

1996 ANNUAL REPORT



High Plains Intermountain
Center for Agricultural
Health and Safety

Colorado
State
University

Project Director's Statement



Dr. Roy Buchan

Agriculture and agribusiness make up less than 5 percent of the U.S. workforce, yet a disproportionately large number of workers in agriculture experience injury, disability, disease, and death each year as a result of their work environment. Agriculture is

America's most dangerous occupation. The High Plains Intermountain Center for Agricultural Health and Safety (HI-CAHS) was established in 1991 as one of four national centers charged with the challenge to address agricultural health and safety problems through educational programs, research, and direct services designed to prevent disease and injury.

This is truly a year to celebrate, since HI-CAHS was recently awarded five more years of National Institute for Occupational Safety and Health (NIOSH) funding to carry out the center's activities. This is a testament to the high level of success HI-CAHS has achieved in its first five years of operation. There are now eight national centers in agricultural health and safety.

It is a HI-CAHS responsibility to take its program throughout the Rocky Mountain region. Principle funding is from NIOSH, but it is supplemented with in-kind support from the Occupational Safety and Health Administration (OSHA). The

Center continues to work with the Environmental Protection Agency (EPA) and its training materials regarding the worker pesticide safety training initiative. HI-CAHS success is tied to a growing network of farmers, ranchers, agribusinesses, Cooperative Extension, many farm and ranch associations, and a very active Advisory Board representing a broad spectrum of agricultural interests and expertise. The Center is also multidisciplinary with input from agricultural engineers, social workers, industrial hygienists, safety consultants, epidemiologists, toxicologists, general environmental health specialists, and professional educators.

We are thrilled to have the program funded for another five years. HI-CAHS commitment to agriculture remains strong, with solid support from its constituency. We shall continue to serve the agricultural community, with our overdrive engaged to save lives, prevent disabilities, and check disease due to conditions in the agricultural workplace.

HI-CAHS Advisory Committee

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Research: Molecular Biomarkers of Grain Dust Exposures

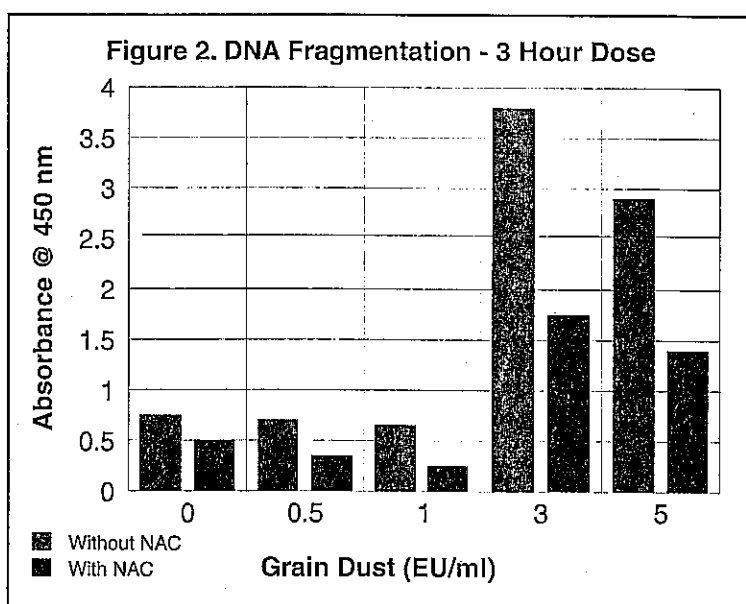
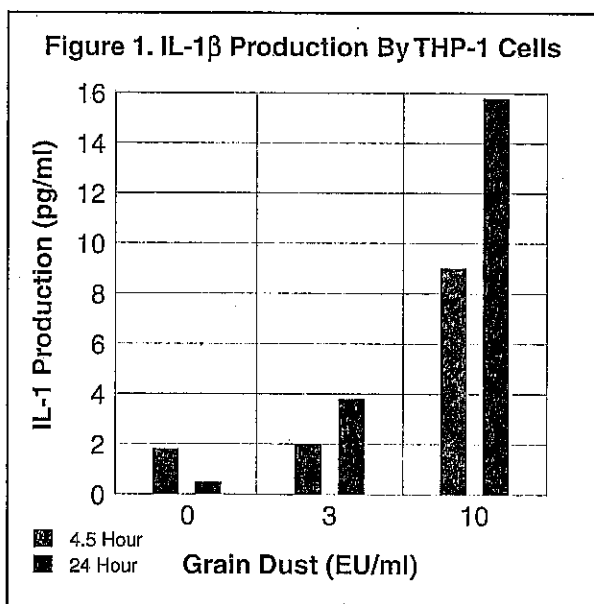
This past year, toxicology researchers at HI-CAHS have identified the major human cell responses that contribute to pulmonary injury following exposures to grain dusts. Human lung cells that were exposed to extracts of grain dusts, including winter wheat dusts collected at Colorado farms and grain elevators, demonstrated elevated levels of pro-inflammatory cytokines (Figure 1) and reactive oxygen species. Once again, as was demonstrated in previous studies using rodent cells, the extent of these responses did not correlate precisely with the levels of bacterial endotoxins present in the dust samples. We firmly believe that the presence of other, as yet unidentified, contaminants in grain dusts

