricultural population. The project PI will work with the Department of Occupational and Environmental Health Sciences' Field Group to conduct field-testing. The Field Group is a consultative and investigative research team that works directly with employers, and we anticipate that this partnership will enable the field-testing of the Virtual Corset.

Summary of the Virtual Corset

PNASH, in conjunction with Microstrain, Inc., has developed a new logger to assess postural and vibrational exposures to agricultural workers. This tool allows researchers to continuously collect data on workers while they work, over the course of one or multiple days. Studies using the Virtual Corset will better develop our understanding of the relationship between cumulative exposure to vibration, posture, and musculoskeletal disorders. This tool has been disseminated to researchers to use in field investigations.

The Virtual Corset is a logger that measures both back flexion/extension and side-to-side bending simultaneously and can be programmed to measure limb rotation. The device is a pager-sized logger with 2 MB of memory that can be mounted on the sternum or upper back of the individual. The logger, weighs only 6 ounces, has 1 Gigabyte of memory, and contains a microprocessor so it can turn itself on and off in order to collect data unattended over several days. The large memory capacity of the logger makes the ambulatory collection of data possible where previously it had not practical (e.g. vibrational exposures where the collection of exposure has to be performed at high sample rates).

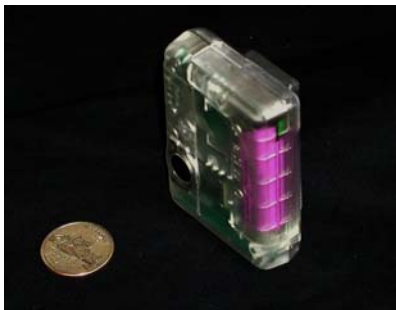


Figure 1: Virtual Corset miniature two axis posture measurement system with 2 Mb of memory.

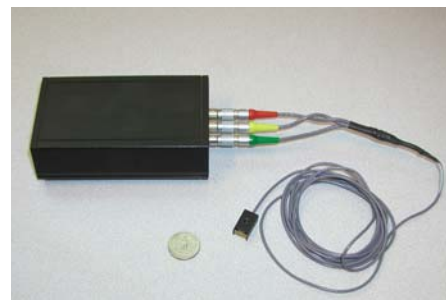


Figure 2: T-HAVS, 1 Gb logger and tri-axial accelerometer system.

F. PROJECT PRODUCTS

1. Presentations:

Johnson P. Tool for Measuring Postural and Vibrational Exposures. NIOSH Site Visit and Western Centers' Showcase, Davis, California, May 13, 2004.

2. Publications

d. Other Publications:

Harrington M. NIOSH Agricultural Center Develops a New Research Tool, NIOSH E-News, Vol 1 No 7, November 2003

Johnson P. The Virtual Corset – A New Logger for the Ambulatory Assessment of Physical Exposures. Ag Connections, Vol 1 No 4, Autumn 2003.

Status updates reported through the PNASH internal, monthly, e-newsletter.

5. Other Products:

The Virtual Corset, a miniature two-axis posture measurement system with 2 Mb of memory.

G. STATES THE PROJECT WAS ACTIVE IN

Washington, Vermont

A. PROJECT TITLE

Pilot 2: Finding Common Ground: Developing, Testing, and Evaluating a Narrative-Based Model for Presenting Safety Information in Two Socially Diverse Farm Communities

B. PROJECT OFFICER(s)

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C. PROJECT DESCRIPTION

The focus of this study was to compare two communication models most reflective of the shift from inter-generational family farming to non-intergenerational farming. The aims of the project were to:

- Identify the discourse features of informal farm stories.
- Analyze farm intervention strategies to determine the role embedded stories may play.
- Present both informal and formal texts to both large and small-scale farmers to elicit attitudes toward the two types of stories.
- Identify variables that would allow quantitative testing of the use of informal stories in

farm safety interventions.

The project focused on gathering accounts of accidents and near misses with farm equipment and farmers' eliciting responses to the stories. We conducted five interviews with intergenerational farm families resulting in 88 informal stories. These stories were analyzed to find their main discourse features. They were defined in terms of their references to social relations, rhetorical structure, linguistic features, and tone. We have also presented samples of these informal stories in contrast to formalized narratives to four separate focus groups. We elicited responses to the two types of stories from a total of 32 farmers.

D. PROJECT START AND END DATES: October 1, 2001 to September 30, 2004

E. PROJECT ACTIVITIES / ACCOMPLISHMENTS

Year 3 marks the completion of this pilot study. Year 3 focused on completing the data analysis, writing a final research paper, and presenting project findings at agricultural professional meetings.

This project defined and contrasted two narrative genres that communicate safety information to agricultural workers. It documented the appeal of informal stories and formalized narratives based on the responses of farmers with varying agricultural experience and knowledge. Results indicated the highly generative quality of informal stories: that is, they usually stimulated further storytelling or higher level thinking about safety. When safety information was packaged in informal, unscripted narrative, receivers of the information added their own comments and evaluation to match or build upon the previous story. In contrast, pre-planned formal safety narratives may have given the impression of being official, complete, and beyond questioning. The informal stories, by their very nature, invited participation and engagement.

Based on preliminary findings, we suggest three hypotheses for future research:

- Informal stories are an effective part of safety training.
- The stories need to have sensory impact.
- The stories must accommodate differences among learners, taking into account such factors as age, experience, type of farm, interests, and cognitive styles.

One of the tangible results of this preliminary study was the collection of 88 informal stories that are now available for use in safety interventions. The next step is to incorporate the informal stories into formal intervention strategies. A new intervention strategy that incorporates informal stories with more direct formats of safety instruction combines the best of both worlds of discourse.

Please see Appendix B for a copy of the final report.

F. PROJECT PRODUCTS

1. Presentations:

Landa M. Developing a Story-based Model for Presenting Safety Information, NIOSH Site Visit and Western Centers' Showcase, Davis, California, May 13, 2004.

2. Publications

c. Fact Sheets / Brochures / Technical Publications:

Landa M. Finding Common Ground: Developing, Testing and Evaluating a Narrative Based Model for Presenting Safety Information in Two Socially Diverse Farm Communities. Final Report, 2004.

Landa M. Developing a Story-based Model for Presenting Safety Information (edited volume pending).

5. Other Products:

88 informal farm safety/hazard stories

G. STATES THE PROJECT WAS ACTIVE IN

Washington

A. PROJECT TITLE

Prev1: Development of a Community Theater Troupe: Health and Farm Safety Training for Hispanic Agricultural Workers

B. PROJECT OFFICER(s)

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C. PROJECT DESCRIPTION

During the first two years of the project we learned that it is too costly and labor intensive for a group to adopt an ongoing community safety play program. In Year 3 of the project, we changed our strategy to marketing the video productions of two of the community plays. The following were Year 3 objectives:

- Revise the pesticide safety and the ergonomics videotapes.
- Market these videos.
- Stream portions of these videos on the Farm Center Web page.
- Design a questionnaire to accompany each video.
- Conduct an evaluation of grower participation.

D. PROJECT START AND END DATES: October 1, 2001 to September 30, 2004

E. PROJECT ACTIVITIES / ACCOMPLISHMENTS

In March of 2003, the ergonomics play was filmed at Yakima Valley Technical Skills

Center studio. The pesticide and ergonomics videotapes were revised to enhance the quality of sound and lighting and English subtitles were added. The videos were available for distribution beginning June 2003 and a marketing campaign was developed to promote the videos. Portions of them were streamed on the Farm Center Web page for review purposes. A questionnaire was designed to accompany each play video and advertised on the Web site. A summary of marketing strategy and grower participation follows.

News releases were sent to newspapers and many of the TV and radio outlets in the Columbia Basin and Wenatchee areas. Special interest publications and Hispanic newspapers were targeted. A Center research assistant followed-up with phone contacts to newspapers and radio/television stations. Thirty-seven media phone contacts were made and received the news release. Several medical centers, major grower organizations, and individual farms were contacted.

In addition to the four grower associations and ten individual farms, the following organizations ordered videos: Oregon OSHA Resource Center; Laupus Library, Greenville, North Carolina; Sunnyside Community Hospital; Washington Friends of Farms & Forests; Texas A & M School of Public Health; Wenatchee Valley College; Yakima Valley Regional Library and the Washington State Migrant Council.

A total of 52 videos were ordered, 30 of the pesticide safety video and 22 of the ergonomics video. There were an additional 14 contacts made that chose not to order the videos. Overall, feedback from the grower associations, farm operators, and the organizations was positive. Of those who provide worker training, approximately 1,860 workers were expected to be trained. Due to harvest demands, we were unable to obtain feedback from six farms. Fourteen of the twenty-two participant groups responded to evaluation questions.

Comments from growers associations, individual farms and organizations included: “This is helping me a lot,” “let me know if you have more materials,” “the quality of the video varied from great to good,” “wish you had more.” Grower associations noted there were several stereotypical comments in the video, such as “time is money,” and at times the English subtitles ran too fast; the video was not filmed in a farm setting but in a studio; and it may be difficult to get macho guys to do the warm-up exercises to reduce musculo-skeletal injuries.

Please see Appendix B for a copy of the final report.

F. PROJECT PRODUCTS

1. Presentations:

Pitts K. Evaluating the Communication of Farm Safety Information Through Community Theater. Poster presentation at Future of Rural Peoples Conference, Saskatchewan, Canada, October 19-23, 2003.

Pits K. Evaluating the Communication of Farm Safety Information Through Community Theater. Poster presentation at 2004 Migrant Farmworker Stream Forum, Seattle. Hispanic Theater Poster presentation,

Pitts K. Evaluating the Communication of Farm Safety Information Through Community Theater. Poster presentation at the NIOSH Site Visit and Western Centers' Showcase, Davis, California, May 13, 2004.

Pitts K. Evaluating the Communication of Farm Safety Information Through Community Theater. Poster presentation at Cultivating a Sustainable Agricultural Workplace Conference, Troutdale, Oregon, Sept. 12-14, 2004.

2. Publications

d. Other Publications:

Press release

Articles: Wenatchee World; Yakima Valley Business Journal; Yakima Herald-Republic; Walla Walla Times; Record-Bulletin, Prosser; The Outlook, Othello; Grant County Journal, Ephrata; and the Capital Press.

Swenson E. Development of a Community Theater Troupe: Health and Farm Safety Training for Hispanic Agricultural Workers. Ag Connections, Vol 2 No 2.

3. Education / Training / Outreach

f. Other:

Videos: Spanish language safety plays: Pesticide Safety and Reducing Musculoskeletal Injuries (with English subtitles) In VHS and DVD format and streamed on the Farm Center Web page.

Questionnaires: Two "quick" test questionnaires with answer keys and photonovelas for each play to accompany videos.

G. STATES THE PROJECT WAS ACTIVE IN

Washington, Idaho, Oregon, California

A. PROJECT TITLE

Educ1: Agricultural Health and Safety Communication and Education Project

B. PROJECT OFFICER(s)

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C. PROJECT DESCRIPTION

This project had an overall goal to develop, disseminate, and evaluate agricultural safety and health information to agricultural workers, their families, and others in professions who work with this topic. Information was selected from Center research, prevention and intervention, and education and outreach projects, as well as materials generated on a national level. Specific aims included:

Aim 1. Develop a partnership with the Agricultural Health and Safety Center at UC Davis to sponsor an annual Western Regional Conference

Aim 2. Conduct workshops based on the research priorities established in the Center's Hazard Priority Ranking process for northwest farming and forestry

Aim 3. Provide professional education in collaboration with the University of Washington's Northwest Center for Occupational Health

Aim 4. Maintain and revise the PNASH Web page

Aim 5. Disseminate information, including professional and non-professional presentations, newsletters, and other informational materials

D. PROJECT START AND END DATES: October 1, 2001 – September 30, 2004

E. PROJECT ACTIVITIES / ACCOMPLISHMENTS

In the third and final year of the communication and education project, major activities took place on all 5 project aims. While these aims were accomplished, they are also the ongoing aims for the PNASH Center's outreach program as funded in Year 4 and 5 under the Agricultural Communication, Outreach, and Education Program (ACOEP).

A significant change in Year 3, was the change in project leads. In February of 2004, Dr. Patricia Boiko, PNASH Director of Outreach, left the PNASH to pursue her documentary film making interest. Before she left, she led and hosted the Pesticide Issues Conference and called the newly formed Outreach Advisory Board together for their first meeting.

In May of 2004, the PNASH Center hired Helen Murphy, as the new PNASH Director of Outreach and Lead of the communication and education project (See Appendix B for Murphy's biosketch). Murphy brings a wonderful mix experience in health care, epidemiology, educational intervention development, and participatory research. She has a background in nursing and public health. Much of her life's work has been conducted internationally, but she spent much of her nursing career in the Northwest and most recently worked with Washington Department of Health. She had been active in agricultural safety and health in the West and was a known colleague through her participation in meetings and conferences.

Following are PNASH's activities and accomplishments under each of the project's stated aims.

Aim 1. Develop a partnership with the Agricultural Health and Safety Center at UC Davis to sponsor an annual Western Regional Conference

The third annual Western Regional Agricultural Safety and Health Conference, Cultivating a Sustainable Agricultural Workplace, convened September 12-14, 2004, in Troutdale,

Oregon. The venue—McMenamins Edgefield— was most appropriate to the theme. It is the former Multnomah County Poor Farm, where residents once sustained themselves and supplied other county facilities by their agricultural production.

Cultivating a Sustainable Agricultural Workplace brought to light worker safety and health as an essential part of social equity, one of the three branches of the field of sustainable agriculture: environment; economics; and equity. The conference was designed so that the participants could address how occupational safety and health can be integrated into sustainable agriculture practices and how research and outreach can contribute to that effort.

Continuing education credit was offered to:

- Safety and environmental health professionals
- Industrial hygienists
- Nurses
- Physicians (Category 2 CME)

Planning

Conference planners from the PNASH Center, the Western Center, and regional partners convened in a series of planning meeting winter and spring of 2004. The planning committee consisted of:

Chuck Benbrook, Benbrook Consulting Services
Chris Feise, WSU Center for Sustaining Agricultural and Natural Resources
Richard Fenske, Pacific Northwest Agricultural Safety and Health Center
Marcy Harrington, Pacific Northwest Agricultural Safety and Health Center
Steve Hecker, University of Oregon, Labor Education & Research Center
Ketty Mobed, Western Center for Agricultural Health and Safety
Ron Strohlich, California Institute for Rural Studies
Eric Swenson, Pacific Northwest Agricultural Safety and Health Center
Jennifer Weber, University of California Statewide IPM Project

Planners developed specific aims to:

- Gather experts and interested stakeholders in agricultural worker safety and health and sustainable agriculture from throughout the West
- Foster the development of collaborative relationships
- Stimulate discussion through didactic and participatory sessions
- Help participants understand the meaning of sustainable agriculture and associated worker health and safety issues

Promotion

The conference was promoted in spring – summer of 2004 with a Web site, brochure, and by placing announcements through calendars, newsletters, and list serves. A contact database was developed and the brochure was direct mailed to 1300 contacts in agriculture, sustaining agriculture, occupational health and safety, health care, and labor throughout the far West. Announcements were placed through 93 organizations. The Web site will be

maintained for one year after the event with the proceedings posted for downloading in pdf format, <http://depts.washington.edu/pnash/conf04/index.html>.

Program

Sunday, September 12

2:00 Tour of Columbia Gorge

(Blackberry Hall)

3:30 Registration and poster set-up

7:00 Poster reception with light dinner fare

Monday, September 13

(Blackberry Hall)

7:00 Registration and continental breakfast

8:30 Welcome Richard Fenske, PNASH

Marc Schenker, Western Center

8:45 Keynote - *Making the Workplace Safe, Healthy, and Sustainable*
Karla Chambers, Stahlbush Island Farms, Inc.

9:30 *Sustaining the Worker*, Richard Fenske, PNASH

10:00 Break

10:30 *Sustainable Agriculture: Global, National, and Regional Trends*
David Granatstein, Washington State University

Key Issues

- 11:00** *Current Workplace Practices and Challenges*
Jim Cochran, Swanton Berry Farms
Ann Thrupp, Fetzer Vineyards
Lon Inaba, Inaba Produce Farms
Eric Swenson, PNASH, *moderator*
- 12:15** Lunch
Thematic Table Discussions
- 1:30** *Organic vs. Conventional Farming and Worker Safety and Health*
Paul Jepson, Oregon State University
Rupali Das, California Department of Health Services
Dain Craver, DAC Consulting
Helen Murphy, PNASH, *moderator*
- 2:45** *International Standards and Certification and Sustainable Practices*
Aimee Shreck, University of California, Davis
- 3:15** Break
- 3:45** *Stoop Posture and its Effects on Workers*
Fadi Fatallah, Western Center
- 4:15** *Developing Worker Health Standards in Sustainable Agriculture*
Chuck Benbrook, Benbrook Consultant Services
Scott Exo, Food Alliance
Mike Gempler, Washington Growers League
Erik Nicholson, United Farm Workers of America, AFL-CIO
Chris Feise, Washington State University, *moderator*
- 6:00** Dinner (Ballroom)
- 7:15** *Sustainability through Native American Eyes*
Judy Bluehorse Skelton, herbalist, educator, writer

Tuesday, September 14

(Blackberry Hall)

- 7:00** Continental breakfast

Emerging Issues

- 8:30** *Health, Safety, and Mega Dairy/Cattle Farms*
Frank Mitloehner, University of California, Davis
- 9:00** *Zoonotic Diseases and Worker Health*
Bruno Chomel, University of California, Davis
- 9:30** *Aquaculture: Worker, Public, and Environmental Health Issues*
Brad Warren, Pacific Fishing magazine

Supporting Sustainability

- 10:00** *Setting Policy*, Martin Goebel, Oregon Sustainability Board
- 10:30** Break (hotel checkout)
- 11:00** *Establishing a Research and Outreach Agenda to Integrate Safety and Health into the Sustainable Ag Workplace*, Helen Murphy, PNASH, *facilitator*
- 12:30** Lunch Research and Outreach Agenda Report

Research Showcase

2:15 Concurrent Sessions

Track I: Characterizing Injuries and Illness

Injuries in Northwest Orchards, Matthew Keifer, PNASH

Health among Farmer and Farm Worker Populations, Marc Schenker, Western Center

Survey of Adolescent Injuries on California Farms, Steve McCurdy, Western Center

Track II: Preventing Injuries and Illness

Pesticide Take-home Pathway Interventions, Kit Galvin, PNASH

Safety Training for Employers and Supervisors of Adolescent Farm Workers

Barbara Lee, National Children's Center for Rural and Ag Health and Safety

Hygiene Activities to Reduce Farm Worker Home Dust Pesticide Levels

Linda McCauley, University of Pennsylvania

3:45 Closing Remarks Richard Fenske, PNASH

Poster Presentations

Comparing Cholinesterase Assays Used to Detect Pesticide Exposure and Chemical Terrorism. Daniel Arrieta, University of California, Davis

Identification and Prevention of Injuries in Northwest Orchards: Analysis of Survey-Based Worker Interviews on Risks and Hazards. Heather Barr, University of Washington

Farm Work and Preterm Low Birthweight Delivery Among Hispanic Women. Jeffrey Bethel, University of California, Davis

An Initial Investigation into Issues of Environmental and Occupation Concerns of Yakima Valley Residents. Noe Cardens, Marisela Velazquez, Maria Valencia, ConneX Program Northwest Community Action Center.

