

Improving the Health and Safety of People Working in Agriculture in the West

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WCAHS YouTube Channel: [youtube.com/channel/UCCrF9GcijzIdd2shYwCFGjw](https://www.youtube.com/channel/UCCrF9GcijzIdd2shYwCFGjw)

Ag Centers' YouTube Channel: [youtube.com/user/USagCenters](https://www.youtube.com/user/USagCenters)

SECTION ONE

Center Summary, Administration & Evaluation



Summary

Agriculture in the Western United States represents one of the most labor-intensive and productive operations in the world. California's agricultural industry alone is the largest and most diverse in the nation, producing two-thirds of the country's fruits and nuts and one-third of the country's vegetables.

WCAHS' mission is to improve the health and safety of farmers, farmworkers, and their families and communities, with particular consideration of those issues unique to western agriculture in the states of Arizona, California, Hawaii, and Nevada, where more than 30% of the nation's farmworkers live. Agriculture ranks among the most hazardous occupations in the United States and WCAHS has a direct public health importance by increasing the understanding of what causes injuries and illnesses in this population and applying the findings to develop interventions.

Research accomplishments include the recognition of inorganic dust as a cause of respiratory disease in agriculture, ergonomic changes to reduce injury in grape harvest, new assays for pesticide monitoring, outreach to farmworkers on pesticide and heat-related illness prevention, and addressing the health impacts of migrant status on farmworkers. WCAHS works with regional growers, industry, labor, governmental and non-governmental organizations (NGOs), and community groups to address agricultural safety and health issues through the translation of research results into effective workplace interventions.

WCAHS is located at the University of California, Davis, which is ranked number one in the United States for its agriculture program.

Center Administration

The WCAHS administrative team, including the Director, Associate Director, Outreach Director, Research Director, and Center Manager meet at least twice a month to review, prioritize, and advance Center activities. The administrative core provides leadership in convening center faculty and stakeholders in research and advisory meetings.

WCAHS hosted several events during 2018–2019, including the annual WCAHS Seminar Series and a Fall Symposium. Seminar topics for the 2018–2019 academic year included air quality on dairies, alternatives to soil fumigation, harvest-aid robots, health care for vulnerable populations, and chemical compositions of wildfires. The Fall Symposium featured WCAHS-funded research from core investigators, small grant awardees, and graduate students. It also highlighted sexual harassment in agriculture, a WCAHS emerging issue topic, through panel and roundtable discussions. Speakers from a state agency, advocacy organization, and university researchers spoke about the topic from their vantage point, highlighting the vulnerability of agricultural workers to sexual harassment and assault. A second panel explored persistent and emerging safety issues with perspectives from an agricultural industry-serving insurance company, a large California grower, the California Farm Bureau, and a university extension specialist.

Communication

WCAHS continues to disseminate agricultural health and safety information utilizing numerous formats to target our diverse stakeholders. Our electronic newsletter features WCAHS research, outreach, funding opportunities, and center events through topical monthly themes. *Próximamente*, our bilingual electronic newsletter, targets the agricultural community (e.g., growers, farm supervisors, farmworkers) with safety tips, regulatory reminders, and training event opportunities. WCAHS utilizes social media to connect with other researchers and agencies (i.e. Twitter), growers (i.e. Instagram), and UC Davis centers and institutes (i.e. Facebook).

Evaluation

The WCAHS evaluation component assesses the impact of the Center's research and outreach efforts, as well as the Center overall. The evaluation team collects data from program records and study investigators to document outputs and outcomes. WCAHS evaluation findings are shared to develop and disseminate best practices for evaluating NIOSH Agricultural Health and Safety Centers. Evaluation supports Center-wide activities, including systematically tracking all

outreach trainings and events, evaluating participant experience of the annual symposium, synthesizing External Advisory Board feedback, and evaluating the small grant program.

In June 2019, the WCAHS evaluation team conducted an evaluation of small grant awardees from 2016 to 2018 to determine outcomes and activities related to their WCAHS-funded research. The primary goal of the WCAHS small grant program is to encourage the development of creative research and intervention projects while nurturing researchers

who are new to investigating agricultural health and safety. Results indicated that many grantees have been successful in furthering and disseminating their work. Forty percent of grantees noted they had formed new collaborations, 25% reported receiving subsequent funding, and 15% had a subsequent publication. These numbers are impressive considering the relatively short timeframe since grantees had received their small grant award from WCAHS. The evaluation team will conduct a similar evaluation on outreach awards in the upcoming year.

