

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

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WCAHS YouTube Channel: youtube.com/channel/UCCrF9GcijzIdd2shYwCFGjw

Ag Centers' YouTube Channel: 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.

The Western Center for Agricultural Health and Safety's (WCAHS) mission is to improve the health and safety of those working in western agriculture, with particular consideration of the unique issues 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 impact 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 during the 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 Program Director, 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 2019–2020, including the annual WCAHS Seminar Series and a Fall Faculty Workshop. Seminar topics for the 2019–2020 academic year included all-terrain vehicle safety, California's heat illness prevention regulation, food security and nutritional status among farmworkers, and community-based participatory research in Imperial Valley, CA. The Fall Faculty Workshop provided an opportunity for WCAHS to engage University of California, Davis faculty researchers by sharing information about current projects from faculty and explaining the competitive renewal process.

Communication

WCAHS continues to disseminate agricultural health and safety information utilizing numerous formats to target our diverse stakeholders. The WCAHS website is a resource hub that provides downloadable, bilingual training resources and information about topical areas of expertise. With the addition of timely resources related to wildfires and COVID-19, WCAHS website traffic doubled in site visits from 2019 to 2020.

The Center sends two monthly email newsletters. One features WCAHS research and outreach activities, funding opportunities, and center events. The other, *Próximamente*, is a bilingual newsletter and targets the agricultural community (e.g., growers, farm supervisors, farmworkers) with safety tips, regulatory reminders, and upcoming training opportunities.

Additionally, WCAHS utilizes the social media channels Twitter, Instagram, Facebook, and YouTube to connect with other researchers and agencies, growers, and UC Davis centers and institutes.

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. The findings of the WCAHS' evaluation 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 2019–2020, WCAHS' outreach specialists conducted 50 trainings and events, reaching over 2,700 people. WCAHS continued in a successful partnership with the Strawberry Commission, conducting sexual harassment prevention and heat illness prevention for over a thousand of its members. WCAHS investigators were featured in over 20 media pieces, which were primarily focused on COVID-19.

Cross-Center Collaboration

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. The WCAHS outreach and evaluation teams participate in all ECO Group 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 its 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 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:

- 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 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).
- Funding for field trial assessments of biosolarization using almond residue amendments to improve soil health and manage pests in almond orchards continues with the Almond Board of California (PI: Christopher Simmons).

Numerous pending proposals will engage WCAHS in outreach and dissemination. WCAHS is positioned as a hub of agricultural health and safety research and outreach, and continually builds 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 novel 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. During the 2019–2020 reporting period, our focus has been on COVID-19, sexual harassment in agriculture, cannabis worker health and safety, and wildfire smoke exposure.

COVID-19

WCAHS initiated a multifaceted rapid response to COVID-19 beginning in March 2020, which included a comprehensive needs assessment, resource development, and farmer and employer data collection. This work is ongoing and expanding through new partnerships with farmworker-serving organizations, employer associations, and local and state agencies.

Feedback from the assessments indicated the need for agriculturally specific information on COVID-19, culturally and linguistically tailored information, a recognition of the large number of hired workers in western agriculture, and the desire for resources to provide brief and to-the-point instructions. WCAHS responded with a worksite checklist, training guide, and a robust website. In collaboration with other universities and organizations, WCAHS developed a series of COVID-19 infographics for farmworkers and an infographic poster outlining best practices for increasing the effectiveness of cloth face coverings. All COVID-19 resources developed and disseminated by WCAHS are available in English and Spanish.

Farmer/Employer Survey

From June through July, WCAHS conducted an online survey of California agricultural employers and farm owners about their worksite responses to COVID-19. The goal of the survey was to identify successful COVID-19 prevention practices and areas where the prevention recommendations are challenging to implement. Survey elements included county, commodity, labor size, knowledge of COVID-19, adaptations made in response to COVID-19, source of COVID-19 information, and worker training approaches. A number of comment fields throughout the survey allowed respondents to explain their COVID-19 control strategies and challenges.

COVID-19 Farmworker Study

WCAHS supported the COVID-19 Farmworker Study, the first survey of farmworkers during the pandemic. The COVID-19 Farmworker Study provides critical information on farmworkers' abilities to protect themselves and their families during the COVID-19 pandemic. The study brings together a collective of community-based organizations, researchers, and advocates to reveal information that can only be gathered directly from farmworkers who have been working during the COVID-19 pandemic.

Sexual Harassment in Agriculture

A UC Davis graduate student is continuing research initiated as a WCAHS emerging issues project to examine sexual harassment in agriculture in California and Mexico as part of a PhD program in epidemiology. Outputs from the project include a journal article, conference presentations, an educational story (or Cuento), and a policy brief.

Cannabis Worker Health and Safety

California recently legalized recreational marijuana use, facilitating an opportunity to characterize the cannabis worker population. A pilot project was undertaken to identify key health and safety issues of the industry. The pilot project enrolled 29 workers from two cannabis cultivation facilities. Participants were mostly white and Latino men under 30, with a median of 26 months of employment in the cannabis industry. Nasal, skin, and eye irritation were reported as well as respiratory symptoms including cough and wheeze. Outputs from the project include outreach materials, and a manuscript for publication in a peer-reviewed journal is under development.

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. The WCAHS outreach core created training resources for the agricultural industry in response to Cal/OSHA's emergency regulation to protect outdoor workers from wildfire smoke exposure.

SECTION THREE

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



Core Center Research

WCAHS has five core research projects that 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 24 proposals for the 2019–2020 funding cycle. An external review committee scored each proposal using the NIH scoring system and the WCAHS leadership group made funding recommendations. Six 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.