Smart Engineered Ladders for Targeted Interventions to Prevent Injuries. Qianmei Feng, University of Washington

What Does The Institute of Medicine Gulf War and Health Panel Report (Volume 2) Suggest with Regard to Future Investigations of Pesticide Chemicals? David Goldsmith, George Washington University

Pesticide Health and Prevention, Collaboration with Native American Communities: The EPA-Supported Tribal Medicine Program. David Goldsmith, George Washington University

Pesticides, Genetics and Risk of Parkinson Disease – Pilot Study Update. Anne Greenlee, Marshfield Clinic Research Foundation

Agricultural Work, Migration and Acculturation In Female Mexican Migrants. Tamara Hennessy, University of California, Davis

Health and Safety Awareness for Working Teens in Agriculture: A New Curriculum for Agricultural Educators in Washington State. Darren Linker, University of Washington

Agromedicine and Sustainable Agriculture—A Fertile Field for Collaboration:

Nutritional Gardens, Engineering Healthier Implements. Carol Maxwell, North Carolina Agromedicine Institute; Bryan Green, Center For Environmental Farming Systems

University of California, Davis Farmer Health Study: Third Survey of the Cohort. Diane Mitchell, University of California, Davis

A View from the Field: How Communities Members Feel About the Research done in their Communities. Maria Negrete and Helen Murphy, PNASH, University of Washington.

Evaluating the Communication of Farm Safety Information Through Community Theater. Kathy Pitts, Eastern Washington University

Social Sustainability, Farm Labor, and Organic Agriculture: Findings From an Exploratory Analysis. Aimee Shreck, University of California Sustainable Agriculture Research and Education Program & Department of Environmental Science, Policy, and Management, University of California, Berkeley

Agricultural Fatalities: The Washington State Face Assessment & Control Evaluation (FACE) Program. Tom Sjostrom, Washington State Department of Labor & Industries / SHARP

Northeast Spanish-Speaking Dairy Workforce Study. Suzanne Stack, New York Center for Agricultural Medicine & Health

Modeling Deposition form an Aerial Spray Application. Michael Yost, PNASH, University of Washington.

Program and Conference Result

The conference drew 110 participants, bringing in more people than our target of 100. One remarkable feature of this conference was the broad range of participants, both by discipline and geography. In addition to Oregon, California, and Washington, attendees came from Idaho, Hawaii, Nevada, and as far away as North Carolina. A little more than half of our 110 conferees were from academia, including 12 students. Almost a quarter came from public (mostly western state) agencies. Producers, business people, private consultants, and several non-profit organizations were well represented, with health care providers, labor representatives, and members of the Yakama and Paiute Nations also attending.

The conference keynoter was Karla Chambers, co-owner of Stahlbush Island Farms, a 2,000-acre sustainable family farm in Corvallis, Oregon. A fifth-generation Oregon farmer, she immediately underlined equity as one of the “Three Es” that define sustainable agriculture—Environment, Economics, and Equity. Chambers said she and her husband began farming sustainably because they “didn’t want to ask our workers to do anything that we were no longer willing to do.” Their commitment to workplace equity continues with worker benefits, including a retirement plan; good wages, and good housing.

More than 25 other speakers addressed the forum on topics as diverse as worker standards, zoonotic diseases, new safety interventions, and injuries to workers in both California and the Northwest. Dinner speaker Judy BlueHorse Skelton, a Portland herbalist, educator, and writer talked about “Sustainability through Native American Eyes.” She saw agricultural products such as corn and salmon not as resources to be extracted, but as relatives to be cherished so they can continue to nourish us. But Skelton emphasized that, “when we say salmon is our brother, we are not speaking as though it were a child’s story about salmon. It’s that we should treat salmon with respect because it’s like a brother.”

One conference aim was to showcase sustainable agriculture success stories from the West Coast. Conference organizers believe in the philosophy of the microbiologist and Pulitzer Prize-winning writer, Rene Dubos: “Since there are countless ways to go wrong but only a very few ways to do right, our best chance to deal successfully with our contemporary problems and those of the future is to learn from the success stories of our times.”

Conferees learned how producers at several Columbia Valley orchards, Washington’s Inaba Produce Farms, California’s Swanton Berry Farm and Fetzer Vinyards, and Oregon’s Stalbush Island Farms are succeeding in improving the workplace and the quality of their land, water and crops. For workers, they described their efforts with housing, health care, shared management, and strategies to provide year-round work. For the environment, they related their move to organic, strip tilling, cover cropping, composting, and using low pressure irrigation and pesticide alternatives. Presenters from the Oregon Sustainability Board and Portland-based Food Alliance spoke to how sustainability can be supported by policy and certification.

Workshop Results

The aim of the workshop was to start the development of a research agenda on worker health and safety within sustainable agriculture. This workshop crosses with Aim 2 of the communication and education project and will be reported in detail in this section (see pages 36–37).

Evaluation

To evaluate the conference, PNASH weighed if the conference met its stated aims and considered participants’ assessment of the conference process. To improve the quality of the participant feedback, we also took a new approach; conducting randomly selected face-to-face interviews. These interviews were limited to 42 people (38% of conferee population) because of staff and time constraints. They were conducted after Day 1, Day 2 and on the phone one to three weeks after the conference. We also added an extra learning impact indicator to our evaluation.

Looking both at the attendance list and professions of those that evaluated the conference, it is clear that the conference met its goal to gather experts and stakeholders in both agricultural worker safety and health and sustainable agriculture. The western region was also well represented with attendees coming from Washington 41%, California 25%, Oregon 17% and other states 13%. Qualitative comments about the venue, schedule and group work plus quantitative data on contacts made during the conference demonstrate that collaborative relationships were fostered. Although not all sessions allowed adequate participation, people seemed to feel the thematic lunch tables, workshop groups and conference setting itself stimulated good interactive discussion. Finally, the evaluation does indicate that the participants were able to identify the issues related to worker health and safety within sustainable agriculture. Also a substantial proportion of the attendees did understand of the meaning of sustainable agriculture, if not before then as a result of the speakers and panels.

The variety of stakeholders attending, especially producers and worker advocates, gave the event a lot of translational relevance not typical at university events and foreshadowed the “Research to Practice” theme of next year’s conference, to be held at Asilomar Conference Grounds, Monterey, California, September 7-9, 2005.

Aim 2. Conduct workshops based on the research priorities established in the Center’s Hazard Priority Ranking process for Northwest farming and forestry.

In the last year, three major activities continued PNASH’s efforts to understand the research priorities of Northwest agricultural workers:

- PNASH Outreach Advisory Committee meetings.
- El Proyecto Bienestar farm worker community survey.
- Workshop: Establishing a Research and Outreach Agenda to Integrate Safety and Health into the Sustainable Agricultural Workplace.

PNASH Outreach Advisory Committee (OAC) Meetings

The Outreach Advisors are an independent group who work with the PNASH Center in the planning and development of communication and outreach strategies and help inform PNASH research and prevention activities. The eleven members represent various stakeholder groups and expertise. One half of OAC membership will turn over every year in October. OAC will meet once per year and by phone every other month.

February 18th, Yakima, WA

This was the first OAC meeting. The major contribution of the committee to the PNASH Center will be keeping us relevant to our regional stakeholders and assisting us in building a cohesive and strategic approach for our next 5-year cycle. The committee reviewed the Center's present and proposed projects, our project selection criteria, and the outreach plan for this program cycle.

Summer 2004

Over the summer of 2004, PNASH’s new Director of Outreach, Helen Murphy, met individually with each OAC member. From each member she learned about their experience and the stakeholders they represent. She asked each:

- Did they have additions to the OAC meeting minutes?
- What was their response to the PNASH research criteria?
- What was their response to PNASH outreach plan?
- What should we be doing in regard to outreach and education?
- Is their individual role on the OAC clear to them?
- What is the role of the OAC in general?
- How would they describe the organization they represent?
- How can PNASH serve them and their constituents?
- How could they assist PNASH with:
 - education/outreach through their organization.
 - ideas on research that would serve their community/stakeholders

- What did they think were the key the outreach/education issues?

These meetings set the stage for future work with each stakeholder and better identified what population of stakeholders each member represented and could reach.

Some suggested research areas were:

- Causes of cholinesterase depressions (case-control studies)
- Ladder injuries in contract pickers
- Ergonomic issues (back pain) in asparagus pickers who are using short knives
- Women in packing houses and chemical residuals
- Fetal glutathion levels as women are doing all the thinning
- OP urinary metabolites in pregnant women
- Barriers to instituting sustainable agriculture
- Expanding cholinesterase testing to farm workers and their families

Most useful were people's views on the role of the OAC. Aside from being a method to inform our research priorities and an educational conduit, a few members felt the OAC should maintain a balance between the sometimes competing priorities of farm worker/employees and grower/ owners. There was fairly good consensus that the relationship was reciprocal in that the members would bring agricultural health concerns to PNASH while in turn PNASH hopes the OAC can distribute our relevant research findings to the community. The OAC can also serve as a reality check on the institution's research and a means to implement findings through formal training programs such as that conducted by the Washington Department of Agriculture. It can also review planned education strategies, materials, and language.

Growers Viewpoints: The Director of Outreach also visited a number of farms to understand the growers' points of views and the conditions under which they must work. These visits were preceded by a complete review of all the safety regulations [Growers League Manual] and the paperwork employers are obligated to deal with. The site visits provided a physical orientation to farm safety operations and conditions, the health hazards they see or experience, and what sources they turn to for information. One farm was large with its own health and safety personnel director who was responsible for training on CPR/first aid, ladders, pesticides, masks, PPE, tractors and lifting. The grower's wife on another operation served as the health and safety officer. She relied on videos and mentoring by other workers for training. The noted health issues were dependent on the type of commodity and operation, but included:

- Coping with the logistic difficulties in getting cholinesterase testing for the staff
- Burns (from their mint and dill distillery)
- Ladder accidents (missing the two lower steps)
- Complaints of more time keeping safety records than doing safety
- Risks of orchard tractor roll-overs when turning at end of row (no time to raise ROPS)
- Eye injuries from trellis ties

September 14th, Troutdale, OR

Most OAC Members participated in the conference, Cultivating a Sustainable Agricultural Workplace. On the last day of the conference, the OAC group met in conjunction with the PNASH Center's External Advisors. At this meeting each member shared the one project they would like to see PNASH pursue in the competitive renewal application. Study suggestions included:

- Indigenous languages of workers
- Literacy training in conjunction with safety training
- Exposure study on incidents of cholinesterase depression in Washington state
- Tractor Safety Initiative
- Providing research results to those working in the field
- Unreported injuries
- Training for foreman and supervisors
- Factors of longevity of work in the field, such as obesity
- Prenatal pesticide exposure
- Respiratory problems
- Ergonomics in packinghouses

El Proyecto Bienestar Farm Worker Community Survey

El Proyecto Bienestar, or The Well-being Project seeks to develop strategies for improving environmental and occupational health among Hispanic agricultural workers and their families in the Yakima Valley. This is a four-year environmental justice and community partnership project, funded by the National Institute for Occupational Safety and Health (NIOSH). This project grant is run through the PNASH Center and is considered an important mechanism for the PNASH Center to understand the safety and health needs of Washington state farm workers.

As a component of this project, in the summer of 2004, undergraduate students completed a community survey that was conducted in eastern Washington. The student investigators were participants in the Connecting Students to Health Careers (ConneX) program, which is federally funded through the Health Careers Opportunity Program (HCOP) and recipients of a supplement through Proyecto Bienstar. The ConneX students conducted a community survey that characterized perceptions of environmental and occupational risks among agricultural worker families in the Yakima Valley.

Workshop: Establishing a Research and Outreach Agenda to Integrate Safety and Health into the Sustainable Agricultural Workplace.

A workshop was held in conjunction with the conference Cultivating a Sustainable Agricultural Workplace to start developing a research agenda on worker health and safety within sustainable agriculture.

Methods

To draw on the collective brainpower of the participants in initiating this process, the conference attendees (n=110) were divided into five groups and tasked to answer the following questions.

- What are the worker health and safety issues in sustainable agriculture?

- Which are the top three issues?
- Define the best strategy to address these issues (e.g. by research, interventions, or education).
- Identify the partners who should implement the strategy.
- Define the timeline for implementation of the strategy.
- List the resources required to implement the strategy.

Each group was assigned a facilitator and scribe to record the discussions and conclusions. Below we summarize the major findings.

The Issues: Worker health and safety in sustainable agriculture

Many groups felt the issues they identified were not unique to sustainable agriculture. Rather they also are issues common to conventional farming. Only 21% of the identified issues could be classified as sustainable agriculture specific. As one group said; “because sustainable agriculture is not a locally common practice, it is hard to attack these specific worker health and safety questions.”

But it is worthwhile to describe the issues that do fall under the rubric of *sustainable agriculture*. They include the worker health and safety implications of the labor-intensive nature of sustainable ag, increased mechanization, pesticide alternatives, and other new technologies. One group felt there is a need for quantitative data to promote sustainable ag. The need to proactively define worker health and safety within sustainable ag was also mentioned.

Another cluster of issues that came out of the groups concerned *specific worker health problems* (16%) such as heat stress, mental stress, depression, disability, chronic illnesses, ergonomic problems, and the lack of health insurance. Although not unique to sustainable agriculture, the groups gave equal attention to both *legal/ regulatory* (12%) and *employer-employee issues* (12%), likely because social equity is one of three pillars to sustainable agriculture. A related topic was culture with its implications on training workers.

Top issues with strategies, partners, timelines, and resources

Because worker health and safety within sustainable agriculture is a relatively new concept, most of the groups focused on defining the issues and strategies. Only a few groups completely specified the partners, timelines, and resources.

A few themes emerged from the more detailed discussions within the groups. In all of the groups, *equity* as a worker health and safety issue figured prominently. The strategies to address worker inequity included fair wages, empowering workers through employer-employees collaborative relationships, unionization, and immigration reform.

Another prominent theme was *defining the difference between sustainable and conventional agriculture* as it applies to worker health and safety. And with this is the need for more quantitative data on the issue.

Finally were a few *health specific themes related to increased labor and mechanization* in

sustainable agriculture. Mechanical versus education interventions to improve worker health and safety was stressed as the strategy of choice. The focus should be to engineer out the risks of injuries and ergonomic solutions to musculo-skeletal problems. Another health specific area not limited to sustainable agriculture is that of worker emotional stress and other mental health issues. Two groups felt this should be an area of increased research and full-scale education.

Conclusion

This may have been an overly ambitious exercise for the participants, given the newness of the topic as well as the limited time for discussion. Furthermore, most of the issues that came out of the groups were not unique to sustainable agriculture. But a sustainable agriculture research and intervention agenda that focuses on worker equity can only improve age-old health and safety problems found in conventional agriculture.

Aim 3. Provide professional education in collaboration with the University of Washington's Northwest Center for Occupational Health

Two 2004 events offered professionals in the Northwest continuing education credit:

- Pacific Northwest Pesticide Issues Conference, February 19th, Yakima, Washington.
- Cultivating a Sustainable Agricultural Workplace, September 12-14, 2004, in Troutdale, Oregon.

Pacific Northwest Pesticide Issues Conference, February 19th, Yakima, WA

The second annual Pesticide Issues Conference and continuing education course was attended by 140 people, made up of producers, medical staff, agricultural pesticide handlers, worker advocates, university researchers, and others.

Co-sponsored by the Washington State University Pesticide Education Program, Northwest Center for Occupational Safety & Health, the 7th annual conference focused on the new Washington state pesticide monitoring regulations. Plenary sessions reviewed issues of pesticide toxicity and exposure. During concurrent breakout sessions, growers/managers, applicators/handlers, and medical providers were given information and materials on how best to comply. A featured address by Michael Alavanja, Senior Investigator, National Cancer Institute, reported on recent links found between pesticides and cancer.

Continuing education credit was offered to:

- Pesticide handlers in Washington, Idaho, Oregon
- Safety and environmental health professionals
- Industrial hygienists
- Nurses
- Physicians (Category 1 CME)

Planning

The event's sponsors are Washington State University's Pesticide Education Program and the Pacific Northwest Agricultural Safety and Health Center, the Northwest Center for Occupational Safety and Health at the University of Washington.

The event was designed to:

- Provide perspectives on pesticide related health and safety issues in agriculture.
- Facilitate interaction between medical providers and agricultural pesticide handlers, producers and agency staff regarding pesticide poisoning prevention, cholinesterase monitoring, diagnosis, and Labor and Industry claims.
- Offer cholinesterase rule training sessions tailed to: medical providers; producer/managers: and, pesticide handler/applicators.