Cross-Center Collaboration

WCAHS was highly engaged in the planning and implementation of the Western Agriculture Safety and Health Conference—Cultivating Collaborations, held in Seattle, WA in August 2019. In addition to participating in the conference steering committee, WCAHS led all communications and promotion efforts. WCAHS faculty, staff, and students were involved in leading two thematic sessions, giving numerous presentations, and presenting 10 posters.

WCAHS is an active participant in the Agriculture, Forestry, and Fishing (AFF) Evaluation, Communication and Outreach (ECO) Group, a cross-center forum that enables all 11 AFF centers to share approaches to evaluation and outreach and collaborate on priorities, challenges, and opportunities. From April 2018 to February 2019, the outreach and evaluation staff led ECO calls, facilitated call discussions, and took notes. The WCAHS outreach and evaluation team has since participated in all subsequent calls. WCAHS contributes to cross-center safety campaigns by ensuring content is translated into Spanish and is culturally tailored for target audiences. The U.S. Agricultural Safety and Health Centers YouTube channel has seen an increase in average view duration, subscribers, likes, and shares as a result of these efforts.

Leveraging Impact

WCAHS maximizes the impact of NIOSH Center funding by obtaining extramural funding, nurturing existing partnerships, and building new community organization and private industry partnerships. We also receive substantial funding from UC Davis to support graduate student research on agricultural health and safety topics which further allows us to leverage the core Center funding from NIOSH. These activities broaden our impact, enhance outreach and training activities, and nurture the next generation of researchers.

Examples of ongoing contracts and grants affiliated with WCAHS include:

- In partnership with a NIOSH-funded U01 (PI: Kent Pinkerton), WCAHS created first-of-its-kind wildfire smoke exposure training materials in response to a new Cal/OSHA regulation.
- Through the Worker Occupational Safety and Health Training and Education Program (PI: Heather Riden), an initiative of the California Department of Industrial Relations to reduce injury and illness in California's workers, WCAHS conducts Injury and Illness Prevention Program trainings, among others. A particular recruitment focus is paid to newly licensed growers and farm labor contractors.
- UC Davis students are funded through the UC Berkeley NIOSH Education and Research Center to study agricultural health and safety (PI: Fadi Fathallah).
- WCAHS is also partnering with the California Department of Pesticide Regulation to develop pesticide safety resources for indigenous language-speaking farmworkers (PI: Heather Riden).

Numerous additional grant submissions will engage WCAHS in outreach and dissemination. WCAHS is positioned as a hub of agricultural health and safety research and outreach, continually building new partnerships and collaborations.

SECTION TWO

Emerging Issues Program



Program Goals

The goal of the Emerging Issues Program is to respond quickly to emerging agricultural health and safety topics. This program has the potential to mobilize academic expertise and achieve breakthroughs in never- or understudied areas of agricultural occupational health, and to create relationships between Center members and potential new members, both at UC Davis and at other institutions. Projects may be research-, education-, or outreach-related. New emerging issues topics are discussed during Steering Committee meetings, center events, and External Advisory Board meetings.

Sexual Harassment in Agriculture

In 2016–2017, WCAHS funded an emerging issues project to examine sexual harassment in agriculture in California. Outputs from the project include conference presentations and poster presentations. A UC Davis graduate student continues the research as part of a PhD program in epidemiology.

Cannabis Worker Health and Safety

California recently legalized recreational marijuana use, facilitating an opportunity to characterize the cannabis worker population. In 2017–2018, WCAHS funded an emerging issues project to estimate the size and composition of the cannabis workforce in California, including the geographic and demographic characteristics of both the labor and farm types, and to determine the key health and safety issues of the industry as a whole as well as for specialized worker job categories. Outputs from the project include conference and industry presentations; a chapter is under review. A small pilot project will continue in 2019–2020 to survey Yolo County cannabis workers.

Wildfire Smoke Exposure

With the intensity and frequency of wildfires increasing in the West, smoke exposure is a new concern for the agricultural industry. In 2018–2019, WCAHS funded a small emerging issues project on the topic and has subsequently funded two 2019–2020 projects on wildfire smoke exposure among agricultural workers. To date, outputs include an WCAHS newsletter article and Migrant Clinicians Network feature article. An R01 proposal was submitted to NIOSH to further the research and to evaluate the new Cal/OSHA ‘protection of outdoor workers’ regulation.

SECTION THREE

Research: Core Projects, Small Grants, and Graduate Student Funding



Core Center Research

WCAHS has five core research projects which are funded for five years (descriptions below).