contribute markedly to their pulmonary toxicities in exposed individuals.

Studies were also begun to identify potentially protective agents that can inhibit injury in grain dust-exposed cells. Figure 2 demonstrates the inhibition of cellular DNA damage in human monocytes that were pre-treated with an antioxidant agent, NAC, prior to their exposures to grain dusts. These studies have elucidated both the pathways of cellular damage, as well as possible clinical interventions for occupationally exposed individuals with chronic inflammatory respiratory diseases.

Ongoing and future studies will begin screening individuals exposed to grain dusts in the workplace in

order to develop our laboratory studies for application to worker surveillance and protection programs. In addition, we have begun a nationwide initiative that will link the NIOSH Agricultural Safety Centers in order to collect grain dust samples from the major geographical areas of agriculture in the United States. In collaboration with NIOSH laboratories in Morgantown, West Virginia, we plan to perform multiple analyses of grain dust components and to correlate the levels of these agents to toxicities in human cells. In this fashion, we hope to derive a more precise indicator of the potential human health threat of dust samples, so a reliable worker protection standard can be adopted for agricultural dusts.



Engineering Control Strategies Based on Tractor Stability

Agricultural tractor overturns are a leading cause of fatalities in the agricultural industry, resulting in an estimated one out of every five on-farm fatalities (National Safety Council). Although the installation of Rollover Protective Structures (ROPS) can significantly decrease the seriousness of injury during field upsets, it does not prevent the accident from occurring.

Tractor overturns need to be reduced, and operators need to be alerted and/or protected when they are operating in a condition potentially hazardous for a field upset. In addition, deployment of safety control features – including ROPS, restraint systems, stabilizing maneuvers and/or warnings – need to be implemented based on reliable measurements and models of tractor

stability. The factors involved in tractor stability include speed, slope, center of gravity, wheel base, tread width, and turning radius. From these factors, a stability model to determine the degree of stability of tractor operations was developed, along with a stability index. The stability index determination incorporates the dynamic

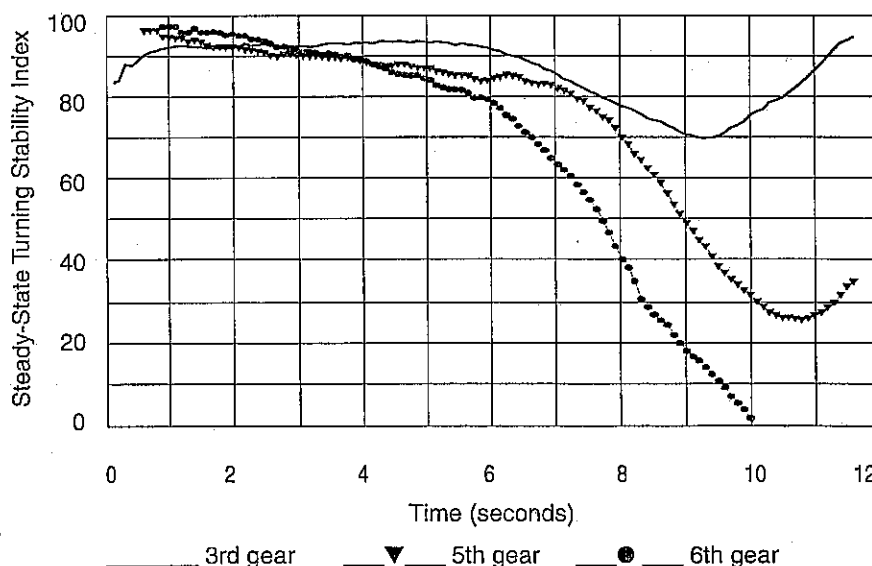
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Engineering Control Strategies (continued from page 3)

measurements, physical tractor characteristics, and stability models to produce an index from 0 to 100 – 0 indicates a tractor operating under conditions where an upset is likely and 100 indicates high stability (tractor on level terrain with no velocity).