Conference planners from both the PNASH Center, WSU and regional partners convened in a series of planning meeting spring and summer of 2003. The planning committee included:

Conference Co-Chairs

Patricia Boiko, University of Washington
Carol Ramsay, Washington State University

Pesticide Medicine Co-Chairs

Lucio Costa, University of Washington
Matt Keifer, University of Washington

Advisory Committee and Contributors

Marty Cohen, Washington Dept. of Labor & Industries, SHARP
Catherine Daniels, Washington State University
Carol Dansereau, Farm Worker Pesticide Project
Pamela Elkind, Eastern Washington University
Allan Felsot, Washington State University
Dan Ford, Columbia Legal Services
John Furman, Washington Dept. of Labor & Industries
Marco Guske, Yakama Nation
Cheryl Hanks, Washington Dept. of Health
Marcy Harrington, University of Washington
Linda McCauley, Oregon Health Science University
Scott McKay, University of Washington
Scott McKinnie, Far West Fertilizer Association
Barbara Morrissey, Washington Dept. of Health
Dan Sudakin, Oregon State University
Flor Tovar, Washington Dept. of Agriculture
Margaret Tucker, Washington Dept. of Agriculture

Promotion and Products

The conference was promoted in Fall of 2003 with a Web site, brochure, and by placing 50 announcements through calendars, newsletters, and list serves. A contact database was developed and the brochure was direct mailed to 1,915 contacts in agriculture, pesticide handlers, occupational health and safety, health care, and labor. Announcements were placed through organizations and further promoted through our partner, Washington State University Pesticide Education Program, and Washington Department of Labor and Industries, because of the special focus on the Washington state cholinesterase monitoring rule.

The conference was especially timely because at the beginning of 2004, the state of Washington mandated that workers handling organophosphate and carbamate pesticides be monitored. It was expected that the focus on cholinesterase monitoring would easily draw participants.

At the event, participants were provided with a course manual. Press releases were distributed and there was one media report in the Wenatchee World and the Yakima Herald Republic. The Web site was maintained for one year after the event with the course manual posted for downloading in pdf format.

Program

General Session

- 8:00 - 8:05 Welcome, Carol Ramsay
8:05 - 8:40 *Overview of acute pesticide toxicity*, Dan Sudakin
8:45 - 9:20 *Measuring pesticide exposure*, Richard Fenske
9:20 - 9:30 Question & answer period
9:30 - 9:40 Break - Attendees meet agency field investigators
9:45 - 10:00 *Perspectives on pesticide-related illness in WA*, Jeff Lutz
10:00 - 10:15 *Perspectives on pesticide-related illness in WA*, Carol Dansereau
10:15 - 10:35 *Pesticide incidents--Department of Health data*, Barbara Morrissey
10:35 - 11:00 *Poisoning determinations*, Ann Byer
11:00 - 11:15 Question & answer period
11:15 - 11:50 *Roadmap for reduced pesticide exposure in the tree fruit industry: products used and technology*, Jim McFerson
11:50 - 12:00 Question & answer period
12:10 - 1:00 Luncheon Address: *Pesticide and lung cancer risks*
Michael Alavanja
1:00 - 1:15 *Facilitated discussion on health and safety issues*, Allan Felsot

Pesticide Handler/Applicator Breakout

- 1:30 - 2:00 *Cholinesterase basics*, Carol Ramsay
2:00 - 3:00 *Cholinesterase testing; Cholinesterase monitoring; Informed consent/dissent*, Karl Weyrauch
3:00 - 3:15 Break - Handlers interact with growers and medical providers
3:15 - 3:35 *Compliance with the rule*, Pedro Serrano
3:35 - 4:00 *Illness prevention - respiratory protection*, Carol Ramsay

Growers/Manager Breakout

- 1:30 - 2:00 *Cholinesterase basics*, Patricia Boiko
2:00 - 3:00 *Cholinesterase monitoring rules; Cholinesterase testing; Informed consent/dissent*, John Furman
3:00 - 3:15 Break - Handlers interact with growers and health care providers
3:15 - 3:35 *Practicalities of the rule*, Todd Denny
3:35 - 4:00 *Grower experiences a monitoring program*, TBA

Medical Provider Breakout

- 1:30 - 3:00 *Diagnosis of cholinesterase poisoning and other common pesticide illnesses; Differential diagnosis; Cholinesterase testing and monitoring, Matt Keifer*
- 3:00 - 3:15 Break- Handlers interact with growers and health care providers
- 3:15 - 3:40 *Practice cases, including L&I claims, Matt Keifer*
- 3:40 - 3:50 *Grower perspectives on working with medical providers, Jeff Lutz*
- 3:50 - 4:00 *Farm labor perspectives on working with medical providers, Patrick Pleas*

Reconvene into General Session

- 4:15 - 4:45 *Facilitated discussion for working together: Health care providers, growers, and farm labor, Patricia Boiko*
- 4:45 - 5:00 Wrap up, Carol Ramsay
- 5:00 Adjourn

Evaluation

Out of 140 attendees, 47 returned evaluation forms. Their responses showed that most (62%) heard of the course through the brochure mailing. The secondary route was through the Internet (25%). Professional fields varied widely, with the most forms turned in by pesticides regulators (9%) and people in the agricultural industry (11%). The facility was rated mostly in the categories “OK” and “Excellent.” 72% of respondents felt the course met their expectations. Most presenters ranked highest in the “good” (second to top) category and 6 presenters received top ranking of “excellent.” No presenters had an overall ranking that placed them in “Fair”, “Poor” or “Not Relevant.”

Aim 4. Maintain and revise Center Web page

PNASH Web site: <http://depts.washington.edu/pnash/>.

The PNASH Center Web site had approximately 1,300 hits in 2004. Due to the counter being down, average hits were calculated using past data as well as data collected since 6/04 (new Web launch). Contributing variables to the hits include: a complete Web site overhaul, new site posting, and posting of the Cultivating a Sustainable Agricultural Workplace conference (9/12-14/04).

Revisions:

In 2004 the Center Web site underwent a complete redesign and was launched in June of 2004. This redesign was developed with the goal of improving usability and function of the site. The site has new look and navigation features, updated content, and a new structure using templates and style sheets that saves space and will streamline future site management. The new site has been circulated for feedback and some of these suggestions and the addition of more graphics/images will be conducted in a second phase of revisions in Year 4. New content and features include:

- Project listings, personnel biosketches, mission statement, publications, activities.
- Calendar of Events

- New and Noteworthy section on the home page
- Spanish language resources/links
- PNASH Center press releases
- A search function
- Drop down menus
- Show and hide drop down extensions of text

Companion Sites

Web sites that were developed for projects that were based from our PNASH Web site include:

- Tractor initiative: one page with downloadable pdf docs of the initiative, Keystone meeting audience response, and presentations.
- CE Course: 7th PNW Issues Conference: Pesticides, Safety, Health, and Medicine (six pages including downloadable pdf registration form, regional links and proceedings).
- 2004 Western Regional Conference: Cultivating a Sustainable Agricultural Workplace (nine pages including downloadable registration form and brochure and regional links) and complete proceedings.

Graphic Library Additions/Improvements:

The graphics library was reorganized. This library of images supports our Web site design activities as well as presentations and printed materials. Organization efforts included:

- Development of graphic resource binders. These include contact sheets of new and existing digital images, CDs archiving the same digital images, hard copy photographs.
- Images have been requested from and shared with individuals from within the UW Environmental and Occupational Health Sciences department, other NIOSH Ag Centers, and regional partners.

Aim 5. Disseminate information, including professional and non-professional presentations, newsletters, and other informational materials.

Information was disseminated primarily through presentations, event exhibits, newsletters, and direct mailings in response to inquiries.

Major events are an important route for information dissemination. In 2004, PNASH faculty and staff presented as speakers, poster presenters and through educational displays at:

- Future of Rural Peoples: Rural Economy, Health People, Environment, Rural Communities conference, October 12-23, 2003, Saskatoon, Canada. PNASH presented a display and hosted a session on Pesticide Health Risks.
- 2004 Western Migrant Stream Forum, January 30–February 1, 2004, Seattle, WA, PNASH presented, had a display with resources for health care providers, and hosted an evening research reception with poster presentations.
- Pacific Northwest Pesticide Issues Conference, February 19, 2004, Yakima, WA. PNASH presented and offered a display with resources.

- NIOSH site visit and Western Centers Showcase, Davis, CA, May 13, 2004. Platform and poster presentations.
- National Symposium on Agricultural Health and Safety and Tractor Safety Initiative meetings, June 20-24, 2004, Keystone Resort, CO. PNASH presentations and poster.
- Western Regional Agricultural Safety and Health Conference, Cultivating a Sustainable Agricultural Workplace, September 12-14, 2004, Troutdale, Oregon. Platform and poster presentation and exhibit with resources.

The PNASH Center's primary newsletters include the quarterly dissemination of the NIOSH Ag Centers' *Ag Connections* with inserts specific to PNASH and the annual distribution of the *Northwest Forestland Worker Safety* newsletter. For each issue of *Ag Connections*, PNASH contributes an article related to the theme of the newsletter. In addition, we insert a page with information specific to the PNASH Center and region, such as announcing events or new projects. *Ag Connections* is directly distributed to over 500 key Northwest stakeholders, this database of contacts is updated quarterly. In Year 3, 62 new key stakeholders were added to the contact database.

In January 2004, the *Northwest Forestland Worker Safety* newsletter was sent to about 500 key players in safety and logging in the Northwest. We provided news of activities in the region, injury and fatality statistics, and a calendar of upcoming safety events.

The staff of the communication and education project also assisted project investigators with the dissemination of information on their project and products—these are listed in the report on these projects. For specific listings of this education project's presentations, materials, meetings, displays and other information dissemination products, see the products section below.

F. PROJECT PRODUCTS

1. Presentations:

Harrington M. Stakeholder Communication and Professional Education. NIOSH Site Visit and Western Centers' Showcase, Davis, California, May 13, 2004.

Fenske R. Sustaining the Worker. Cultivating a Sustainable Agricultural Workplace, Troutdale, Oregon, September 12-14, 2004,

Negrete M, Murphy H. A View from the Field: How Communities Members Feel About the Research done in their Communities. Poster presentation at Cultivating a Sustainable Agricultural Workplace, Troutdale, Oregon, September 12-14, 2004,

Negrete M, Murphy H. A View from the Field: How Communities Members Feel About the Research done in their Communities. Panel Presentation at Immigrant Worker Safety and Health Symposium, Lowell, MA, September 28-29, 2004.

2. Publications

c. Fact Sheets / Brochures / Technical Publications:

Brochure: PNASH (revised)

Fact sheet: PNASH current projects (revised)

Fact sheet: El Proyecto Bienestar / Project Well Being (English and Spanish)

Brochure: Pacific Northwest Pesticide Issues Conference

Fact sheet: UW Pesticide Exposure Studies

Brochure: Cultivating a Sustainable Agricultural Workplace Conference

d. Other Publications:

Keifer M, Salazar M, Snyder K. Community Health Intervention with Yakima Agricultural Workers. Spotlight, Spring 2003.

Swenson E. Challenges in Agricultural Safety and Health. DOEHS Newsletter, Fall 2003.

Hall K. Partnerships. Winter 2004.

Hall K. Farm Worker Health. Winter 2004.

Swenson E. Collaboration for Community Health Intervention, Ag Connections Vol 2, No 1.

Web site: Pacific Northwest Pesticide Issues Conference

Press release: Pacific Northwest Pesticide Issues Conference

Course manual: Pacific Northwest Pesticide Issues Conference

Web site: Cultivating a Sustainable Agricultural Workplace Conference

Press release: Cultivating a Sustainable Agricultural Workplace Conference

Web site: Pacific Northwest Agricultural Safety and Health Center

3. Education / Training / Outreach

a. Training Seminars:

Boiko P, Keifer M, Weyrauch K. Onsite Clinic Cholinesterase Monitoring Training, Walla Walla, Washington, December 1, 2003.

Boiko P, Keifer M, Weyrauch K. Onsite Clinic Cholinesterase Monitoring Training, Burlington, Washington, December 4, 2003.

Boiko P, Keifer M, Weyrauch K. Onsite Clinic Cholinesterase Monitoring Training, Wenatchee, Washington, December 8, 2003.

Boiko P, Keifer M, Weyrauch K. Onsite Clinic Cholinesterase Monitoring Training, Yakima, Washington, December 11, 2003.

b. Short Courses:

Pacific Northwest Pesticide Issues Conference, February 19, 2004, Yakima, Washington.

Cultivating a Sustainable Agricultural Workplace Conference, September 12-14, 2004, Troutdale, Oregon.

c. Hazard Surveys / Consultations:

Consultations

Murphy H. Addressing Cholinesterase Depressions: WSU Farmworker Education Working Group, May 26 2004 and Oct 7, 2004

Murphy H. Oregon State University Agriculture Chemistry Dept. June 6, 2004.

Murphy H. Washington State Growers League. June 16, 2004.

Murphy H. Farm Worker Pesticide Project. July 7, 2004

Murphy H. Yakama Nation Department of Agriculture. July 13, 2004.

Murphy H. Dekker Farm, July 13, 2004

Murphy H. Washington State Department of Health, Pesticide Unit. June 19, 2004

Murphy H. HOPS Group of Washington, July 20, 2004

Murphy H. Larry Knudsen Orchard, July 20, 2004

Murphy H. Adrienne Hidy (previous PNASH manager), July 22, 2004

Murphy H. Yakima Valley Farm Workers Clinic, July 26, 2004

Murphy H. Field Group, Department of Occupational and Environmental Health Sciences, University of Washington, July 29, 2004

Murphy H. Goodheart, University-Community Partnerships, Educational Partnerships and Learning Technologies August 3, 2003

Murphy H. Radio KDNA, August 9, 2004

Murphy H. Sharon Morris (Association Chair of UW SPHCM) Previous PNASH Outreach Director, August 13, 2004

Murphy H. Washington State Department of Agriculture, August 20, 2004

Murphy H. United Farmworkers of America AFL/CIO, August 20, 2004

Murphy H. Roy Farms, August 25, 2004.

Murphy H, Harrington M. Review newly developed educational curriculum for Ag in the Classroom, Health and Safety Awareness for Working Teens in Agriculture. Project of the Center for Ecogenetics and Environmental Health at the University of Washington.

Harrington M. Review of publication on hearing protection in Washington state packing houses. Project of faculty, William Daniels of the Department of Environmental Health, University of Washington.

Hazard Survey

El Proyecto Bienestar farm worker community survey, Summer 2004.

d. News Letters:

Northwest Forestland Worker Safety Newsletter, 2003

Ag Connections

- Vol 1 No 4. Article: The Virtual corset – a New Logger for the Ambulatory Assessment of Physical Exposures. Insert: *In the Northwest – Upcoming Farm Safety and Health Events*
- Vol 2 No 1. Article: Collaboration for Community Health Intervention.
- Vol 2, No 2. Article: Development of a Community Theater Troupe: Health and Farm Safety Training for Hispanic Agricultural Workers. Inserts: *Spanish-Language Safety training Videos for Agricultural Workers Available*; and, *El Proyecto Bienestar: Community Health Intervention with Yakima Agricultural Workers* (English and Spanish).

f. Other:

Exhibit: Western Migrant Stream Forum, Seattle, Washington, January 30 - February 1, 2004.

Exhibit: Pacific Northwest Pesticide Issues Conference, Yakima, Washington, February 19, 2004.

Exhibit: Cultivating a Sustainable Agricultural Workplace Conference, Troutdale, Oregon, September 12-14, 2004.

4. Conferences / Meetings Sponsored:

Pesticide Health Risks session at Future of Rural Peoples: Rural Economy, Health People, Environment, Rural Communities conference in Saskatoon, Canada on October 12-23, 2003.

Research Reception at the Western Migrant Stream Forum, Seattle, Washington, January 30 - February 1, 2004.

PNASH Outreach Advisory Committee (OAC) Meeting, Yakima, Washington, February 18, 2004.

Pacific Northwest Pesticide Issues Conference, Yakima, Washington, February 19, 2004.

Fishing vessel safety meeting, Seattle, Washington, May 4, 2004.

NIOSH Site Visit and Western Regional Showcase and Director's Meeting, Davis, CA, May 13-14, 2004.

PNASH Outreach Advisory Committee (OAC) Meeting, Troutdale, OR, September 14, 2004.

Cultivating a Sustainable Agricultural Workplace Conference, Troutdale, Oregon, September 12-14, 2004.

Workshop: Establishing a Research and Outreach Agenda to Integrate Safety and Health into the Sustainable Agricultural Workplace. At Cultivating a Sustainable Agricultural Workplace Conference, Troutdale, Oregon, September 12-14, 2004.

5. Other Products:

Graphics Resource Binders

Planning Committee: Boiko, P. Western Migrant Stream Forum, Seattle, Washington, January 30 - February 1, 2004.

Poster: PNASH. National Symposium on Agricultural Health and Safety and Tractor Safety Initiative meetings, Keystone Resort, Colorado, June 20-24, 2004.

Murphy H. Thematic Table Discussion: Bridging the Gap between Employers and Workers. Cultivating a Sustainable Agricultural Workplace Conference, Troutdale, Oregon, September 12-14, 2004.

Swenson E. Attended the WA Governor's Industrial Safety and Health Conference, Spokane, WA, September 29-30, 2004.

G. STATES THE PROJECT WAS ACTIVE IN

Washington, Idaho, Oregon, Alaska, Montana, California

A. PROJECT TITLE

Educ2: Document Development for Prevention of Tractor-Related Injuries and Fatalities

B. PROJECT OFFICER(s)

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C. PROJECT DESCRIPTION

PNASH led the development of the document capturing the national agricultural center initiative to reduce tractor-related accidents. For the first time, all of the NIOSH centers are collaborating on a national prevention program. Tractor accidents remain the leading cause of farm fatalities and injuries. The document produced will be used within NIOSH/CDC, with other stakeholders, and for seeking additional national support and partners. In Spring 2004, PNASH received a supplement to print, distribute and launch the document. The key distribution channel to potential partners was the National Symposium on Agricultural

Health and Safety in June 2004.