Small Grant Program

The WCAHS Small Grant Program (pilot project funding) funds new research projects annually for 12 months. When additional funds become available, WCAHS announces additional funding opportunities resulting in rapid response/short-term funding.

The Small Grant Program received 13 proposals for the 2018–2019 funding cycle. An external review committee scored each proposal using the NIH scoring system and the WCAHS leadership group made funding recommendations. Four projects were funded and awardees included junior investigators, a graduate student, and new investigators to the center. Awards ranged in amounts from \$10,000 to \$30,000. A second call for proposals was announced for short-term and rapid response projects. Five projects were funded and completed in Summer 2018.

Graduate Student Research Funding Program

UC Davis provided institutional support to fund graduate students working on research related to agricultural health and safety. Through a competitive application process, WCAHS provided financial support (tuition and stipends) to graduate students each quarter.

PROJECT 1

Differential Characterization of Air Pollutant Emissions and Associated Toxicity from Common Agricultural Practices in the San Joaquin Valley

Kent Pinkerton, PhD, School of Medicine and School of Veterinary Medicine, and Keith Bein, PhD, UC Davis



Problem: This project aims to understand the toxicity of agriculturally related air pollution as a means to protect and improve farmworker health through education, translation, and outreach. Air pollution (particulate matter emissions) from agricultural practices differs in physical and chemical composition, which determines its toxicity and resulting health effects. California farmworkers represent an especially susceptible population given a combination of exposure to multiple known stressors, including heat, physically demanding labor, and adverse socioeconomic conditions.

Project overview: Particulate matter from California's San Joaquin Valley and Imperial Valley is being collected at various farming sites with different labor-intensive crops. The impact of these particles on respiratory health is being studied.

Progress to date: Particle-sampling sites in three agricultural regions of California have been identified in which particulate matter samples have been collected and are undergoing biological testing. These sites include Parlier, CA; Taft, CA; and Calipatria, CA. The project team established a cell culture-screening assay, which has been successfully applied to initial particulate matter samples gathered from Parlier, Taft, Calipatria, and the Caldecott tunnel in California. PIs have established a strong relationship with an advocacy group (Comite Civico del Valle) in the Imperial Valley of California with conference calls, on-site visits, and the formation of a community advisory group. Placement of a field station at Calipatria High School for air sampling is complete. The students have been trained in the operation of the field station, changing of air filters, and storage of air filters for future particle extraction. A second year of a student summer program was completed in 2019 to bring nine high school students from Calipatria and El Centro High Schools for one week to work in the laboratory at UC Davis.

PROJECT 2

Reducing Toxin Exposure for Workers in Western Agriculture: Development of Sustainable Alternatives to Soil Fumigation

Chris Simmons, PhD, College of Agricultural and Environmental Science, UC Davis



Problem: Many conventional and widely used soil fumigants have been identified as being toxic and/or carcinogenic. As a result, acute and chronic exposure risks exist for agricultural workers and communities near fumigation sites.

Project overview: Biosolarization is a potential alternative to toxic soil fumigation and is less damaging to health and the environment. Instead of toxic conventional pesticides, biosolarization uses solar heating and microbial activity to create soil conditions that are lethal to many pests but relatively safe for humans. This project tests whether biosolarization is an effective fumigation substitute in the context of western agriculture, which entails controlling major western agricultural soil pests in western specialty crops.

Progress to date: Experiments were conducted to examine biosolarization in California agriculture. This entailed using major sources of residual biomass in the state, such as hulls and shells from almond processing, as soil amendments to trigger production of natural biopesticides during biosolarization. Additionally, ongoing experiments are cultivating major California crops such as almonds, berries, lettuce, and tomatoes in biosolarized soils. To date, pest inactivation and persistent increases in plant nutrient content in the soil have been observed. In the past year, the work has focused on overcoming challenges that affect grower adoption of biosolarization, such as the persistence of pest-inactivating compounds that may inhibit crop growth. The interactions between amendment physical and chemical properties, biosolarization conditions, and remediation conditions have been measured to inform guidelines for ensuring that biosolarized soils are suitable for crop planting. Furthermore, experiments have captured and profiled volatile compounds released during biosolarization to gauge the relative exposure risk for workers near biosolarized fields compared to fumigated fields. For certain compounds released during biosolarization, such as carbonyl compounds that may pose risk in high levels, additional work is being conducted to ensure that worker exposure remains at tolerable levels. Industry engagement continues to be an integral element of this project, with active collaborations involving the California almond and berry industries that are geared towards increasing grower awareness and adoption of biosolarization.