The overall objective of this project is to develop and evaluate a tractor stability monitoring system designed for monitoring relative tractor stability and engineering control deployment strategies. A radio-controlled Ford 8N tractor has been equipped with the stability monitoring system including sensors to monitor pitch and roll angle, rate and acceleration, yaw rate, and ground speed. Verification of the stability index model for the deployment of engineering control strategies is underway with field testing on slopes ranging from 15 to 60 degrees at the Agricultural Engineering Research Center. Model parameters have been chosen based on rigid body and dynamic analysis.

Figure 3. Upset Test



Video technology was incorporated to assist in model verification. Results indicate the ability of the model to predict a tractor field upset (stability index < 0) when the tractor is operated in 6th gear (see Figure 3). The model correctly indicated non-upset situations when operating in

3rd and 5th gears. The application of the stability monitoring system for the deployment of engineering control strategies will be explored in various field upset conditions, including longitudinal and lateral overturns.

Research: Colorado Agricultural Fatalities, 1989-1995

Work-related traumatic injury each year claims the lives of an average of 15 persons performing agricultural tasks in Colorado. Using data from the Colorado Fatality Assessment and Control Evaluation (FACE) program, HI-CAHS conducted a descriptive study of the Colorado agricultural fatality experience for the seven year period of 1989-1995. The objectives of the study included (1) broadening the understanding of the circumstances surrounding the state's agricultural deaths; (2) identifying potential risk factors for agricultural fatalities in the Rocky Mountain and High Plains regions; (3) using this information to correctly target education and injury prevention efforts; and (4) developing a system for regional use of relevant FACE data.

The Colorado FACE Program, a NIOSH occupational fatality surveillance effort located within the

State Health Department, compiled information on all fatal work injuries from death certificates, workers' compensation claims, coroner and law enforcement reports, media clippings, and on-scene accident investigations by the FACE investigator. Between January 1, 1989, and December 31, 1995, 107 agricultural fatalities were investigated and included in the FACE database. These cases were analyzed and described by fatality type and agent, victim characteristics, and occupational, geographic, and environmental factors.

Ninety-five percent of the victims of agricultural work fatalities were male. Most (78.5 percent) were working in agricultural production (farming and/or ranching) or agricultural support activities (16.8 percent) when the injury occurred. About one third of the victims were farm or ranch owners/operators or family members;

another one third were hired hands or migrant workers. Farm machinery such as tractors, loaders, and ATVs were the most frequent sources of fatal injury, causing 39 fatalities. Of the farm machinery deaths, the three most frequent causes of death were from vehicle overturns (12), run-overs (12), or collapse of equipment or loads onto the operators (9). Fatal injuries tended to peak during the summer months. However, when separated by type of production, the fatal injury experience of livestock producers did not show the same seasonal peak noticed in crop producers.

Additional agricultural fatality data from Colorado FACE for 1996, as well as statistics from other states in the region, will be added to the dataset. This information will be used by HI-CAHS to assist in targeting research and when planning intervention efforts.

Research: Economic and Social Impacts of Agricultural Occupational Fatalities

Very little information is available on the economic and social impacts that occur on a farm or ranch and in the wider community following a fatal agricultural occupational injury. From studies in other industries, and from a few previous retrospective studies among farmers, it is believed that the long-term impact of the loss of a wage earner is devastating. Of foremost importance is the personal loss of a loved one to family and friends, as well as the serious impact of the income loss on surviving family members. Because agriculture is often based upon a family or other self-sufficient unit of production, the impact is potentially greater than in other occupations. In addition, some of the usual safety net benefits found in other industries

are often not available or affordable for the family farm operation.

HI-CAHS researchers (with assistance from the Colorado State Department of Agricultural and Resource Economics, the Colorado and Wyoming Fatality Assessment and Control Evaluation Programs, and Cooperative Extension Services) are seeking to fill some of the knowledge gaps that exist for this very important part of the American workforce. The NIOSH-funded FACE projects are mandated to investigate occupational fatalities. Following the investigations of agricultural fatalities, and should it seem appropriate, the FACE investigator will offer a description of the research project to the surviving family members or former employers of the victim. If there is interest

in participating, the HI-CAHS research team will be invited to contact the potential participants to further explain the study. Persons who agree to participate in the study will be contacted, at their convenience, for an initial interview and periodic follow-up visits. At no time will there be pressure to participate or continue if participants feel uncomfortable. In the past, it has been found that families and friends of the fatality victims may wish to share their experiences with others in a desire to prevent other similar incidents. With the assistance of participants, HI-CAHS hopes to better understand the economic and social impacts of agricultural trauma and lend further support to prevention programs.