D. PROJECT START AND END DATES: August 1, 2003 – July 31, 2004

E. PROJECT ACTIVITIES / ACCOMPLISHMENTS

The National Agricultural Tractor Safety Initiative publication (See Appendix B) was a major focus of the PNASH Center in Year 3. From the period of October to March, activities revolved around the development of the document. March to July saw the development of the final electronic and printed document and its distribution and launching to some key interested parties.

The development of the document, National Agricultural Tractor Safety Initiative, was done in partnership with all nine NIOSH agricultural centers and the National Childrens' Center. In Year 3 these representatives met by phone and in person to plan, write and review that document as developed by PNASH. On October 23, 2003, PNASH presented an initial draft copy (as compiled from team submissions) and design prototypes. PNASH led the team through a discussion of the draft—early identifying problems with gaps, contradictions, and redundancies. Over the fall and winter, PNASH facilitated the document contributions through phone conference calls, group e-mails, and an internal Web site. On January 21, 2004 the working group convened in Washington DC and presented a draft document to John Howard and other NIOSH officers. In preparation for this meeting, PNASH developed the document into a polished form through additional writing; copy editing to ensure a tone of “one voice” and achieve consistency; and by refining the design layout. The final electronic publication was presented to the working group by the deadline, February 28, 2004.

In March, PNASH received a supplement to launch the document, including adding some additional content, printing, and distributing/presenting at the National Symposium on Agricultural Health and Safety in June 2004. New content writing included adding lists of the 2003 tractor-related fatalities in the US. On June 2004 the final document was printed and sent to symposium coordinators and to each Agricultural Center. Along with the final preparations of the publication, PNASH worked with a small team to prepare a special half-day session in conjunction with the National Symposium on Agricultural Health and Safety, June 20- 23. The initiative was introduced to a wider group of partners through a short presentation of the Ag Centers' proposed initiative. Then, more than 90 people participated in a discussion of their interests, concerns, and commitment to furthering the initiative. A smaller group participated in an educational session on how social marketing could advance tractor safety. In addition, Ag Centers leadership met to plan the next steps for the Ag Centers to launch this initiative with other national partners. PNASH led the planning of the social marketing session, submitted press releases and announcements to symposium attendees, and facilitated the Ag Centers' meeting on next steps. Final activity on this project was the write up and publication of a summary article on the Initiative and participatory session in June.

F. PROJECT PRODUCTS

2. Publications

c. Fact Sheets / Brochures / Technical Publications:

National Agricultural Tractor Safety Initiative

d. Other Publications:

Swenson E. Ag Center Introduce Tractor Safety Initiative. Western Center for Agricultural Health and Safety News, Summer 2004.

4. Conferences / Meetings Sponsored:

Tractor Initiative planning meeting, Saskatoon, Canada, October 23, 2003.

Tractor Initiative presentation to NIOSH and planning meeting, Washington DC, January 21, 2004.

Tractor Initiative Launch and Planning meeting, Keystone, Colorado, June 23, 2004.

5. Other Products:

Web site

G. STATES THE PROJECT WAS ACTIVE IN

Nationwide

IV. FEASIBILITY PROJECT REPORTS

CONCLUDED PROJECTS

No	Project Title	Project Investigators	Page
Feasibility1	Wildland Firefighter Injuries in Idaho and Montana	M. Keifer, R. Mangan	50-63
Feasibility3	Assessment of Farmers' Exposure to Smoke from Agricultural Burning	S. Liu, C. Claiborn	63-70
Feasibility4	Evaluation of the Worker Protection Standard Train-the-Trainer Model Curriculum	R. Fenske, P. Boiko, G. van Belle	70-72

A. PROJECT TITLE

Feasibility 1: Wildland Firefighter Injuries in Idaho and Montana

B. PROJECT OFFICER(s)

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C. PROJECT DESCRIPTION

In an effort to reduce wildland firefighter injury and illness, PNASH is working with the USDA Forest Service and Blackbull Wildfire Services to characterize injuries to wildland firefighters. The study reviews injury records from major fires that occurred in Idaho and Montana during the summer of 2000. Detailed information was recorded concerning the injuries that occurred, but has not been compiled and analyzed to identify trends and possible mitigation measures. This study will look at the association between the type, severity and rate of injuries, the class of firefighter involved, and the time spent fighting the fire.

D. PROJECT START AND END DATES: May 1, 2002 – April 31, 2004

E. PROJECT ACTIVITIES / ACCOMPLISHMENTS

Year 3 accomplished the final stages of analyzing and reporting the results. The majority of Year 2 was spent securing authorization for access and use of the injury data. Authorization to use the USFS data was granted in Summer 2003 and investigators were then prepared to start data entry and analysis. A report of the results was submitted by the deadline, April 31, 2004.

Final Report

Executive Summary

Fire season 2000 in Montana and Idaho was one of the most serious in recent memory, with 122, 827 fires burning 8,422,237 acres across the U.S. At the peak of the fires in the western states—on August 29, 2000—more than 28,400 people were involved in suppressing fires.

This study looks at the two largest Northwest fires that burned in 2000: the Clear Creek fire in Idaho, and the Valley Complex fire in Montana. Our purpose was to review injuries that were documented on these fires, to determine if types of individuals, environmental factors, fatigue and/or fitness levels impacted the numbers and types of injuries.

We found that while several of our hypotheses were difficult or impossible to validate with the available data, there was an elevated injury frequency rate for the T-1 “Hotshot” crews assigned to the Clear Creek fire. It can be surmised that this higher rate is because, with their high levels of training and experience compared to most T-2 crews, these T-1 crews are assigned to work in the most difficult segments of the fire. Injuries in the fire camp setting were a significant number, and offer opportunities to reduce injuries on future fires.

The study finishes by making recommendations to improve firefighter safety and reduce injuries, both on the fireline and among fire support personnel in the fire camp setting. It also proposes future research needs to better define the types of injuries, the resources affected, and the need to look at fire illnesses as another component of the wildland fire Health and Safety program.

Introduction & Purpose

Wildland fires have been, and continue to be, an important natural component of life in North America, and especially in the Pacific Northwest and Northern Rockies. Wildland firefighting is a dangerous business: between 1910 and 2002, more than eight hundred eighty three (883) fatalities have been recorded on wildfires. In spite of all the improvements made in technology, communications, and protective equipment over the past ninety(90) years, one hundred thirty three (133) individuals died during fire activities between 1990-1998.

While we have reasonably accurate and complete records of the fatalities that have occurred on wildfires, there is a significant gap in the information available about firefighters that have suffered non-fatal injuries battling wildfires. Many of these injuries are well known to those who work in the fire environment: slips/trips/falls; cuts from hand tools and power saws; muscle strains; bruises (and worse) from rolling rocks and falling objects.

Although this knowledge exists in a “general” context, there is a serious lack of specificity regarding the injuries that would allow fire managers and Safety and Health Specialists to

develop a meaningful plan to reduce them.

The purpose of this study is review the injuries that occurred on selected large, long-duration wildfires in northern Idaho and western Montana during the 2000 fire season, with special emphasis on: what type of injury occurred; what type of person was injured; and was fitness/fatigue a factor in the injury occurring?

Background: Fire Season 2000

Fire season occurs every year across the United States, beginning in the Southeast during January and February and ending during November and December in Southern California. Over the period of those twelve months, nearly all geographic regions of the US experience wildfires: the numbers and severity of those fires is determined by a number of factors such as winter rainfall/snow pack; fuel conditions; human and natural caused ignitions; and significant weather events such as the Santa Ana winds the affect Southern California.

By any measure, the year 2000 fire season was one for the record books: from the first fire that burned less than an acre in Florida on January 1, until the end of the calendar year 366 days later, smoke was in the air and firefighters were on the line taking suppression action. The size of early season fires in the Southwest required a large commitment of firefighting resources, and may have resulted in fatigue becoming a factor in fire fighter safety over the duration of the fire season. Two 40,000 acre-plus fires burned in New Mexico before the end of February; twelve (12) States experienced large fires before Spring was over; and in New Mexico, the National Park Service had a prescribed fire that escaped, burning 47,650 acres and destroying 235 residences. A firefighting force of more than 2000 battled this fire for several weeks in May 2000.

A series of lightning storms started numerous fires in Northern Idaho and Western Montana during July and August: while initial attack efforts were often successful, a few fires escaped those efforts and became massive. In Idaho the Clear Creek fire began on July 16, burned 71 days, and eventually burned 216,961 acres. More than 86,000 firefighter-days were expended in the suppression effort. Montana's Bitterroot Valley, July 31st saw 78 new lightning caused fires. They eventually burned 356,000 acres of Public and private lands, destroying 70 homes, 170 other buildings and 94 vehicles.

The large number of fires across the Western States, with the most complex and highest priorities in Idaho and Montana, drained the entire firefighter pool in the US: fighters were imported from Canada, Australia, New Zealand and Mexico, and six (6) battalions of US Marines were pressed into firefighting service.

On the peak day of August 29, 2000, the firefighting workforce consisted of:

- 28,462 people
- 667 20-person crews
- 1249 engines
- 226 helicopters
- 42 air tankers

At the close of the 2000 fire season in the US, the final total was 122,827 fires burning 8,422,237 acres; the Federal agencies alone spent \$1,362,367,000 in suppression costs.

The two fires being reviewed in this study (Clear Creek and Valley Complex) were rated as the #1 and #2 sized fires for the entire year in the US.

Hypotheses

While many experienced wildland firefighters have a good “gut-feeling” about what causes injuries on wildfires, there has been a serious gap in the database of information that actually documents the injuries that occur, let alone to do any type of analysis.

For the purposes of analyzing the data developed by this study, the following hypotheses were established:

Hypothesis #1: Injuries to wildland firefighters are associated with:

- Type of crew/individual
- Number of days on the fire
- Number of hours on shift

Hypothesis #2: the frequency of injuries is positively correlated with environmental factors (steep slopes, loose footing, tripping on ground fuels, etc).

Hypothesis #3: There is an inverse relationship between the risk of injury and the differing levels of firefighter fitness.

Methodology

Because no previous study has analyzed injuries to wildland firefighters on specific multi-day large fires, the methodology selected was developed to maximize the use of information from the incidents (fires) being studied.

Data Sources

The data used for analysis in this study was derived from material contained in the “Final Fire Package”, a compilation of all records that are generated on every large fire managed under the Incident Command System (ICS) in the US by all Federal agencies and many of the State fire agencies.

The Incident Command System (ICS) is a standardized on-scene emergency management concept specifically designed to allow its users to adopt an integrated organizational structure equal to the complexity and demands of a single or multiple incidents, without being hindered by jurisdictional boundaries. Several key components of this concept include standardization of position terminology, equipment typing, and forms.

In extracting data for this study from the Final Fire Packages, the following ICS forms were referenced:

- **ICS-209 “Incident Status Summary”** which is prepared daily on each fire incident,

showing the type of resources assigned by agency of assignment;

- **ICS-211 “Check-in List”** which documents when each specific resource (crews, individual overhead personnel, engine crews) arrive at the fire incident;
- **ICS-214 “Unit Log”** which the medical unit leader fills out daily documenting events, such as injuries, that occur during their operational period on shift.

In addition to the ICS forms reviewed, nationally accepted fire documentation was reviewed, including:

- **NFES Form #1672 “Field First Aid Station Log Patient Evaluation”** which gives information on the more “serious” injuries that are treated;
- **CA-1 “Report of Traumatic Injury and Claim for Compensation,”** a Department of Labor form used by Federal employees to document on-the-job injuries;
- **CA-16 “Request for Examination and Treatment,”** another Department of Labor form required when federal employees are sent to physicians and/or medical facilities (outside of the fire base camp).

Data Analysis

The data contained on these fire forms were extracted and placed in an MS Excel database for analysis. Resources were separated by agency of employment and type of resource (crew, engine, overhead, etc) using standard incident command system (ICS) typing.

Data for the medical unit logs and associated injury report forms were reviewed, and stratified by type of person injured, type of injury suffered, and location where the injury occurred (fireline versus incident base camp). Whenever the data was available, the age and gender of the injured individual was also noted, although this information was not always available because of federal Privacy Act issues.

The data included from these reports was:

- Fire (incident) name
- Case #
- Date of injury
- Type of resource (person) injured
- Geographic area of origin
- Gender
- Age
- Type of Injury
- Location of Injury
- Venue (fireline or camp)

One of the original intents of the study was to determine if there was a correlation between days on the fire (incident) and the injury event. It was not possible to obtain this information because Privacy Act concerns mandated that the injured individual’s unit of assignment was often “redacted” and prevented us from identifying the date of arrival at the fire.

An important aspect of this study was a comparative analysis of accident frequency rates by type of resource, based upon number of person days worked. Resources were typed by activity (hand crew, engine crew, camp crew, overhead, etc), as well as agency affiliation and geographic area of origin (US Forest Service from the southern US vs state personnel from California etc.). The geographic Areas identified by the National Wildfire Coordinating Group were used for this delineation, and included:

- 1 = Northern Rockies;
- 2 = Rocky Mountains;
- 3 = Southwest US (Arizona & New Mexico);
- 4 = Great Basin;
- 5 = California;
- 6 = Pacific Northwest (Oregon & Washington);
- 8 = Southeast (20 Southern States from Virginia to Texas);
- 9 = Eastern (Eastern US States from Maine to West Virginia, and the mid-West States);
- 10 = Alaska;
- 11 = Canada;
- 20 = Australia/New Zealand.

Although standardization is a key component of the Incident Command System, some variances occurred in the reporting processes used on the daily ICS-209 form. For example, some Incident Management Teams reported the numbers of crews assigned to their Fire/Incident, while others not only identified the number of crews, but also the total number of crew members assigned. When discrepancies appeared in the numbers reported compared with the ICS “standard” (a “crew” is defined as 16-20 persons), adjustments were made to achieve consistency with total numbers reported. Variance in these numbers is estimated at +/- 1% when the totals for the entire fire/incident are considered.



Barriers

Because a study of this nature (looking at wildland firefighter injuries from recorded fire records on various fire incidents) has never been undertaken before there were barriers that arose throughout the study that affected its timeliness and ability to analyze all the desired aspects of firefighter injuries.

1. Although there was strong support among the wildland fire community for this study when it was initially proposed, obtaining the records proved difficult once the study had been approved. The administrative managers in the U.S. Forest Service responsible for the records determined that a “Freedom of Information” request had to be initiated to both the Regional Offices in Ogden, Utah and Missoula, Montana to receive these records. While the desired records were eventually received, there was a considerable time lag involved.
2. The same administrative managers determined that, since the medical unit records and injury reports contained information about specific individuals, then any information that would compromise their anonymity had to be redacted or blacked out. In many of the records received, the redactions removed references to employing agency, resource type (hand crew, engine crew, overhead, camp crew), as well as information identifying the age or gender of the injured individual. This not only restricted the level of analysis possible, but also prevented any in-depth follow-up with specific individuals that might have provided additional information about their injury, and their previous work history in the hours, days, weeks and even months prior to the injury occurrence.
3. The completeness and quality of the medical unit records were highly variable, ranging from excellent to poor. While some medical personnel were thorough and complete in documenting the injury and the individuals involved, other records gave only cursory information that made further analysis difficult at best.
4. The ICS-209, which is completed daily on all large fires, show the numbers and types of resources assigned to a specific incident, and was our basis for comparing the total numbers of resource types on an incident versus the injury occurrence rates. There were numerous days when it was difficult to accurately account for the total personnel shown versus the individual resources broken out by agency and resource type.

In spite of these barriers, the available data still allowed for a meaningful analysis of the firefighter injuries by resource types, and some limited analysis based on both gender and age of the injured firefighters.

Findings

Although the Clear Creek fire in Idaho and the Valley Complex fire in Montana were the two largest fires that occurred in the U.S in 2000, they were unique, and very different from one another. Those differences are reflected in the injuries that occurred on each. For that reason, this findings discussion will address each fire and the resultant injuries as separate entities.

Clear Creek Fire Injuries

The Clear Creek fire was a lightning-caused fire that began in mid-July 2000 and burned for 71 days, eventually covering 216,961 acres in an area northwest of Salmon, Idaho. Eighty six thousand, six hundred seventy seven (85,677) person days were expended in the suppression effort. Because much of the burned area was away from main roads and too steep for mechanized equipment, hand crews were an important component of the firefighting workforce on Clear Creek: 10,558 person-days of Type 1 (Hotshot crew) days were used, as was 31,067 person-days of Type 2 hand crews. Because of their expertise and experience levels, Type 1 “Hotshot” crews are frequently used in the most difficult and dangerous parts of the fire; the Clear Creek fire was no exception. Type 2 hand crews, on

the other hand, are generally not as experienced as the Type 1 Hotshot crews. They are usually placed in less difficult fireline conditions, but are sometimes used side-by-side with Type 1 crews, or in their place, as fire conditions and crew availability dictates.

The composite mix of resources used for the fire suppression effort on the Clear Creek fire include: T-1 Crews: 10558 person-days (12.3%); T-2 Crews: 31067 person-days (36.2%); Engines: 6447 person-days (7.5%); Helitack/Heli-rapellers: 2161 person-days (2.5%); Overhead: 25862 person-days (30.2%); Heavy Equipment: 4655 person-days (5.4%); and Camp/others: 4927 person-days (5.8%).

While the numbers show T-2 crews and Overhead to be the largest groups assigned, there is a wide range of hazards and risks associated with the resource types represented: T-1 and T-2 crews, as well as most Engines, are directly involved in the suppression effort on the fireline. Some over the personnel classified as “Overhead” are also involved in leadership positions on the fireline. Many others in “Overhead”, as well as the Helitack/heli-rapellers and Camp/others, seldom if ever are on the fireline. Their work environment is the incident Base camp, helibases and helispots, and driving the roads between the incident facilities.