PROJECT 3

Ergonomic and Biomechanical Evaluation of Mechanical and Robotic Strawberry Harvest-Aids

Fadi Fathallah, PhD, College of Engineering and College of Agricultural and Environmental Science, UC Davis



Problem: Workers who harvest strawberries can suffer from musculoskeletal disorders, especially low-back disorders. Interventions to reduce low-back disorders, while maintaining acceptable productivity levels are needed.

Project overview: This project evaluates the ergonomics, biomechanics, and productivity of using mechanical and robotic strawberry harvest-aids to protect workers from low-back disorders while maintaining yields. This project strives to use a series of optimized and controlled interventions to gain a better understanding of the balance between productivity and ergonomics of multi-person and personal labor-aid machines for strawberry harvesting. Machine-specific interventions will be evaluated for safe deployment.

Progress to date: Investigators have developed the first prototype of the harvest-aid system to simulate various speeds and field configurations. The first prototype proved to be impractical for prolonged harvesting time. Another prototype system is currently under development, which will allow semi-continuous harvest by workers. Optimal workers' biomechanical response and systems continues. Individual co-robot has been modified based on field trials and additional field trails are planned. Optimization algorithms for co-robot deployment are underway. The study team is continually assessing the best means to deploy the results of this project into useful and practical guidelines that minimize the risk of musculoskeletal disorders among strawberry harvesting workers.

PROJECT 4

Heat Illness Prevention in Farmworkers: Translation of Economic, Socio-Cultural, and Physiological Factors into Effective Interventions

Marc Schenker, MD, MPH, School of Medicine, UC Davis



Problem: Despite major campaigns to reduce heat-related illness in agricultural workers, deaths and illnesses still occur at higher rates than in other industries where workers are exposed to hot environments.

Project overview: This project engages farm organizations and workers in a collaborative effort to better understand and address the complexities of heat-related illness. Our goal is to translate the physiological and behavioral data collected from our earlier research into effective risk reduction strategies.

Progress to date: More effective participatory heat-related illness prevention trainings are being created and evaluated. Three Training of the Trainer sessions were held this year in St. Helena and Modesto, reaching 65 participants (supervisors of farmworkers). Each participant received a manual on participatory instruction methods and interactive training at the sessions. Evaluation from the participants was positive and the supervisors have gone on to train over 650 workers using the 'Heat-related illness toolkit.'

Investigators are working to determine the economic costs and benefits of reducing heat-related illness in California, and whether such a reduction will be motivation for changes in practices. Preliminary results show that acclimatized workers worked an average of 56 minutes longer than unacclimatized workers. Additionally, piece-rate participants worked on average 84 minutes less per day than hourly workers. Analyses show a nonlinear response of workers' exertion with respect to increasing heat exposure. The results show piece rate increases the average workers' exertion under moderate conditions but lowers the exertion under extreme heat exposure. Under extreme heat exposure, piece rate reduces piece-rate workers' exertion compared to workers paid an hourly wage rate. However, at lower temperatures, piece rate increases workers' effort exertion resulting in a higher risk of heat-related illness within the range of certain heat exposure.

Lastly, investigators are developing user-friendly mobile phone applications to assist supervisors in managing the safety of their work crews. A beta version of this application is being tested and the app will be launched publicly next summer.

PROJECT 5

Reducing Occupational Exposure to Zoonotic Pathogens in California Dairy Workers

Edward R. Atwill, DVM, MPVM, PhD, School of Veterinary Medicine, UC Davis



Problem: Numerous zoonotic pathogens, diseases or conditions that can be passed from animals to humans, are common in dairy cattle populations and throughout the dairy environment. Zoonotic pathogens can cause illness in both humans and animals. Working within a dairy system increases the risk of exposure to dairy feces that may harbor zoonotic pathogens. However, the amount of exposure required before a worker inadvertently ingests enough zoonotic pathogens to become ill is poorly understood.

Project overview: The project will identify high-risk occupational tasks based on exposure to different concentrations of zoonotic pathogens and then develop recommendations that will reduce the risk of exposure for dairy workers. Fecal samples will be collected and analyzed to quantify five zoonotic pathogens shed by infected dairy cattle. Enrolled dairy workers will be observed performing usual job tasks to help identify occupational tasks and specific personal behaviors that increase a worker's exposure to zoonotic pathogens. Based on project findings, outreach training and materials will be developed and disseminated through outreach training programs.