Research: Designing Safety Warnings and Instructions

With funding from the High Plains Intermountain Center for Agricultural Health and Safety (HI-CAHS) and the Colorado Injury Control Research Center (CICRC), we (a) developed a database of communication and injury-prevention literature relevant to designing agricultural safety warnings and instructions; (b) pretested focus groups as methodology for developing this model on two agricultural populations; (c) drafted a procedure for usability testing of agricultural warnings and instructions; and (d) conceptualized a communication research-based process for designing farm and ranch safety messages.

Our database includes more than 850 articles covering:

- risk communication
- safety warnings and instructions
- information design
- agricultural warnings and safety
- hypertext
- usability testing
- farmer computer use

First, we developed a protocol for compiling keyword lists and

constructing abstracts and entered them in the database, and then we organized the articles by topic area and authors' last names. We used Nota Bene/Oberon's Citation 7 as our bibliographic database, which operates in both WordPerfect 6.1 and Microsoft Word 6.0.

Second, we evaluated the effectiveness of focus groups as a qualitative research method to assess agricultural warnings and instructional needs. We conducted focus with two groups of farmers — owners/operators and part-time farmers. The focus groups provided insights into the participants' perceptions of agricultural injuries, circumstances associated with injuries, and perceptions of warnings and instructions. In addition, we developed contacts with key agricultural leaders and gained insights into how different groups approach agricultural safety warnings and instructions.

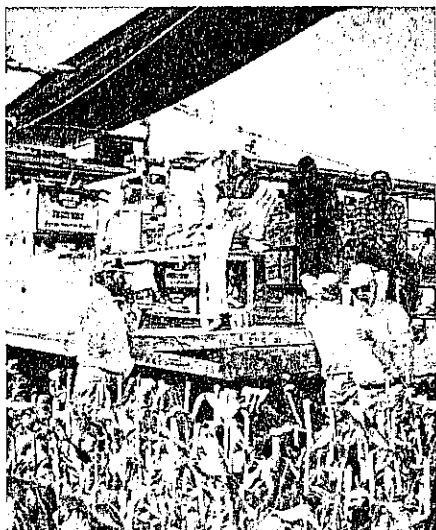
Third, we drafted a procedure for usability testing of agricultural warnings and instructions. Usability

testing consists of having subjects talk aloud as they read/view instructions and carry out tasks.

Finally, we conceptualized a formative, research-based model for designing agricultural warnings and instructions. We are drafting an article based on our conceptualization.

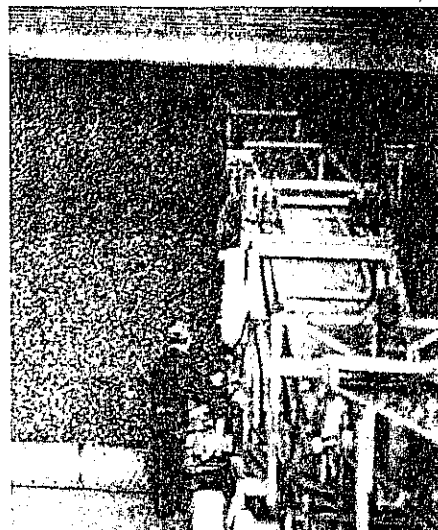
Based on the foregoing, we conceptualized a five-year communications research program designed to enhance agricultural warnings and instructions. Our agenda includes (a) developing a web of causation for agricultural injuries and a segmentation strategy for audience analysis; (b) exploring alternative designs for print instructions and warnings; (c) exploring alternative designs for delivering agricultural warning and safety information over the World Wide Web and CD-ROMs; and (d) assessing the effectiveness of an information campaign/ technology transfer program designed to reduce agricultural injuries.