Injury records from the Clear Creek fire showed that a total of seventy eight (78) reportable injuries occurred: 55 on the fireline (70.5%) and 23 in the fire camp (29.5%). On a fire that was fought for 71 days, this averaged 1.1 reportable accidents per day; coincidentally, the overall accident frequency rate for this fire was 1.1/1000 person-days worked.

Falls, both on the fireline and in the incident base camps, were the largest single cause of injuries on the Clear Creek fire; 34.6% of all injuries were caused by falls: 19 on the fireline (34.6%) and 8 in camp (34.8%). Strains were the next most frequently occurring injury (14 injuries, 17.9%), causing injuries both on the fireline (9 injuries, 16.4% of fireline injuries) and in camps 5, 21.7%). The other most significant cause of injuries on Clear Creek was from falling objects, which were 14.1% of all injuries (11 injuries): 7 occurred on the fireline (12.7%), and 4 happened in camp (17.4%).

Other injuries, which accounted for less than 10% of the totals, included being hit by rolling objects such as rocks, 2.6%; burn injuries, both on the fireline and in camp, 6.4%; vehicle accidents, 6.4%; blowing material, 3.8%; and both power tool cuts and puncture wounds at 1.3%. 3 injuries, 3.8%, were classified as “other – undefined”.

In all but one case on the Clear Creek fire, it was possible to determine both the gender and age of the injured personnel. Ten females were injured (12.8%), and 68 males (87.1%). The females suffered three injuries on the fireline, and seven injuries in camp. Their ages were 22, and 48-58 years old. The injuries included one cut, one impact from a falling object, and five falls. Three women on the fireline were injured by a rolling object, a vehicle accident, and an undefined injury. Their ages ranged from 20-45 years old. The males had 52 injuries on the fireline (76.4%) and 16 injuries in camp (23.6%). The males injured in camp ranged in age from 17-60 years of age, evenly distributed by decade.

Looking more closely at the injuries by type of individual injured, we found that while the

T-1 Hotshot crews only comprised 12.3% of the total workforce, they experienced 23.1% of the injuries overall, and 32.7% of all fireline-related injuries. The US Forest Service “Hotshots,” which were 76.5% of the total T-1 crew workforce, had 13 injuries (16.7% overall, and 23.6% of fireline injuries). Bureau of Land Management “Hotshots consisted of 6.5% of the T-1 “Hotshot” workforce, and experienced five injuries, four on the fireline (5.1% of the total, and 7.3% of the fireline injuries), and one in camp. Perhaps of more interest is that the BLM Hotshots, while comprising 6.5% of the T-1 crew workforce, experienced 27.7% of the injuries. Of the other T-1 crews assigned (National Park Service, Bureau of Indian Affairs, and state) which made up 16.9% of the T-1 crews, only the BIA experienced one personal injury on the fireline, and none in camp.

The Type 2 crews assigned to the Clear Creek fire show a decidedly different record of participation and injuries. The State, Private and Federal T-2 crews were assigned to the fire for 10216 person-days (32.0% of T-2 Crew days), while the US Marine Corps and US Army units worked 20854 person-days (68.1%).

The review of the T-2 crew accidents shows a total of 30 accidents; 27, or 90%, were charged against the federal, state and private crews, while only three accidents (90%) were reported by the military. Twenty eight of the injuries occurred on the fireline, while two occurred in camp. Twenty eight of the injured T-2 firefighters were male, and two were female. Ages of the injured ranged from 20-60 years old, with 22 of the 30 falling in the 20-39 age range.

The injury frequency rates among the non-military units, based on 1000 person-days worked, range from 0.65 for the private contract crews to 2.15 for the state crews and 2.71 for the USFS crews, to a high of 11.86 for BIA crews.

The military record of three injuries may not reflect all the injuries that occurred to their personnel, since each military unit that was deployed to the fires came with a fully staffed medical component, including medical doctors and/or physician assistants. Thirteen of the T-2 crew injuries were from falls (43.3%), while the remainder of the 17 accidents were well-distributed between impacts from falling objects (4) and rolling objects (3), burns (3), strains (3) cuts from hand tools (1), blowing material in the eyes (1) and “un-defined” (2).

Engine crews, with 6447 person-days on the fire, had only five reportable injury accidents, and three of those resulted from a single vehicle accident. The other two injuries, one fall and one injury from a falling object, both occurred on the fireline to males in their early 30's. The injury frequency rate for engine personnel was 0.78/1000 person-days.

Valley Complex Fire Injuries

The Valley Complex started several weeks later than the Clear Creek fire, and was located in an area with greater road access. It also had a large number of homes and other structures “at risk” in Montana’s Bitterroot Valley, and there was serious competition among numerous other fires for scarce resources like crews and engines.

There were a total of 51,926 person-days reported on the Valley Complex fire. Suppression

action occurred from August 2 – September 24. Type 1 Hotshot crews spent 1,417 person-days (2.7%); Type 2 crews had 18,882 person-days (36.4%), which included 12,022 person-days from the military. Engine crew had 7,240 person-days (13.9%), helitack/Helirapellers spent 1,047 person-days (2.0%), Overhead had 16,887 person-days (35.5%), Camp/Others were at 4,790 (9.2%), and heavy equipment operators spent 1,663 person-days (3.2%).

Forty three injuries occurred on the Valley Complex: 29 on the fire line (67.4%), and 14 in camp (32.6%). Of those injured, 35 were males, and eight were female. Twenty-five males were injured on the fireline, and 10 in camp; four females were injured on the fireline, and four others in camp.

Ages of those injured ranged from 16-66 years old. Females hurt on the fireline were 24-30 years old (with one unknown age), and those injured in camp were 18, 19, and 66 years old (with one unknown age). Males injured on the fireline ranged from 18-52 (with nine ages unknown); six of the twenty-five injuries on the fireline occurred on those individuals 18-20 years of age. Of the 10 camp injuries to males, ages ranged 16 – 50, with four of the injuries occurring to those males 16-17 years of age.

Type 1 crews reported only two injuries on the Valley complex, working a total of 1,417 person-days. This injury frequency rate of 1.41/1000 person-days worked is slightly lower than the rates experienced on the Clear Creek fire, in much more demanding terrain.

Review of Hypothesis

At the start of this study, three hypothesis were identified:

Hypothesis #1: Injuries to wildland firefighters are associated with:

- Type of crew/individual
- Number of days on the fire
- Number of hours on shift

Hypothesis #2: the frequency of injuries is positively correlated with environmental factors (steep slopes, loose footing, tripping on ground fuels, etc).

Hypothesis #3: There is an inverse relationship between the risk of injury and the differing levels of firefighter fitness.

Because of the incomplete and inconsistent information extracted from the ICS and medical forms, as well as the Privacy Act concerns that caused some vital information to be redacted, it was not possible to completely analyze all the data presented in the context of the three hypotheses proposed at the beginning of this study.

That being said, there were some opportunities to test our hypotheses against the data, and the following describes our findings, compared to our original expectations:

Hypothesis #1: it was not always possible to track specific injured firefighters to a specific

crew, so determining that the number of days on a fire before an accident occurred was relevant to the injury was not possible. Similarly, the lack of detailed information on the medical reports prevented us from establishing the time of the injury in nearly all the events, and so we were unable to prove or disprove this hypothesis. The data did allow us to stratify injuries by type of crews and individuals. Although the two fires recorded only a total of 121 reportable accidents, there was some evidence that T-1 crews experienced injuries at a much higher frequency rate than did some of the T-2 crews. This could be a reflection of the more difficult fireline assignments that are normally given to T-1 crews. T-2 crews from different agencies and organizations (federal, state, private and military) were more difficult to analyze, for a number of reasons. Military units provided their own medical support and did not use the established ICS reporting system to document injuries. There may have been an under-reporting of injuries among private crews because of concerns about raising the costs of Workman's Compensation for specific companies, but this remains unproven.

Hypothesis #2: the data appears to support the hypothesis that injury frequency is correlated with environmental factors such as steep slopes. Trips/slips/falls was the most frequently occurring cause of injuries, with events happening both in the fireline among experienced firefighters, and in camp among support personnel.

Hypothesis #3: the proof that there is an inverse relationship between the risk of injury and differing levels of firefighter fitness remains unproven. The existing three levels of the Work Capacity Tests (Arduous, Moderate, and Light) are based on the ICS position filled by an individual. All on-the-ground firefighters (T-1 crews, T-2 Crews, and many line-going overhead positions) all require the "Pack Test," (carrying a 45 pound pack for three miles on flat ground in less than 45 minutes). This is simply a "Pass/Fail" work capacity test, and no attempt is made to differentiate between T-1 and T-2 crews. While it is generally known that T-1 crews usually conduct physical fitness training for one hour daily during non-fire periods, and T-2 crews generally do not, the hypothesis is affected by other factors such as difficulty of assignment that cannot be measured in this study.

Recommendations

While this study only looked at two large fires that burned in Idaho and Montana during the 2000 fire season, they were representative of the large wildfires that burn across the US each year and the firefighting resources that work on them. Based on our findings, the following recommendations are offered to the wildland fire community in order to help reduce injuries that occur both on the fireline and in the fire support functions:

- Even though all individuals working as firefighters must pass the Work Capacity Test at the "Arduous" level on a yearly basis, additional work hardening efforts such as those used by the Type 1 Interagency Hotshot Crews should be encouraged among all firefighters. Although they often are assigned to the most rugged terrain and the most difficult firefighting areas, their injury rate reflects the excellent physical conditioning that they emphasize during non-fire workdays.
- Additional emphasis should be focused on the Incident Base Camp environment, and the crews and support personnel working there. Injury frequency rates among the camp

crews are higher than for fireline personnel, and while they may not seem to be as serious in nature, the frequency could also lead to increased severity of the injuries. Incident management teams should consider a Safety Officer with specific responsibilities in the Incident Base Camp when large numbers of incident support personnel are assigned.

- The injuries in the fire camp setting reflect a possible need to have a minimal fitness level for all individuals who go on fires in any capacity. Falling appears to be the greatest risk to camp workers and may be reflective of short-term or long-term fatigue.



Future Study Needs/Opportunities

As the complexity of the wildland fires in the U.S. increases, there is a growing concern about the loss of experience in the firefighting workforce. The need for better information and analysis about injuries and those that are injured is essential if we are to provide firefighters a safe workplace and reduce lost time accidents.

Because large wildland fires occur across the US nearly every year, there are ample opportunities to improve our knowledge base about wildland fire accidents by:

- Working with the major wildland fire agencies to conduct future studies in other geographic areas to parallel the work done in this study;
- Reaching agreement with Agency fire and administrative personnel so that specific, necessary demographic information (age, gender, agency/crew, etc) is not removed from research material before it is forwarded on for future studies;
- Developing a cooperative agreement that allows future researchers to be physically present in Incident Base Camp Medical unit facilities on large, long-duration fire incidents. This will enable these researchers to conduct oral interviews which may provide more in-depth information about the effects of shift length and fire assignment tour length relative to injury occurrence;

- Studying other large, long-duration fire events (such as Oregon’s “Biscuit Fire” in 2002) for comparable data with the finding developed from this study with similar resource types assigned.
- Undertaking a study is needed that will allow researchers to conduct in-depth follow-up interviews with injured firefighters to ascertain the effects of short-term and season-long fatigue on work performance and injury frequencies.

F. PROJECT PRODUCTS

2. Publications

c. Fact Sheets / Brochures / Technical Publications:

Mangan R. Wildland Firefighter Injuries in Idaho and Montana – Fire Season 2000. Final Report, 2004.

G. STATES THE PROJECT WAS ACTIVE IN

Idaho, Montana

A. PROJECT TITLE

Feasibility3: Assessment of Farmers' Exposure to Smoke from Ag Burning

B. PROJECT OFFICER(S)

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C. PROJECT DESCRIPTION

The objective was to characterize farm workers' exposure to various airborne pollutants from agricultural (Ag) burning and to assess any potential health hazards from such exposure. This project aims to:

- Investigate exposures to Ag burning smoke among farmers
- Assess potential health effects from Ag burning exposure

D. PROJECT START AND END DATES: May 1, 2002 – April 31, 2004

E. PROJECT ACTIVITIES / ACCOMPLISHMENTS

In Year 3 this feasibility study was successfully completed with the target number of Ag burning activities. With the assistance from the Washington Wheat Growers' Association, the Washington Department of Ecology, and the Columbia Conservation District, nine farmers participated in the study for a total of 10 burns. The results showed acute exposure at levels far higher than the EPA's National Ambient Air Quality Standard and the occupational standards for respiratory dust.

Study results have been communicated to the community through: two town meetings in Pullman and Spokane, Washington, June 7 and June 10, 2004. The Washington Ag Burning Task Force, the Washington Department of Ecology, and the public were included.

Summary

Methods

This study was conducted in the Columbia County, Washington in the Fall 2003. Fall burning season usually involves more acreage burned (DOE 2001) and higher pollution levels due to less atmospheric ventilation for pollutant dispersion than burns at other times of the year (Jimenez 2002). Nine farm workers were recruited for exposure monitoring. They were recruited through the Washington Wheat Growers' Association and the word of mouth. Each farmer was monitored for personal exposure to PM_{2.5}, NO₂, CO, and aldehydes on the burn day. One farmer (W01) was monitored on two separate burn days.

PM_{2.5} were collected on Teflon filters with the Harvard Personal Environmental Monitor (HPEM_{2.5}) connected to a personal pump (BGI AFC 400S, Waltham, MA) with a mass flow controller operated at 4 LPM. The HPEM_{2.5} is a single stage inertial impactor with a 50% cut point of $2.4 \pm 0.1 \mu\text{m}$ (Sioutas et al. 1999). The precision ($2.2 \mu\text{g}/\text{m}^3$) and accuracy ($0.4 \mu\text{g}/\text{m}^3$) of the HPEM_{2.5} have been determined in our previous study (Liu et al. 2003). PM_{2.5} also was measured continuously using a passive personal light scattering device without a size-selective inlet, the personal DataRAM (pDR, Thermo-MIE, Inc., Smyrna, GA), to capture short-term peaks (Liu et al. 2002). The range of concentrations measurable by the pDR is between $1 \mu\text{g}/\text{m}^3$ and $400 \text{mg}/\text{m}^3$.

NO₂ and SO₂ were monitored using the Ogawa passive personal sampler (Ogawa & Co., Pompano Beach, Florida) (Goswami et al. 2002) over the burn period. The passive badge contains two cellulose filters coated with triethanolamine (TEA). TEA reacts with NO₂ and SO₂ and form nitrite and sulfate, respectively, that can be determined with ion chromatography. Based on our previous lab work (Goswami et al. 2002), the limit of detection is 32 ppb for NO₂ and 70 ppb for SO₂ over 3 hours. CO was monitored continuously with the Langan CO monitor (Model T15, Langan Products, Inc., San Francisco, CA). The Langan CO monitor measures CO using an electrochemical sensor through the reaction of CO and water that produces CO₂, 2H⁺ and 2 electrons. Aldehyde compounds, including formaldehyde, acetaldehyde, and acrolein were measured over the monitoring period using a personal syringe-style passive sampler (PSSPS) developed in our lab (Liu et al. 2001; Kheirbek, 2003). The PSSPS consists of a modified 60-cc syringe, which contains C18 packing coated with 2,4-dinitrophenolhydrozine (2,4-DNPH). Aldehydes react with 2,4-DNPH to form hydrozones which are quantified with HPLC (Liu et al. 20010).

All personal monitors were fitted onto a backpack and carried by each farmer subject during the entire burn period. After being exposed in the field, the Teflon filters were first analyzed gravimetrically for mass gain using a 7-place electronic ultramicrobalance (Mettler Toledo, Model UMT2, Greifensee, Switzerland). The filters were equilibrated for at least 24 h prior to weighing inside a controlled environmental chamber with constant relative humidity ($34.7 \pm 2.5 \%$) and temperature ($22.4 \pm 1.9 \text{ }^\circ\text{C}$) (Allen et al. 2001). Filters were analyzed with x-ray fluorescence for trace elements by the Chester lab (Tigard, OR) and analyzed for light absorbing carbon using the integrated plate method in our lab

(Larson et al. 2004). All Teflon filters were later extracted and analyzed for levoglucosan using GC-MS (Simpson et al. 2004).

Urine samples were collected before and after Ag burning for analysis of a series of methoxyphenols (MPs). The urine samples collected before Ag burning served as the baseline of MPs in individual farmers, while the difference between the post and pre burning urine MPs gives indications of the amount of smoke entering the body. As consumption of smoked foods may produce wood smoke-like inhalation markers in urine samples, farmers were asked to record smoked foods that they consumed within the past 24 hours. This form included an exhaustive range of possible smoked foods, some of which were beef jerky, barbeque flavored chips, grilled vegetables, barbeque sauce, and beer.

Each subject recorded his/her activities and locations during the burn day on a time-activity-diary (TAD) with 10-minute resolution. The TAD included six micro-environments: working in the field, outside away from the field, indoors, driving a field truck, in a passenger car, and resting in the field. It also included a column indicating when they were near smokers and when the field was actively burning. Technicians, with the assistance from farmers, recorded the general characteristics of the burn, including the burn location (latitude, longitude, elevation), meteorological conditions (precipitation, wind speed, humidity), field conditions (crop type, acreage burned, amount of residues, and moisture content), burn type and method, type of vehicles used in field, and field burn time.

Data analysis

Quality control for the aldehydes and NO₂/SO₂ samples included 3 blank and 8 duplicate samplers. While three blanks were deployed for the HPEM_{2.5} sampler, no duplicates were used due to the prohibitive weight of adding another pump. Similarly, no duplicates were deployed with either the Langan CO monitors or the pDRs. The malfunction of one Langan monitor resulted in the loss of half of our CO data.