Progress to date: The project team has enrolled 40 dairy workers into the study. Enrollment will remain open throughout the duration of the project. Each enrolled participant has completed the occupational exposure survey which covers standard demographic items, dairy worker job satisfaction and job stress, and microbial risk exposures. Pilot data was collected to optimize the behavioral data collection techniques; data was collected during five sampling events totaling ~20 hours of observational data collection. Study data collection began in July 2019 resulting in nearly 50 hours of behavioral data collected, to date. A total of 409 fecal samples have been collected from the three participating dairies. Each fecal sample has been processed to determine the presence and concentration of five zoonotic pathogens, including: *Escherichia coli* O157:H7, *Salmonella* spp., *Listeria monocytogenes*, *Campylobacter jejuni*, and *Cryptosporidium parvum*. To date, we have not collected fecal material from the same dairy cow.

SMALL GRANTS

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Funded Small Grant Projects 2018–2019

Metal and Inorganic Particulates in the Lungs of California Agricultural Workers

Jayveeritz Bautista, Graduate Student, UC Davis

A Qualitative Study of the Mental Health and Alcohol Use of Indigenous Mexican Farmworker Youth

Seth Holmes, MD, PhD, UC Berkeley

Developing a Test Station to Evaluate Performance of Crush Protection Devices in Agricultural ATV Rollover Accidents

Farzaneh Khorsandi, PhD, UC Davis

Exploring Stressors and Psychological Distress of Hired Mexican Migrant Agricultural Workers in California

Alvaro Medel-Herrero, PhD, UC Davis

Food Security and Nutritional Status among Agricultural Workers in the California Central Valley: Pilot Study

Reina Engle-Stone, PhD, and Leslie Olivares, UC Davis

Preliminary Assessment of Risk of Exposure to Aflatoxin of Workers of the Almond Industry

Jesus Fernandez Bayo, UC Davis

Knights Landing Environmental Health Project

Skye Keltz, PhD student, UC Davis

Forces Required to Operate Controls on Agricultural All-Terrain Vehicles: Implications for Young Operators

Farzaneh Khorsandi, PhD, UC Davis

Exploring Heat Exposure and Kidney Functioning in Migrant Farm Workers in the Arizona-Sonora Border Region

Nicolas Lopez-Galvez and Rietta Wagoner, PhD students, University of Arizona

SECTION FOUR

Outreach, Training, and Education



The WCAHS outreach core builds and maintains relationships with agricultural stakeholders throughout California and the region through free safety trainings, resources, and events. Years of collaboration and support at the individual and organizational levels have resulted in an increasing number of new opportunities to expand the reach of the program.

Trainings

The WCAHS outreach core develops bilingual agricultural safety resources and delivers trainings on a variety of topics. Areas of particular expertise include heat illness prevention, sexual harassment prevention, and pesticide safety, among others. Trainings range in length from short tailgate trainings held in the field to three-hour train-the-trainer courses for farm supervisors. The train-the-trainer format maximizes the reach of important safety information through the subsequent dissemination by the supervisors to their workers, resulting in the education of more individuals than could be reached by a single trainer from the Center. While most trainings are offered in English and Spanish, translators have been employed to assist in the training of Punjabi or Hmong workers. The outreach core presents to growers, farm labor contractors, and policy makers. It is also engaged in local promotores networks.

In 2018–2019, WCAHS outreach specialists conducted over 70 trainings and events, reaching over 3,500 people. WCAHS continued in a successful partnership with the Strawberry Commission, conducting sexual harassment prevention and heat illness prevention for thousands of members. WCAHS investigators were featured in over 20 media pieces on topics ranging from Valley Fever and heat illness to wildfire smoke exposure.

Outreach Small Grants

WCAHS launched an outreach small grant program in 2018 to expand and enhance the topical and regional reach of WCAHS and facilitate stronger collaboration between University of California Cooperative Extension personnel, academic and private educators, and community organizations.

Funded Outreach Small Grant Projects 2018–2019

California Worker Protection Standard Training Video

AgSafe
Modesto, CA

Health and Safety Outreach for Hawaii’s Women Farmers

O’ahu Resource Conservation & Development Council
O’ahu, HI

Development of Farmworker Health & Safety Educational Materials in Mixteco and Spanish

Radio Bilingüe
Fresno, CA

Respiratory Illness Training for Promotores in the Central Valley

Health Initiatives of the Americas (HIA), UC Berkeley
Berkeley, CA

Pesticide Safety Training for Farmworkers in Arizona

Campeños Sin Fronteras
Somerton, AZ