Outreach: On-Site Health and Safety Services



The focus of health and safety services this year was modified to stress programmatic issues. Health and safety programs have long been recognized as valuable tools in reducing accidents and illness. Therefore, HI-CAHS members have begun to assist agricultural opera-

tions in recognizing the need for developing these programs. Safety and health audits and program assistance performed on request at farms or agricultural businesses continue to be significant outreach activities of HI-CAHS. These strictly confidential services are provided free of charge to clients to point out potential hazards and to train owners and managers in hazard assessment and correction. Services can involve a comprehensive workplace safety hazard audit, health/industrial hygiene audit, and evaluation of any written company safety programs. The survey can be in the form of on-site, hand-written notes or a more formalized, written, standard-referencing report. Once the clients understand that our program is not regulatory and that they are the only recipients of the report, the latter format is by far the most requested. During the survey and in the report, our effort is



educational and reference appendixes are often included. During the past year, 25 comprehensive health or safety audits were completed. Nine of these were conducted in combination with the silica dust study during the potato harvest.

Outreach: Training and Education Activities

During our fifth year, HI-CAHS staff members conducted 76 training and education activities impacting 4,345 individuals. Twenty-nine of these sessions were requested as a result of the pesticide training efforts initiated by the Center in cooperation with the Environmental Protection Agency. Many of the pesticide training sessions (21) were conducted at labor camps, during which migrant workers received valuable health and safety information and became certified under the WPS program. Although the formal Worker Protection Standard (WPS) training program was finished last year, HI-CAHS has become recognized as a source of quality health and safety assistance.

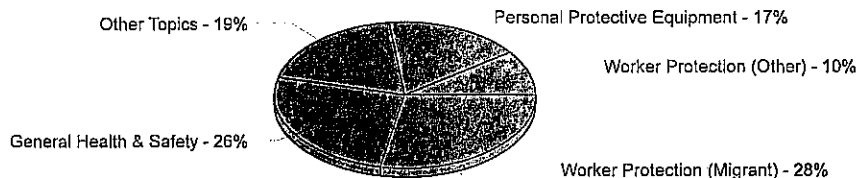
Pesticide health and safety training was the most frequently requested topic for training and

education. However, several other health and safety topics were frequently requested and made up a large portion of the educational effort. Figure 4 shows the major categories of training and education provided by HI-CAHS. Personal protective equipment is a frequently requested topic, but information on general health and safety in agriculture is the most common topic of interest to diverse audiences.

The recipients of these services were as diverse as the topics. Farm and ranch children were a major audience again this year, and 1,874 received health and safety information. Agricultural workers and business owners, health care providers, college students, and government employees received training provided by HI-CAHS.

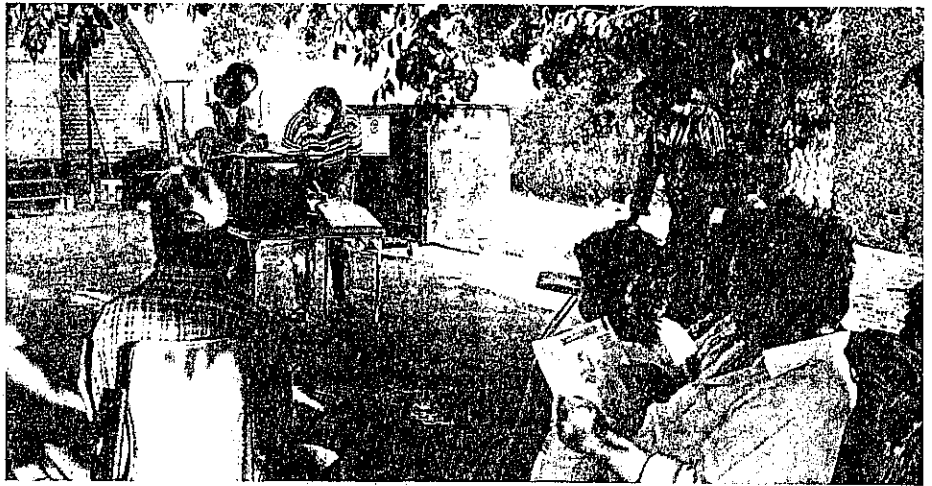
Figure 4. Training and Education Activities

Major categories as a percent of total effort.



Outreach: Migrant Worker Activities

Pesticide training provided for migrant workers reached 482 individuals this year. There has been a growing interest in helping this labor force become certified under the EPA Worker Protection Standard. HI-CAHS has responded to the need using EPA-approved, bilingual training materials for the 21 sessions conducted both at private farms and the migrant labor camps in Boulder, Weld, and Larimer counties. HI-CAHS staff members also continued to provide health and safety services to the migrant farm worker population in the area. Sixteen migrant housing camps were visited this year. Health, safety and environmental audits were completed at the housing facilities, and hazard control recommendations were provided to camp owners/managers. Well-water samples also were taken and analyzed to help assure a safe drinking water supply at the camps. HI-CAHS members also assisted SALUD clinic personnel with mosquito trapping.