After the field work was completed, summary tables were made to examine the relationship between PM exposure and burn conditions. Scatter plots and non-parametric regression analyses were performed to examine relationships between PM exposure, defined as average concentration multiplied by exposure duration, $\mu\text{g}/\text{m}^3 \cdot \text{hr}$, and urinary MPs. As five NO₂ and eight SO₂ samples were below the limit of detection, these results were not analyzed further.

Major findings

The Ag burning duration ranged between 37 minutes and 3 hours (Table 1). All burns were for the winter wheat crop and occurred during a “metered” burn call condition. The total acreage burned ranged between 25 and 420 acres and averaged 149 acres. The earlier burns occurred in relatively moist conditions while the residues in later burns were much dryer. The amount of residual stubble ranged from 2000 to 10000 pounds, with an average of 7200 pounds.

Table 1. Summary of Monitored Agricultural Burns from 9 subjects (one repeated).

ID	DATE	DURATION (hrs)	ACRES BURNED	MOISTURE CONTENT	BURN CONDITIONS	RESIDUAL LOAD (lbs)	VEHICLE MODEL
W01-01	10/15/2003	1.25	125	wet to dry	head fire	10000	Honda 300 4-trax
W01-02	10/22/2003	2.08	400	dry	backing fire strip head fire		Honda 300 4-trax
W02	10/14/2003	0.62	1	wet	backing fire	10000	John Deere 3020 Tractor
W03	10/15/2003	1.00	25	very wet	backing fire head fire	2000	Honda 400 ATV
W04	10/20/2003	1.87	66	bone dry	backing fire	10000	Chevrolet 4wd pickup truck
W05	10/21/2003	2.27	154	dry	backing fire	7500	Yamaha 4x4 Kodiak
W06	10/21/2003	2.38	155	dry	backing fire head fire strip head fire	7500	Honda "Foreman" 400 Series
W07	10/22/2003	2.98	71	dry	mass ignition backing fire head fire strip head fire	4500	Honda "Fourtrax 300"
W08	10/22/2003	1.63	420	dry	mass ignition backing fire	9000	Motorcycle - Honda Fatcat
W09	10/22/2003	2.98	71	dry	backing fire head fire strip head fire mass ignition	4500	Ford F250 Lariat Diesel

For most subjects, the majority of time was spent driving their field truck while lighting the field. The percent time of the monitoring while the field was actually burning ranged from 32% to 100%. Table 2 shows the subjects’ exposure to various pollutants and the average meteorological conditions during Ag burning. Exposure to PM_{2.5} ranged between 111 and 7000 µg/m³, based on the pDR readings. SO₂ results ranged from non-detected to 107.8 ppb, while NO₂ ranged from non-detected to 79.6 ppb. Valid CO measurements ranged from 1.13 to 5.1 ppm, not very different from those observed in urban areas.

Table 2. Summary of subjects' PM exposure as measured by pDR (1-min averages), SO₂, NO₂, and levoglucosan, and environmental conditions during burns.

ID	N	pDR (µg/m ³)	SO ₂ (ppb)	NO ₂ (ppb)	Levoglucosan (µg/m ³)	CO (ppm)	T (°C)	RH (°C)
W01-01	135	1505 ± 2874	15.7	34.9	2.49	*	16 ± 2	42 ± 9
W01-02	174	5503 ± 6865	107.8	79.6	2.65	*	29 ± 3	23 ± 1
W02	67	168 ± 388	0.0	0.0	0.13	1.13	15 ± 1	58 ± 3
W03	68	1418 ± 2250	0.0	15.3	19.57	1.96	14 ± 1	55 ± 7
W04	130	111 ± 315	76.0	23.3	0.09	*	24	36 ± 1
W05	166	647 ± 1336	0.0	3.0	2.63	*	35 ± 3	27 ± 3
W06	172	4239 ± 6902	19.9	8.8	3.90	5.1	35 ± 3	28 ± 8
W07	229	2034 ± 3929	1.3	41.6	6.32	4.37	30 ± 4	31 ± 10
W08	133	6957 ± 13238	1.0	0.0	5.05	*	29 ± 2	30 ± 3
W09	197	677 ± 1378	0.0	47.4	3.01	*	31 ± 3	28 ± 6

*no data; machine malfunction

As acreage burned increases, PM_{2.5} measured by pDR increases as well (Figure 1). Similarly, levoglucosan measured in the air samples collected on by HPEM also relates to acreage. As acreage increases, levoglucosan measured also increases (Figure 2). Moisture is related to the mean pDR divided by acreage burned (Figure 3). The acreage adjustment removes biases caused by the obvious relationship between pDR readings and acreage. As the moisture ratings were subjective and made by the farmers, it is entirely likely that the two middle ratings could be very similar to each other. Levoglucosan relates to categorical moisture in much the same way as the pDR readings; as moisture increases, levoglucosan increases.

Figure 1. Categorical acreage burned vs. mean PM_{2.5} measurements on pDR.

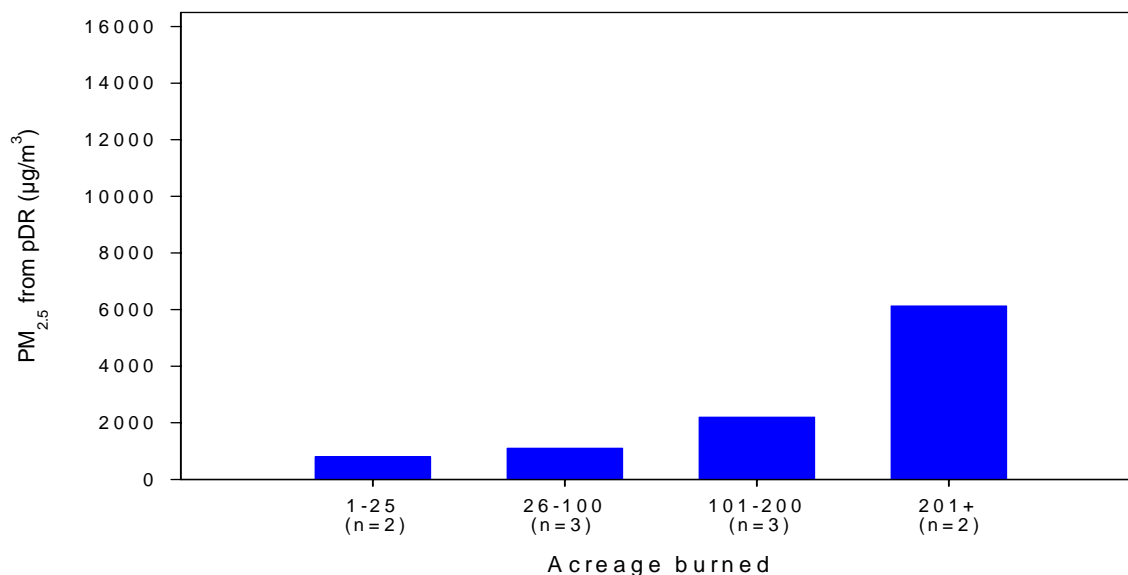


Figure 2. Categorical acreage vs. levoglucosan measured in air samples by HPEM.

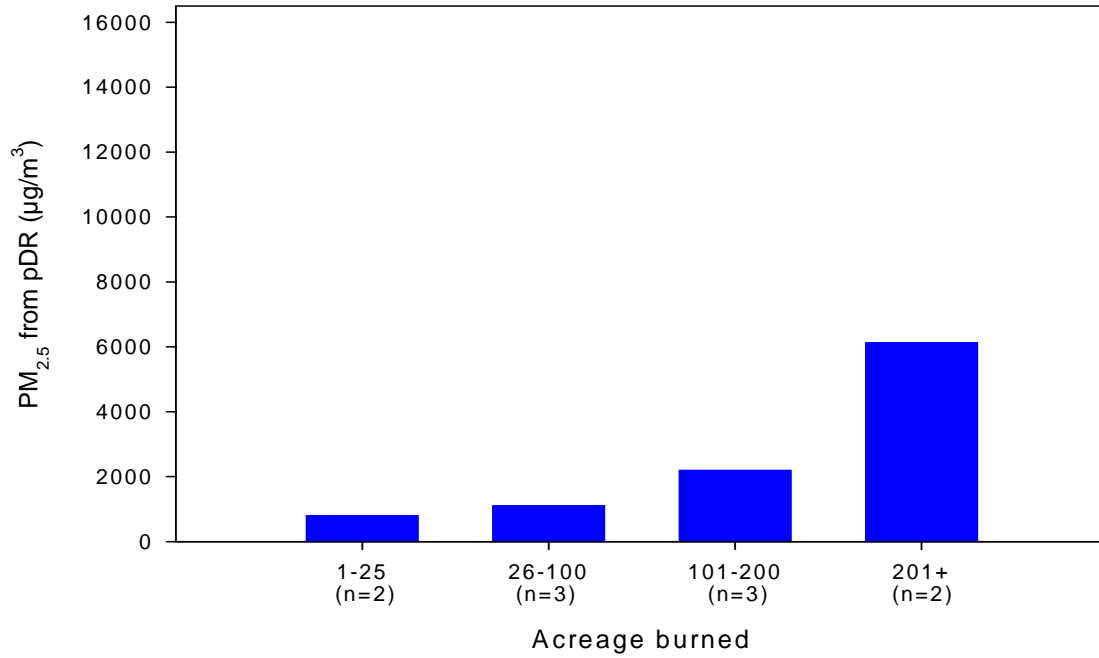


Figure 3. Categorical Moisture vs. mean pDR measurements divided by acreage burned

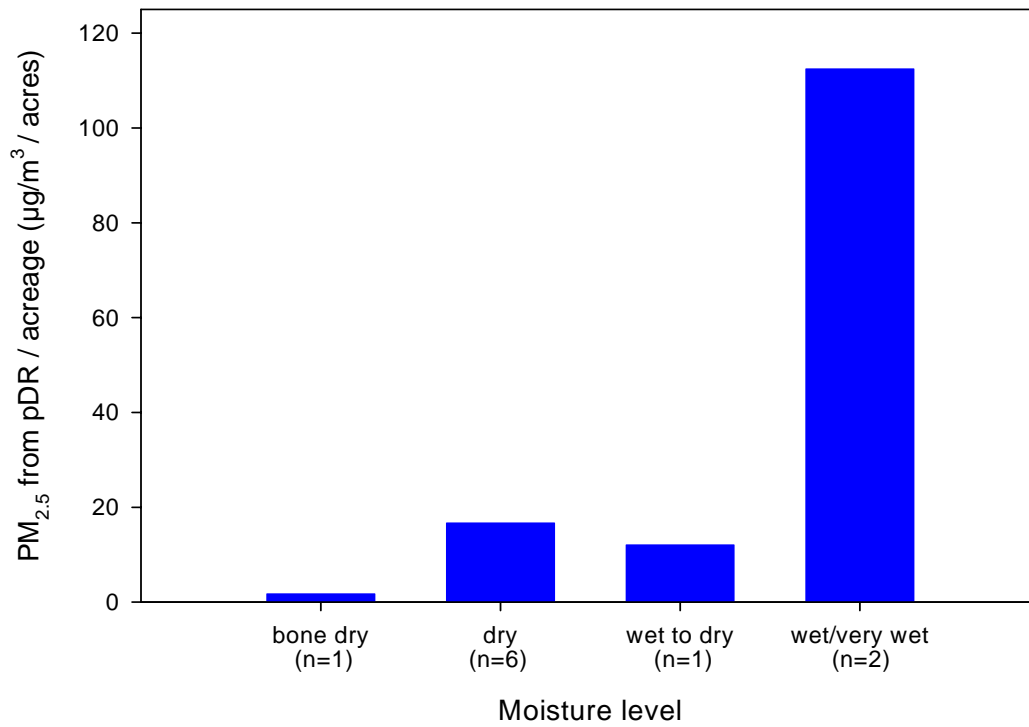


Table 3 shows the results of the analysis of the farmers' urine. The compound that was the most common among the subjects was guaiacol, with an average of 0.916 µg/ml. The least common compounds were coniferyl-aldehyde and butyryl-syringone, both with an average of 0 µg/ml.

Table 3. Results of biomass burning biomarkers in urine samples (shown as differences in exposure between post- and pre- burn).

Compound (µg/ml)	W01-01	W01-02	W02	W03	W04	W05	W06	W07	W08	Average
Guaiacol	1.018	1.826	0.938	0.087	0.220	0.586	1.293	1.174	1.098	0.916
methyl-guaiacol	0.049	0.000	0.048	0.012	0.020	0.392	0.422	0.159		0.138
2,3-dimethoxyphenol	0.062	0.056	0.042	0.002	0.004	0.032	0.349	0.114	0.022	0.076
ethyl-guaiacol	0.022	0.030	0.035	0.005	0.005	0.065	0.072	0.034	0.041	0.034
Syringol	0.114	0.149	0.005	0.010	0.008	0.508	0.132	0.866	0.404	0.244
Eugenol	0.473	1.314	0.008	0.039	0.030	0.947	1.730	2.696	0.059	0.811
propyl-guaiacol	0.001	0.001	0.001	0.001	0.000	0.005	0.009	0.003	0.002	0.003
vanillin	0.070	0.095	0.024	0.023	0.088	0.072	0.122	0.104	0.059	0.073
cis-isoeugenol	0.012	0.000	0.000			0.013	0.018	0.016	0.030	0.013
methyl-syringol	0.037	0.044	0.000	0.003	0.003	0.136	0.023	0.274	0.110	0.070
trans-isoeugenol	0.013	0.023	0.004	0.004	0.004	0.037	0.035	0.062	0.041	0.025
aceto-vanillone	0.571	0.586	0.069	0.243	0.028	0.629	0.843	0.118	1.016	0.456
ethyl-syringol			0.002	0.018	0.018	0.062		0.117		0.043
guaiacyl-acetone	0.034	0.053	0.015	0.007	0.008	0.075	0.035	0.152	0.070	0.050
allyl-syringol	0.009	0.020	0.000	0.084	0.001	0.038	0.031	0.059	0.048	0.032
propyl-syringol	0.002	0.002	0.000	0.001	0.001	0.005	0.005	0.012	0.006	0.004
syring-aldehyde	0.000	0.000	0.000	0.020	0.000	0.000	0.000		0.017	0.005
aceto-syringone	0.014	0.030	0.005	0.014	0.008	0.117	0.093	0.050	0.033	0.040
coniferyl-aldehyde	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
propionyl-syringone		0.007		0.002		0.045		0.013		0.017
butyryl-syringone	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
synapyl-aldehyde	0.028							0.010		0.019

Conclusions

Farmers are exposed to substantial amounts of PM_{2.5} while conducting Ag burning. Acute exposure to Ag burning related PM_{2.5} ranges between 111 and 7,000 g/m³, with a median of 2,326 g/m³. The PM_{2.5} exposure levels are positively correlated with the residue loads of the wheat stubble and the acreage burned. These levels are higher than the EPA's National Ambient Air Quality Standard (65 g/m³, 24-h average). Two subjects had PM averages greater than the OSHA's standard for PM_{2.5} (5000 g/m³, 8-h average). The associated health effects due to such high short-term exposures are yet to be assessed among the farmers.

F. PROJECT PRODUCTS

1. Presentations:

Liu S. Assessment of Farmers' Exposure to Smoke from Agricultural Burning. Poster presentation at the NIOSH Site Visit and Western Centers' Showcase, Davis, California, May 13, 2004.

Liu S. Washington Ag Burning Task Force, the Eastern Washington Department of Ecology, and the public, on June 10, 2004 in Spokane, Washington.

4. Conferences / Meetings Sponsored:

Town meeting: Pullman, Washington, June 7, 2004.

Town meeting: Spokane, Washington, June 7, 2004.

G. STATES THE PROJECT WAS ACTIVE IN

Washington

A. PROJECT TITLE

Feasibility4: Evaluation of the Worker Protection Standard Train-the-Trainer Model Curriculum

B. PROJECT OFFICER(s)

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C. PROJECT DESCRIPTION

PNASH initiated this evaluation project at the request the Environmental Protection Agency (EPA) and the Council for Agriculture Science and Technology (CAST).

The overall goal was to evaluate if the feasibility project, Worker Protection Standard (WPS) train-the-trainer model curriculum, ensures consistency and quality WPS training in Washington, Florida, and New Jersey, and if it is feasible as a national model. The objective of the evaluation of the pilot is to evaluate if the train-the-trainer model curriculum ensures all potential trainers obtain the basic training skills, tools, and knowledge they need to impart quality WPS training to workers.

D. PROJECT START AND END DATES: May 1, 2003 – September 30, 2004

E. PROJECT ACTIVITIES / ACCOMPLISHMENTS

PNASH was invited by the EPA and CAST to:

- Evaluate a WPS train-the-trainer model curriculum.
- Determine its feasibility for use throughout the country.
- Ensure that master trainers obtain the necessary skills, tools, and knowledge to train others.
- Impart knowledge to trainers.

Within Year 2, PNASH developed the instruments used to evaluate the trainers, the evaluation was implemented, and data analysis was underway. In Year 3, data analysis was completed and the evaluation report was submitted to the EPA/CAST at the end of February 2004.

Summary Report

Objective

Evaluations from Washington, Florida and New Jersey pilots were assessed for the ability of the program to impart key knowledge to participants, the format of the program and suggestions for improvement.

Methods

To evaluate if the goals and objectives were met, the training, education and experience prior to the training of the participants was evaluated. Then, an evaluation tool determined their perception of the trainings as well as their mastery of the information using questions regarding the information delivered. Information from three groups of study participants were involved in evaluating the program; master trainers (10), trainers (84) and trainee workers (106). Master trainers evaluated the program with a pre-evaluation tool given before their orientation, a post-evaluation tool given after their orientation and finally a tool following their training of the trainers (TOT). The trainer evaluations included questions from a pre- and post-TOT by the master trainers, a trainer evaluation following worker training, and worker and observer evaluations. Assessment of the evaluation tool questions was done by various methods including t-tests, chi square, regression, and analysis of variance. Following a worker training by trainers, trainers did a post-worker written evaluation. Workers did a pre- and post-evaluation using a Spanish or English language tape recorder and answer sheet where they circled the responses, “yes,” “no,” and “I’m not sure.”