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. Pls 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 and address barriers to adoption for biosolarization. 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 and other pest-inactivating conditions during biosolarization. Following field trials in 2017 that demonstrated control of soil pests immediately following biosolarization, ongoing monitoring of field sites has shown long term benefits to soil health associated with biosolarization including persistent pest suppression and elevated plant nutrient content. Data from almond trees grown in biosolarized soils indicated that trees required time to adapt to treated soils before the growth rate improved. As a result, studies were conducted to examine strategies for decreasing the remediation time for soils following biosolarization. The amount and particle size of almond hulls and shells incorporated into the soil ahead of biosolarization were identified as key factors for controlling the remediation time. Furthermore, experiments have captured and profiled volatile compounds released during biosolarization to identify those that may contribute to pest inactivation and to gauge the relative exposure risk for workers near biosolarized fields. Volatile fatty acid and ketone compounds were prominent, with some identified compounds being known biopesticides. All detected volatile compounds with defined exposure limits were measured at levels far below those limits, indicating minimal safety risk for agricultural workers—in contrast to the much greater toxicity of conventional soil fumigants. Industry engagement continues to be an integral element of this project. Direct collaboration with commercial growers, presentations at industry events, and publication of articles in agricultural trade journals were used to increase grower awareness and promote 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 been working on developing the second prototype to simulate various speeds and field configurations. The system will allow semi-continuous harvest by workers. Progress was made into this system prior to the COVID-19 pandemic and campus shut down; however, due to campus restrictions, limited in-person activities took place after mid-March, and most interactions have been virtual/online (via Zoom, phone, internet, etc.). Individual co-robots have been modified based on field trials and additional field trials are still planned within the restrictions of COVID-19 campus and county guidelines. Optimization algorithms for co-robot deployment are still 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: Although in-person training of the trainer sessions were canceled due to the ongoing COVID-19 pandemic, in the three prior years, ten training sessions were conducted, reaching 191 supervisors. Of those, 63 provided valuable feedback three months after the training session. Based on this feedback, as well as our experience conducting these trainings, we are developing more effective participatory heat-related illness prevention training materials to be included in a final toolkit. In addition, we created a “Tips for Trainers” document as supervisors consistently noted the usefulness of concrete suggestions for training their workers. These materials cover Cal/OSHA requirements and emphasize key points found in our research, such as work rate (how fast a worker works) being a risk factor for heat-related illness.

Investigators are working with a video production company to make a video with testimonials about heat illness and prevention to show that proper protections are in the economic interest of all parties involved in agricultural production. This video will stress the importance of proactively protecting workers and show that it saves farms money in the long run.

Lastly, investigators are developing a user-friendly mobile phone application 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: Zoonotic pathogens can cause illness in both humans and animals. Numerous zoonotic pathogens are common in dairy cattle populations and throughout the dairy environment. 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 training programs.

Progress to date: The project team has enrolled 44 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 collection. A total of 528 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, *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. Due to restrictions related to COVID-19, ongoing sampling efforts have been postponed until the current restrictions/state closures are lifted.

SMALL GRANTS

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 24 proposals for the 2019–2020 funding cycle. An external review committee scored each proposal using the NIH scoring system and the WCAHS leadership group made funding recommendations. Six 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.

Funded Small Grant Projects 2019–2020

Evaluating the Implementation of an Emergency Regulation to Protect California’s Outdoor Workers from Wildfire Smoke Exposure

Kathryn C. Conlon, PhD, MPH, UC Davis

Ability of Youth Operators to Reach Agricultural All-Terrain Vehicles Controls

Farzaneh Khorsandi, PhD, UC Davis and Alireza Pourreza, PhD, UC Davis

Occupational Exposure to Antimicrobial Resistant Bacteria and Genes in Dairy Farm Environments

Katie Lee, PhD Student, UC Davis

Policies of Exclusion: Understanding the Impact of the Current Immigration Policy on Self-Reported Health, Healthcare Access and Participation in Public Programs Among California Hired Mexican Agricultural Workers and Their Families

Alvaro Medel-Herrero, PhD, MBA, UC Davis

Exploring Agriculture Workers’ Exposure to and Experience with Wildfires

Laura Stock, MPH, UC Berkeley

Assessment of Worker Exposure to Antimicrobial Resistant Genes from Dairy and Beef Cattle Operations

Xiang (Crystal) Yang, PhD, UC Davis and Xunde Li, PhD, UC Davis

SECTION FOUR

Training and Outreach



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. 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 2019–2020, WCAHS outreach specialists conducted 50 trainings and events, reaching over 2,700 people. WCAHS continued in a successful partnership with the Strawberry Commission, conducting sexual harassment prevention and heat illness prevention for over 1,000 of its members. WCAHS investigators were featured in over 20 media pieces, with the majority of pieces focused on COVID-19.

Small Grants for Outreach-Specific Activities

WCAHS launched a small grant program specific to outreach activities 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.

The Outreach Small Grant Program funded three proposals for the 2019–2020 funding cycle including two agricultural health and safety organizations and a new investigator to the center. Awards ranged in amounts from \$7,500 to \$10,000.

Funded Outreach Small Grant Projects 2019–2020

- Assessing Farm-Stress and Community Support in Imperial County Farmers; Adrienne Keeney, PhD, MSW, SDSU School of Social Work, San Diego State University
- Hawaii Pesticide Safety Webinar Series; AgSafe, Modesto, CA
- Evaluating Effectiveness of Story-Telling Tools in the Gear Up for Ag Health and Safety™ Classroom: Personal Protective Equipment (PPE) and Appropriate Use of PPE During Emergency Response; Ag Health and Safety Alliance