Outreach: Education and Training Product Development

In 1995, the HI-CAHS Education and Training staff created a product entitled *Experiential Learning: Theoretical Underpinnings*. It strongly recommended that learning has the potential to increase if the facilitator uses a learner-centered approach, utilizing the learners' experiences and knowledge in the learning process. The facilitator develops methods in which the learners interact with, and reflect on, the subject matter. In 1996, we felt that, in order to better design booths, exhibits, workshops, and courses, it is important to first look at the theories of why people behave the way they do when they decide to act, or not act, on the health and safety information. The monograph, *Promoting Safe Behavior: Theoretical*

Foundations, examines several theories of behavior and their applications to industrial and agricultural safety programs.

As a follow-up to these theoretical monographs, several others were developed that have more practical implications for the agricultural health and safety specialist. *Hands-On Booth Exhibits: Visitor Learning and Design Basics* is intended to help booth designers and safety information disseminators understand the latest information about message design. It looks at why the hands-on interactive booth design is best for visitor learning and reviews the basic construction and layout of an educational booth exhibit. Another monograph that will help the agricultural health and safety

specialist design workshops and seminars using hands-on educational techniques is *Hands-On Workshop/Seminar: Design of Instruction*. It should be available in early 1997.

The case method is one of the best experiential learning techniques that an agricultural health and safety specialist might use in a course, seminar, or workshop. This teaching and learning method utilizes a participant's experiences, requires the learner to participate in the action, and advocates reflection on what is happening during the activity. *The Case Method: Theory and Application* discusses what a case is and how to develop and implement a case for instructional purposes.

Evaluation: Program Assessment and Resource Development Unit

The Program Assessment and Resource Development (PARD) Unit of HI-CAHS provides a range of evaluation services both to programs within HI-CAHS and to organizations outside of HI-CAHS committed to the prevention of agricultural injury and disease. Summaries of two major evaluation research projects accomplished by PARD during the 1995-96 project year follow.

HI-CAHS provided numerous "Train the Trainer" education sessions in 1984 and 1985 to help inform the agricultural communities in Colorado and Wyoming about the requirements of the EPA's Worker Protection Standards for Agricultural Chemicals (WPS). PARD staff contacted a sample of course participants one to two years later and asked them to evaluate the training based upon the usefulness of the presented information and resource materials, and on the extent of any additional training by the EPA designated trainers. More than three-quarters of our respondents had used the information presented in the training within their agricultural professions, and all of the EPA

prepared resource materials were judged useful by the respondents. Almost 50 percent of the participants had provided training to others in their worksites or communities, with a median of 10 additional persons trained per trainer. Workshops, newsletters, and media releases by Cooperative Extension, agricultural chemical dealers, and HI-CAHS were identified as preferred sources of information concerning agricultural chemical safety. Participants also provided feedback as to what chemical safety issues are emerging as the most challenging for the agricultural community. Continued and targeted advice on how to best comply with the WPS and a growing need for culturally appropriate training materials for Spanish-language field workers were identified as areas of concern among our respondents.

The second major PARD project was a process evaluation of the National Committee for Childhood Agricultural Injury Prevention (NCCAIP), a unique consensus development project. The Children's Safety Network and the National Farm Medicine Center (NFMC) led

a unique consensus development effort related to the prevention of agricultural-related injury and disease in children. Consensus development seeks to synthesize the knowledge base in a particular field and develop agreement and/or recommendations for practitioners based upon that agreement. Over a 16-month period, 42 committee members, representing a wide variety of expertise, drafted and finalized a report, *Children and Agriculture: Opportunities for Safety and Health* (NFMC, 1996). The process evaluation, undertaken by PARD personnel, sought to provide information for others who may choose to use a similar approach to consensus development among targeted experts. NCCAIP committee members, as well as representatives of agricultural organizations who provided input during the early drafting of the document, were interviewed by telephone. The process evaluation addressed procedures, perceptions of the process, committee membership, project objectives, and recommendations for future consensus development efforts.

HI-CAHS Staff

From Left to Right: Juhua Liu, Don Quick, Bart Beaudin, Don Beard, Lori Bereret, Roy Buchan, Del Sandfort, Sue Hewitt, Greg Cosma, Marilyn Davis, Sue Tungate, Ed Hendrickson, Vicky Buchan, Martha Vela, Bret Bowman, Paul Ayers. Not Pictured: Nina Whitehead & Don Zimmerman.



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