Results

Trainer evaluation was conducted at training sites in Washington, New York, and Florida. The vast majority of participants scored significantly higher on the post-evaluation than on the pre-evaluation, showing a 56% improvement in their knowledge as trainers. The subjects with more or higher education knew more at the beginning and learned less. Sex differences in scores pre- and post-test were due to education. Once education was adjusted for, there was no difference in scores between men and women. The amount learned was not significantly different between the English speakers and the Spanish speakers. There was no evidence that number of workers the trainers had previously trained influenced pre, post, and change scores. The impact of the training program on worker trainees was evaluated in Washington, Florida, New Jersey, and Puerto Rico. Of the 106 workers who completed the evaluations, 15% were from Florida, 53% from New Jersey, 27% from

Washington and 11% from Puerto Rico. 96 were matched pre and post training for analysis. Workers completed 77% of the evaluations in Spanish and 23% in English. Puerto Rico and Washington State had predominantly Spanish speakers. In New Jersey 74% completed the evaluation in Spanish whereas in Florida 70% completed the evaluation in English. There was a 74% improvement in worker knowledge after training. Qualitatively, 92% felt they gained new knowledge. Specifically, workers learned most about symptoms of pesticide poisoning, acute and chronic exposures, drift exposure prevention, pesticide residue and that an employer could not fire them for refusing to go into a field while it was being sprayed with pesticides.

F. PROJECT PRODUCTS

1. Presentations:

National Train-the-Trainer Workgroup Report. Agricultural Worker Protection Program National Assessment and Pesticide Worker Safety Workshop. Arlington, Virginia, March 19-21, 2003.

2. Publications

c. Fact Sheets / Brochures / Technical Publications:

Boiko P, van Belle G. Evaluation of the Worker Protection Standard Train-the-Trainer Model Curriculum. Final Report, February 2004.

G. STATES THE PROJECT WAS ACTIVE IN

Washington, New Jersey, Florida, and Puerto Rico

V. SPECIFIC IMPROVEMENTS IN AGRICULTURAL SAFETY AND HEALTH THAT RESULTED FROM CENTER ACTIVITIES (RESEARCH TO PRACTICE)

1. Adoption of three interventions to reduce the take home pathway of pesticides.

R2: Workplace Determinants of Take Home Pesticide Exposure.

Three interventions were developed and adopted by a major fruit orchardist in the summer of 2004. Using the results of the baseline study as a starting point, three interventions were developed to minimize the possibility of pesticides being carried from the workplace into vehicles and then into the home:

- Thinners were given a work boot storage box and sandals so that they had an alternative to wearing their boots into their home.
- Thinners vacuumed their cars once a week using vacuums (equipped with high efficiency particulate air filters) located at a central location.
- Applicators used a locker room that was cleaned daily and had separate lockers for PPE and work clothes. Workers also washed off their boots before entering the locker room.

While the effectiveness of these interventions is still to be determined through the analysis of pesticide residues, these interventions were developed on an informed understanding of the take home pathway. Thus, we consider their adoption by a major Washington state orchardist and their workers to be a positive move toward reducing pesticide exposure to workers and their families.

2. Researchers using Virtual Corset to measure ergonomic exposures in sawmills.

Pilot 1: Developing, Testing and Objective Tool for Measuring Postural and Vibrational Exposures during Forestry and Agricultural Work.

PNASH in conjunction with Microstrain, Inc. has developed a new tool to assess postural and vibrational exposures to agricultural workers. This tool allows researchers to continuously collect data on workers, while doing their work, over the course of a day or multiple days. Studies using the Virtual Corset™ will better develop our understanding of the relationship between cumulative exposure to vibration, posture, and musculoskeletal disorders. This tool has been disseminated to researchers to use in field investigations. PNASH hopes to test this tool on agricultural populations, and currently, the University of British Columbia is using it for an ergonomic investigation in sawmills.

The Virtual Corset™ is a data logger that measures both back flexion/extension and side-to-side bending simultaneously, or can be programmed to measure limb rotation. The device is a pager-sized logger with 1 gigabyte of memory, which can be mounted on the sternum or upper back of the individual. It contains a microprocessor so it can turn itself on and off in order to collect data unattended over several days. The large memory capacity makes the ambulatory collection of data possible where previously not practical.

3. Dissemination of Hispanic safety plays in video format.

Prev1: Development of a Community Theater Troupe: Health and Farm Safety Training for Hispanic Agricultural Workers.

The Hispanic Theater project was successful in using theater to educate farm workers of safety concerns and health promotion techniques. In consultation with area producers and other educators, it was decided that a theater troupe was too expensive to find sustaining support, so instead, plays were filmed and marketed with a questionnaire to use in training.

In 2004 two videos in Spanish with English subtitles were completed and marketed on pesticide safety and reducing musculo-skeletal injuries (ergonomics). There were announced by press releases and direct contact and were streamed on the EWU Farm Center Web page. By the end of this year, orders were in from four grower associations, ten individual farms the following organizations: Oregon OSHA Resource Center; Laupus Library, Greenville, North Carolina; Sunnyside Community Hospital; Washington Friends of Farms & Forests; Texas A & M School of Public Health; Wenatchee Valley College; Yakima Valley Regional Library, and the Washington State Migrant Council.

A total of 52 videos were ordered, 30 of the pesticide safety video and 22 of ergonomics video. Overall, feedback from the grower associations, farm operators, and the organizations was positive. Of those who provide worker training, approximately 1,860 workers are expected to be trained. We will continue marketing and expect further orders on for these videos. In addition to the videos, this project developed a duplication kit, enabling other organizations to produce the plays.

4. Launching of national tractor safety initiative.

Educ2: Document Development for Prevention of Tractor-Related Injuries and Fatalities.

This project brought together all the NIOSH Agricultural Centers in their first joint project to address a known problem area. The Centers worked together to develop an informed solution to the high fatality and injury rates from tractors. While this initiative is still underway, the development and launching of the initiative to national partners at the National Symposium on Agricultural Health and Safety, June 20-24, 2004, is a first step to implementing a plan that will reduce farmer injuries and deaths.

2. Improving injury record keeping for wildland firefighters.

Feasibility 1: Wildland Firefighter Injuries in Idaho and Montana

This study reviewed injuries that were documented on two large fires, to determine if types of individuals, environmental factors, fatigue and/or fitness levels impacted the numbers and types of injuries. The major finding was that it was difficult or impossible to validate with the available data. The report back to the USDA Forest Service will emphasize that there are indicators of areas to improve firefighter safety and reduce injuries, both on the fireline and among fire support personnel in the fire camp. It also proposes future record keeping and research needs to better define the types of injuries, the resources affected, and the need to look at fire illnesses as another component of the wildland fire health and safety program. Improvements in record keeping and further investigation could lead to improved

safety and health for wildland firefighters.

3. Results given on farmers respiratory exposures during agricultural burning.

Feasibility3: Assessment of Farmers' Exposure to Smoke from Ag Burning.

In Year 3 this feasibility study was successfully completed with the target number of Ag burning activities. With the assistance from the Washington Wheat Growers' Association, the Eastern Department of Ecology, and the Columbia Conservation District, 9 farmers participated in the study for a total of 10 burns. The results showed acute exposure at levels far higher than the EPA's National Ambient Air Quality Standard and the occupational standards for respiratory dust.

The study found that farmers' average exposure to respirable particulate matter (PM2.5) during typical field burning ranged between 111 and 7,949 micrograms/cubic meter over 0.6-3.0 hours. (The EPA considers exposure above 65 micrograms/cubic meter within 24 hours to be unhealthy, especially over extended periods.) Farmers with the highest PM2.5 exposure also showed high levels of biomass burning markers in their urine. Note that farmers did try to get out the smoke's way.

Study results have been communicated to the community through two town meetings in Pullman and Spokane, Washington, June 7 and June 10, 2004, involving the Washington Ag Burning Task Force, the Washington Department of Ecology, and the public. A manuscript is currently in preparation. Sharing these results is step toward finding strategies to limit these exposures.

4. Improving WPS Training.

Feasibility4: Evaluation of the Worker Protection Standard Train-the-Trainer Model Curriculum.

PNASH hopes to reduce worker pesticide exposure, through our work in cooperation with a national team to improve Worker Protection Standard (WPS) training. In Year 3, PNASH completed its evaluation of the WPS train-the-trainer model curriculum, finding that the training was effective if increasing knowledge of WPS. This was reported to the Council for Agriculture Science and Technology (CAST) and Environmental Protection Agency (EPA).

5. Professional education for producers, workers, health care providers and safety officers. Educ1: Agricultural Health and Safety Communication and Education Project.

PNASH offered two conferences/continuing education courses, providing the latest information on Northwest agricultural safety and health to stakeholders. Each of these courses provided information that influenced the practices of producers, worker representatives, health care providers and safety officers, thus improving safety and health of agricultural workers.

Pesticide Issues Conference and continuing education course.

The Pesticide Issues conference addressed the new Cholinesterase Monitoring rule in Washington state. This course brought together varied parties and also tailored sessions for those groups: producers, workers/applications, health care providers. Each group received instruction and reference materials to guide them in implementing the rule. 140 people attended and the participant evaluation of speakers showed the high level of interest and applicability of the content.

Western Regional Conference: Cultivating a Sustainable Agricultural Workplace. This conference brought the latest research and practices to sustain workers' health and safety. The conference was designed such that the participants addressed how occupational safety and health can be integrated into sustainable agriculture practices and how research and outreach can contribute to that effort. The 110 participants were academics, producers, safety professionals, health care providers, worker advocates and other service providers. Participant evaluation comments showed that many came away with project ideas, partnerships, and practical means to improve worker's social conditions.

VI. COLLABORATION

R1: Charles Nordstrom, Engineering Consultant, UW Department of Industrial Engineering, UW Community Health Nursing Program, UW Department of Pediatrics, UW Ergonomics Program, Department of Environmental and Occupational Health Sciences Washington State Department of Labor and Industries Region 5.

R2: Washington Growers League, regional orchardists and workers

Pilot1: Microstrain Inc, Williston, Vermont

Pilot2: Eastern Washington University Communication Studies, regional farm families.

Prev1: Chicano Education and YVCC Theater, Gear-Up Program, Camas Elementary, Gear-Up Program Community Center Wapato, Hop Growers of Washington, Washington Department of Health-Pesticide Section, Washington State Department of Agriculture, Washington Department of Labor and Industries, Region 5, Therapist Consultant, Washington Department of Labor & Industries, Yakima Division, Washington Growers League, Yakima Valley Opportunities Industrialization Center, Yakima Valley Community College

Educ1: Agromedicine Consortium, Benbrook Consulting Services, California Institute for rural Studies, Columbia Legal Services, Eastern Washington University's Center for Farm Health and Safety, Far West Fertilizer Association, Heritage College, Northwest Community Action Center

(NCAC), Northwest Community Education (NCEC) Center, Northwest Primary Care Association, Farm Worker Pest Project, Oregon Health Sciences University, Oregon State University, UC Davis Center for Western Health and Safety, Radio KDNA, The United Farm Workers Union, University of California Statewide IPM Project, University of Oregon's Labor Education & Research Center, UW Northwest Center for Occupational Health and Safety, UW Office of Education Partnerships and Learning Technologies, Washington Growers League, Washington Farm Bureau, Washington State Department of Health, Washington State Department of Labor and Industries, Washington State University's Pesticide Education Program, Washington State University's Center for Sustaining Agricultural and Natural Resources, Yakama Nation, Yakima Valley Farm Workers Clinic (YVFWC)

Edu2: NIOSH (Teri Palermo, Max Lum), all NIOSH Agricultural Centers

Feasibility1: Blackbull Wildfire Services, USDA Forest Service

Feasibility3: Christopher Simpson, UW Department of Occupational and Environmental Health Sciences, Columbia Conservation District, Washington State Department of Ecology, Washington State University Department of Civil and Environmental Engineering, and workers with farming communities in Eastern Washington.

Feasibility4: Council for Agriculture Science and Technology (CAST), Environmental Protection Agency (EPA), Washington State University Agricultural Extension

APPENDIX A

I. TOTAL CENTER BUDGET FOR FY 2004

1. **Total NIOSH Expenditures: \$ 700,164 TC**
 (Final Year 3 expenditures will be reported in the Fiscal Status Report, December 2004.)
2. **In-Kind Contributions: \$ 150,000 TC**
 (Estimated effort by students, faculty consultation, partners.)
3. **Other Outside Funding: \$103,736** supplemental support of Year 3 NIOSH projects
\$103,736 in support of independent Ag S&H projects

II. CENTER PROJECTS / ACTIVITIES FOR FY 2004

1. Ongoing Projects: 3

1. Projects Completed:

No	Project Title	Project Investigators
Pilot2	Finding Common Ground: Developing, Testing and Evaluating a Narrative Based Model for Presenting Safety Information in Two Socially Diverse Farm Communities	M. Landa, P. Elkind, C. Woodruff, J. Safford
Prev1	Development of a Community Theater Troupe: Health and Farm Safety Training for Hispanic Agricultural Workers	P. Elkind, K. Pitts, C. Woodruff
Educ1	Agricultural Health and Safety Communication and Education Project	H. Murphy, P. Boiko,, M. Harrington, S. Holland, E. Swenson
Educ2	Document Development for Prevention of Tractor-Related Injuries and Fatalities	R. Fenske, E. Swenson, M. Harrington, K. Galvin, S. Holland

3. New Projects: None

4. Feasibility Projects:

No	Project Title	Project Investigators
Feasibility1	Wildland Firefighter Injuries in Idaho and Montana	M. Keifer, R. Mangan
Feasibility3	Assessment of Farmers' Exposure to Smoke from Agricultural Burning	S. Liu, C. Claiborn
Feasibility4	Evaluation of the Worker Protection Standard Train-the-Trainer Model Curriculum	R. Fenske, P. Boiko, G. van Belle

III. CENTER INVESTIGATORS

1. Scientific Investigators: Faculty (10), Staff Researchers (12), Students (7)

2. Program Support Staff: 4

IV. CENTER PRODUCTS

1. Presentations:

Res1: Barr H. Identification and Prevention of Injuries in NW Orchards: Analysis of Survey-based Worker Interviews on Risks and Hazards. Poster presentation at Western Migrant Stream Forum, January 30 - February 1, 2004, Seattle, Washington.

Res1: Feng Q. Smart Engineered Ladders for Targeted Interventions to Prevent Injuries. Poster presentation at Western Migrant Stream Forum, January 30 - February 1, 2004, Seattle, Washington.

Res1: Keifer M. Snyder K, Salazar M, Negrete M. Injuries and Other Occupational Health Issues of Northwest Orchard Workers. Panel presentation at Western Migrant Stream Forum, January 30 - February 1, 2004, Seattle, Washington.

Res1: Salazar M, Negrete M. Perceptions of Occupational Health and Safety among Orchard Workers: A Descriptive Study, Western Migrant Stream Forum. Poster presentation at Western Migrant Stream Forum, January 30 - February 1, 2004, Seattle, Washington.

Res1: Hoffman J. A Descriptive Study of Workers' Compensation Claims in Washington State Orchards. Poster presentation at the NIOSH Site Visit and Western Centers' Showcase, Davis, California, May 13, 2004.

Res1: Keifer M. Identification and Prevention of Injuries in NW Orchards. NIOSH Site Visit and Western Centers' Showcase, Davis, California, May 13, 2004.

Res1: Keifer M. Injuries in Northwest Orchards. Cultivating a Sustainable Agricultural Workplace. Troutdale, Oregon, September 12–14, 2004.

Res1: Barr H. Identification and Prevention of Injuries in NW Orchards: Analysis of Survey-based Worker Interviews on Risks and Hazards. Poster presentation at Cultivating a Sustainable Agricultural Workplace. Troutdale, Oregon, September 12–14, 2004.

Res1: Feng Q. Smart Engineered Ladders for Targeted Interventions to Prevent Injuries. Poster presentation at Cultivating a Sustainable Agricultural Workplace. Troutdale, Oregon, September 12–14, 2004.

Res 1: Hofmann J. A Descriptive Study of Workers' Compensation Claims in Washington State Orchards. National Symposium on Agricultural Health and Safety and Tractor Safety Initiative meetings, Keystone Resort, Colorado, June 20-24, 2004.

R2: Fenske R. Workplace Determinants of Take Home Pesticide Exposure. NIOSH Site Visit and Western Center Showcase. Davis, California, May 13, 2004.

R2: Galvin K. Pesticide Pathway Take Home Interventions. Cultivating a Sustainable Agricultural Workplace. Troutdale, Oregon, September 12–14, 2004.

Pilot1: Johnson P. Tool for Measuring Postural and Vibrational Exposures. NIOSH Site Visit and Western Centers' Showcase, Davis, California, May 13, 2004.

Pilot2: Landa M. Developing a Story-based Model for Presenting Safety Information, NIOSH Site Visit and Western Centers' Showcase, Davis, California, May 13, 2004.

Prev1: Piits K. Evaluating the Communication of Farm Safety Information Through Community Theater. Poster presentation at Future of Rural Peoples Conference, Saskatchewan, Canada, October 19-23, 2003.

Prev1: Pitts K. Evaluating the Communication of Farm Safety Information Through Community Theater. Poster presentation at 2004 Migrant Farmworker Stream Forum, Seattle, Washington, January 30 – February 1, 2004.

Prev1: Pitts K. Evaluating the Communication of Farm Safety Information Through Community Theater. Poster presentation at the NIOSH Site Visit and Western Centers' Showcase, Davis, California, May 13, 2004.

Prev1: Pitts K. Evaluating the Communication of Farm Safety Information Through Community Theater. Poster presentation at Cultivating a Sustainable Agricultural Workplace Conference, Troutdale, Oregon, Sept. 12-14, 2004.

Educ1: Harrington M. Stakeholder Communication and Professional Education. NIOSH Site Visit and Western Centers' Showcase, Davis, California, May 13, 2004.

Educ1: Fenske R. Sustaining the Worker. Cultivating a Sustainable Agricultural Workplace, Troutdale, Oregon, September 12-14, 2004,

Educ1: Negrete M, Murphy H. A View from the Field: How Communities Members Feel About the Research done in their Communities. Poster presentation at Cultivating a Sustainable Agricultural Workplace, Troutdale, Oregon, September 12-14, 2004,

Educ1: Negrete M, Murphy H. A View from the Field: How Communities Members Feel About the Research done in their Communities. Panel Presentation at Immigrant Worker Safety and Health Symposium, Lowell, MA, September 28-29, 2004.

Feasibility3: Liu S. Assessment of Farmers' Exposure to Smoke from Agricultural Burning. Poster presentation at the NIOSH Site Visit and Western Centers' Showcase, Davis, California, May 13, 2004.

Feasibility3: Liu S. Washington Ag Burning Task Force, the Eastern Washington Department of Ecology, and the public, Spokane, Washington, June 10, 2004,

Feasibility4: National Train-the-Trainer Workgroup Report. Agricultural Worker Protection Program National Assessment and Pesticide Worker Safety Workshop. Arlington, Virginia, March 19-21, 2003.

Carden A. Investigation of Dermal Pesticide Absorption Processes Using Attenuated Total Reflectance Infrared Spectroscopy. Poster presentation at 2004 Migrant Farmworker Stream Forum, Seattle, Washington, January 30 – February 1, 2004.

Lu C. Organophosphorus Pesticide Exposure among Nicaraguan Farmers and Their Children. Poster presentation at 2004 Migrant Farmworker Stream Forum, Seattle, Washington, January 30 – February 1, 2004.

Negrete M. Orchard Worker Case Studies. Poster presentation at 2004 Migrant Farmworker Stream Forum, Seattle, Washington, January 30 – February 1, 2004.

Saltmarsh J. Stress among Farm Workers of Mexican Descent in the Northwest United States. Poster presentation at 2004 Migrant Farmworker Stream Forum, Seattle, Washington, January 30 – February 1, 2004.

Weyraruch K. Building Informed Consent for Cholinesterase Monitoring among Pesticide Handlers in Washington State - Preparation for the Implementation of a New State-wide Cholinesterase Monitoring. Poster presentation at 2004 Migrant Farmworker Stream Forum, Seattle, Washington, January 30 – February 1, 2004.

Carden A. Investigation of Dermal Pesticide Absorption Processes Using Attenuated Total Reflectance Infrared Spectroscopy. Poster presentation at the NIOSH Site Visit and Western Centers' Showcase, Davis, California, May 13, 2004.

Fenske R. PNASH Overview. the NIOSH Site Visit and Western Center Showcase. Davis, California, May 13, 2004.

Harrington M. Stakeholder Communication and Professional Education. the NIOSH Site Visit and Western Center Showcase. Davis, California, May 13, 2004.

Lu C. Organophosphorus Pesticide Exposure among Nicaraguan Farmers and Their Children. Poster presentation at the NIOSH Site Visit and Western Centers' Showcase, Davis, California, May 13, 2004.

Negrete M. Orchard Worker Case Studies. Poster presentation at the NIOSH Site Visit and Western Centers' Showcase, Davis, California, May 13, 2004.

Saltmarsh J. Stress among Farm Workers of Mexican Descent in the Northwest United States. Poster presentation at the NIOSH Site Visit and Western Centers' Showcase, Davis, California, May 13, 2004.

Tsai M. Modeling Deposition from an Aerial Spray Application. Poster presentation at the NIOSH Site Visit and Western Centers' Showcase, Davis, California, May 13, 2004.

Weyraruch K. Building Informed Consent for Cholinesterase Monitoring among Pesticide Handlers in Washington State - Preparation for the Implementation of a New State-wide Cholinesterase Monitoring. Poster presentation at the NIOSH Site Visit and Western Centers' Showcase, Davis, California, May 13, 2004.

Yost M. Exposure of Agricultural Workers and Their Families Due to Spray Drift. NIOSH Site Visit and Western Center Showcase. Davis, California, May 13, 2004.

Fenske R. Cholinesterase Monitoring in Washington State. National Symposium on Agricultural Health and Safety and Tractor Safety Initiative meetings, Keystone Resort, CO, June 20-24, 2004.

Lu C. Saliva Biomonitoring for OP Pesticide Exposures among Farm Workers and their Children. National Symposium on Agricultural Health and Safety and Tractor Safety Initiative meetings, Keystone Resort, CO, June 20-24, 2004.

Noe C, Valazquez M, Valencia M. An Initial Investigation into Issues of Environmental and Occupational Concerns of Yakima Valley Residents. Poster presentation at Cultivating a Sustainable Agricultural Workplace. Troutdale, Oregon, September 12–14, 2004.

2. Publications

a. Peer Reviewed Journal: 3

- c. **Fact Sheets / Brochures / Technical Publications:** 14
- d. **Other Publications:** 20

3. Education / Training / Outreach

- a. **Training Seminars:** 4
- b. **Short Courses:** 2
- c. **Hazard Surveys / Consultations:** 21
- d. **Academic Training:**
 - In Academic Degree Programs: 3
 - Graduated: 4
- e. **News Letters:** 4

g. Other:

Prev1: Videos: Spanish safety plays: 1) Pesticide Safety 2) Reducing Musculoskeletal Injuries (with English subtitles) In VHS and DVD format and streamed on the Farm Center Webpage.

Prev1: Questionnaires: Two "quick" test questionnaires with answer keys and photonovelas for each play to accompany videos.

Educ1: Exhibit: Western Migrant Stream Forum, Seattle, Washington, January 30 - February 1, 2004.

Educ1: Exhibit: Pacific Northwest Pesticide Issues Conference, Yakima, Washington, February 19, 2004.

Educ1: Partnership for Protecting Agricultural Workers meeting, Ellensburg, Washington, May 26, 2004.

Educ1: Exhibit: Cultivating a Sustainable Agricultural Workplace Conference, Troutdale, Oregon, September 12-14, 2004.

4. Conferences / Meetings Sponsored:

R2: Fenske R, Galvin K, Lu C. Negrete M. Met with employer and stakeholders at site to present preliminary results and develop interventions, April 20, 2004.

Educ1: Pesticide Health Risks session at Future of Rural Peoples: Rural Economy, Health People, Environment, Rural Communities conference in Saskatoon, Canada on October 12-23, 2003.

Educ1: Research Reception at the Western Migrant Stream Forum, Seattle, Washington, January 30 - February 1, 2004.

Educ1: PNASH Outreach Advisory Committee (OAC) Meeting, Yakima, Washington, February 18, 2004.

Educ1: Pacific Northwest Pesticide Issues Conference, Yakima, Washington, February 19, 2004.

Educ1: Fishing vessel safety meeting, Seattle, Washington, May 4, 2004.

Educ1: PNASH Outreach Advisory Committee (OAC) Meeting, Troutdale, OR, September 14, 2004.

Educ1: Cultivating a Sustainable Agricultural Workplace Conference, Troutdale, Oregon, September 12-14, 2004.

Educ1: Workshop: Establishing a Research and Outreach Agenda to Integrate Safety and Health into the Sustainable Agricultural Workplace. At Cultivating a Sustainable Agricultural Workplace Conference, Troutdale, Oregon, September 12-14, 2004.

Educ2: Tractor Initiative planning meeting, Saskatoon, Canada, October 23, 2003.

Educ2: Tractor Initiative presentation to NIOSH and planning meeting, Washington DC, January 21, 2004.

Educ2: Tractor Initiative Launch and Planning meeting, Keystone, Colorado, June 23, 2004.

Feasibility3: Town meeting: Pullman, Washington, June 7, 2004.

Feasibility3: Town meeting: Spokane, Washington, June 7, 2004.

NIOSH Site Visit and Western Regional Showcase and Director's Meeting, Davis, CA, May 13-14.

5. Other Products:

R1: Consent Form: Worker Interviews (English and Spanish)

R1: Questionnaire: Worker Interviews (English and Spanish)

R1: Flyer: Recruitment for Worker Interviews (English and Spanish)

R2: Procedures: Interviewer instructions

R2: Procedures: SOP 5: Surface Wipe Sampling Procedures

R2: Consent Form: Agricultural Workers – Intervention (English and Spanish)

R2: Questionnaire: Updated questionnaire with intervention evaluation questions

R2: Questionnaire: Screening questions (English)

R2: Intervention: Work Boot Box Intervention and Instructions (English and Spanish)

R2: Intervention: Car Vacuuming Intervention and Instructions (English and Spanish) and Vacuum Check out card (Spanish)

Pilot1: The Virtual Corset - miniature two axis posture measurement system with 2 Mb of memory.

Pilot2: 88 informal farm safety/hazard stories

Prev1: Press Release

Edu1: Graphics Resource Binders

Educ1: Planning Committee: Boiko, P. Western Migrant Stream Forum, Seattle, Washington, January 30 - February 1, 2004.

Educ1: Poster: PNASH. National Symposium on Agricultural Health and Safety and Educ1: Tractor Safety Initiative meetings, Keystone Resort, Colorado, June 20-24, 2004.

Educ1: Murphy H. Thematic Table Discussion: Bridging the Gap between Employers and Workers. Cultivating a Sustainable Agricultural Workplace Conference, Troutdale, Oregon, September 12-14, 2004.

Educ1: Swenson E. Attended the WA Governor's Industrial Safety and Health Conference, Spokane, WA.

Educ2: Web site: National Tractor Safety Initiative

Fenske R. NIOSH Agricultural Center's Directors' meeting at Future of Rural Peoples: Rural Economy, Health People, Environment, Rural Communities conference in Saskatoon, Canada on October 12-23, 2003

Fenske R. NIOSH Agricultural Center's Director's meeting, Washington DC, January 20, 2004.

Fenske R. NIOSH Agricultural Center's Director's meeting, Keystone Resort, Colorado, June 23, 2004.

V. ADMINISTRATIVE REPORT

In FY 2004 PNASH Center administration had several notable developments:

- Reduction in funding from unobligated balance penalty.
- Personnel changes.
- New project proposals.
- NIOSH site visit.
- PNASH advisory meeting.

2003 Unobligated Funds

From FY 2003 (Year 2), PNASH Center had an unobligated remaining balance of \$400,640 TC from the Center's funding from CDC/NIOSH. This amount exceeded the 25% remaining balance threshold and CDC/NIOSH thus penalized the center by cutting \$50,000 DC from the Year 2 remaining balance to be carried forward into Year 3. Year 3 activities were reduced to reflect the decrease in funds. This cut was distributed across most projects evenly, with the exception of the two pilot projects and Feasibility1, which received a cut by 50% of their unobligated balance. These were cut to a greater degree because each was past their original project end date. The only projects that were not cut were those that supported outreach and education, which has typically received very little funding.

Personnel

FY 2004 saw a number of personnel changes. These are listed in order of occurrence.

On October 1, 2003 the PNASH Center hired Kit Galvin, PNASH Center Research Industrial Hygienist 3. Galvin works with Rich Fenske on his projects looking at the take home pathways of pesticides, pesticide drift and children's exposure. Galvin most recently worked with the DEOHS's Policy Analysis and Program Evaluation Initiative assessing the impact of implementing the Washington state ergonomics rule. She also comes with experience working with companies, unions, health care, and government. Kit has her Masters in Industrial Hygiene from UC Berkeley and is a Certified Industrial Hygienist and a Registered Occupational Hygienist.

In February 2004, the Center said farewell to Dr. Patricia Boiko, PNASH's Director of Outreach. Dr. Boiko worked with the PNASH Center for three years providing dedicated service to our stakeholders, developing sustaining partnerships, and conducting valuable research. Dr. Boiko left her work at the Center to pursue her other passion, documentary filmmaking.

In May of 2004, a new Director of Outreach was hired, Helen Murphy, FNP, PA, MHS. Murphy brings the Center a wonderful mix experience in health care, epidemiology, educational intervention development, and participatory research. She has a background in nursing and public health. Much of her work has been international, but she spent much of her nursing career in the Northwest and most recently worked with the Washington Department of Health. She had been active in agricultural safety and health in the west and was a known colleague through her participation in meetings and conferences. (See Appendix B for Helen Murphy's biosketch).

Maria Tchong, joined the Center over the Summer of 2004 to support the summer field activities of the Take Home Pathways project. Tchong was hired recently as a permanent Research Scientist, and will continue to support the Take Home Pathways projects, as well as others. She received her MPH and completed an industrial hygiene internship at UC Berkeley. Her BS is from the University of Washington and she previously worked on projects with the Department of Occupational and Environmental Health Sciences' Field Research and Consultation Group, and Ergonomics Laboratory.

At the end of August, Karen Snyder, Research Scientist 3 for the Orchard Injury project and El Proyecto Bienestar has left her permanent position. She will continue working on El Proyecto Bienestar by consultation. For the Orchard Injury project, a new managing researcher will be hired in Year 4 to lead the field-testing for the ladder prototype.

NIOSH Site Visit

On May 13-14, the PNASH Center along with the Western Center at Davis received a NIOSH site visit. The site visit included a one-day showcase of the two Center's projects through presentations and posters, meetings w/ NIOSH officials and other NIOSH Agricultural Center Directors. The Showcase of PNASH's current work included:

R. Fenske	<i>PNASH Overview</i>
M. Keifer	<i>Identification and Prevention of Injuries in NW Orchards</i>
P. Johnson	<i>Tool for Measuring Postural and Vibrational Exposures</i>
M. Harrington	<i>Stakeholder Communication and Professional Education</i>
R. Fenske	<i>Workplace Determinants of Take Home Pesticide Exposure</i>
M. Landa	<i>Presenting Safety Information through Story Telling</i>
M. Yost	<i>Exposure of Agricultural Workers and Their Families Due to Spray Drift</i>

Posters:

A. Carden	<i>Investigation of Dermal Pesticide Absorption Processes Using Attenuated Total Reflectance Infrared Spectroscopy</i>
J. Hoffman	<i>A Descriptive Study of Workers' Compensation Claims in WA Orchards</i>
S. Liu	<i>Assessment of Farmers' Exposure to Smoke from Agricultural Burning</i>
C. Lu	<i>Organophosphorus Pesticide Exposure among Nicaraguan Farmers and Their Children</i>
M. Negrete	<i>Orchard Worker Case Studies</i>
K. Pitts	<i>Evaluating the Communication of Farm Safety Information Through Community Theater</i>
J. Saltmarsh	<i>Stress among Farm Workers of Mexican Descent in the Northwest</i>
M. Tsai	<i>Modeling Deposition from an Aerial Spray Application</i>
K. Weyraruch	<i>Building Informed Consent for Cholinesterase Monitoring among Pesticide Handlers in Washington State - Preparation for the Implementation of a New State-wide Cholinesterase Monitoring</i>

New Project Proposals

PNASH developed and submitted two proposals to the Department of Occupational and Environmental Health Sciences for Washington state funds for the biennium 2005 to 2007. Each of these was funded and include:

Fluorescent Tracer Technique for Hands-on Pesticide Handler Training: Development and

Evaluation (supplement of NIOSH funded project).
Communication of Pesticide Health Risks to Agricultural Producers, Workers, and their Families

Proposals were also submitted for NIOSH funding through the component project supplement to NIOSH Agricultural Centers. The PNASH Center submitted four proposals, 3 of which were funded:

Fluorescent Tracer Component for Hands-on Pesticide Handler Training

This project will improve education for pesticide handlers by developing and evaluating a model fluorescent tracer (FT) module for hands-on training by pesticide safety educators. Pesticide handlers will be able to see immediately the potential for pesticide contamination by viewing results of proper and improper handling techniques. This training will provide them with the skills and knowledge to minimize their exposure to pesticides and protect their health. We will develop this module in collaboration with pesticide safety educators from the Washington state Department of Agriculture and Agricultural Extension Service. After regional testing and refinement, PNASH will produce print and Web-based model FT training materials for use nationally.

An Incentive Intervention Program to Encourage Ergonomic Behavior in Latino Farm Workers

This innovative training program will use videotaped Spanish language theater, hands-on demonstrations and practice, and photonovela handouts to train workers on sound ergonomic practices. The project will train 400 migrant and seasonal orchard and packinghouse workers and their supervisors at four worksites in Yakima County, Washington. It will also test if using a Washington state certificate of completion serves as an additional incentive to change ergonomic behaviors.

Communication of Pesticide Health Risks for Children of Agricultural Families

Led by principal investigator, Catherine Karr, UW Pediatric Environmental Health Specialty Unit, this project provides health care professionals with current scientific information regarding neuro-developmental health risks for children with exposure to organophosphorus (OP) pesticides. Neurodevelopmental effects of OP pesticides are the subject of much current research. New findings are published regularly, and there is substantial uncertainty regarding health risk and the relevance of this information to health care providers. PNASH will conduct a systematic and comprehensive review of the issue, synthesizing research results and translating them into public health messages that serve the targeted health care providers. PNASH will develop and distribute to providers case-based educational curricula in print and Web-based formats.

The last new project proposal was submitted to the California Endowment in partnership with the UC Davis Western Center. The subcontract proposal, UW Exposure Assessment Component: Center for Agricultural Worker Health Research for the *Center for Agricultural Worker Health Research* has not yet received award notification.

PNASH Advisory Meeting

The PNASH advisors (both scientific and stakeholder advisors) convened in FY 2004. On February 18 the Outreach Advisory Committee (OAC) met and on September 14 a joint meeting was held with the OAC and scientific External Advisory Committee. Through these meetings the Center gained an understanding of issues important to the region and ideas for PNASH's future direction under the next five-year cycle.