STATE OF THE SCIENCE

Global Pandemics and the Agricultural Workforce: Research and Policy Implications

The Southeastern Coastal Center for Agricultural Health and Safety

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March 2021

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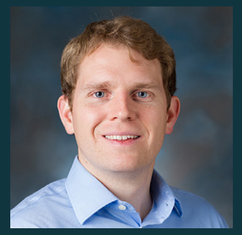

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Suggested Citation

Santa Maria, N., Irani, T., Telg, R., Lundy, L.K., Lindsey, A.B., McLeod-Morin, A., Stokes, P., Kandzer, M., Castano, V., Morris, G., McCue, L., Millerick-May, M., Zhong, Y., Halverson, C., Baker, L.M., Andrews, D., Abler, D., Court, C., Galindo, S., Ramos, A.K., & Sampson, S.; Rampold, S., Kelly-Begazo, C., Pierre, B.F. (2021). State of the Science: Global Pandemics and the Agricultural Workforce: Research and Policy Implications. SCCAHS2020/21-03. Gainesville, FL.: University of Florida/ Southeastern Coastal Center for Agricultural Health and Safety.

Funding

This document was supported by the Grant 1 U54 OH 011230 - 01, and was funded by the Centers for Disease Control and Prevention (CDC). Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the CDC or the Department of Health and Human Services (DHHS). The entire cost of the development and publication of this document was financed with federal funds. This document was prepared with support from the $10 million CDC/National Institute for Occupational Safety and Health (NIOSH) grant, which funds the Southeastern Coastal Center for Agricultural Health and Safety (http://sccahs.org/).

Website Information to SCCAHS

For more information, contact the Southeastern Coastal Center for Agricultural Health and Safety at http://sccahs.org/contact/

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Research and Policy Implications of Global Pandemics on Agriculture, Fisheries and Forestry

The Southeastern Coastal Center for Agricultural Health and Safety (SCCAHS) researches and addresses health and safety issues in agriculture, fishery, and forestry in Alabama, Florida, Georgia, Mississippi, North Carolina, South Carolina, Puerto Rico, and the U.S. Virgin Islands. In early 2020, the SARS-CoV-2 pandemic that made its way to the United States posed new and unexpected threats to agriculture and fishery and the people employed in these sectors.

COVID-19 has shown the agricultural, fishery, and forestry sectors how imperative it is for researchers, scientists, growers, commodity groups, and farmers to discuss health and safety issues and propose new solutions. In particular, agricultural workers who work, travel, and live in confined conditions are at an increased risk of being exposed to and contracting COVID-19, according to the CDC. COVID-19 has also demonstrated how the exposed vulnerabilities of the global and domestic food system and agricultural supply chains can have a negative impact on food access and security.

The third annual State of the Science meeting was assembled with a slate of presenters who could speak to the public health and outcome indicators of the pandemic developing in real-time. The virtual event, entitled Global Pandemics and the Agricultural Workforce: Research and Policy Implications, provided a forum for researchers from a variety of backgrounds to discuss current findings, paving the way for the development of appropriate responses, and further stimulating interdisciplinary research collaborations on this important and timely topic.

This white paper is based on a summary analysis of the meeting's findings, and its purpose is to inform the audience which includes meeting attendees, the SCCAHS Community Stakeholder Advisory Board (CSAB), scientists, public agencies, and policymakers.

Background on SCCAHS

SCCAHS was established in 2016 as part of a CDC and NIOSH Agricultural Health and Safety Initiative. SCCAHS explores and addresses the occupational safety and health needs of people working in agriculture, fishing, and forestry in Alabama, Florida, Georgia, Mississippi, North Carolina, South Carolina, Puerto Rico, and the U.S. Virgin Islands. SCCAHS focuses specifically on the unique environments and occupational communities of this region. SCCAHS is a multidisciplinary partnership of academic institutions, community organizations, and industry representatives that brings together individuals and organizations already pursuing academic and applied basic research, intervention, translational, and outreach solutions for occupational illnesses and injuries. SCCAHS provides centralized regional infrastructure where these individuals, organizations, and companies can engage in mutual learning, leverage resources, build on previous efforts of colleagues, and promote new research.

Meeting Summary

The SCCAHS Outreach Core organized and hosted its first fully virtual State of the Science meeting on Friday, September 11 and 18 via Zoom. SCCAHS utilizes the State of the Science approach as a key component of its community engaged research to practice model (Figure 1).

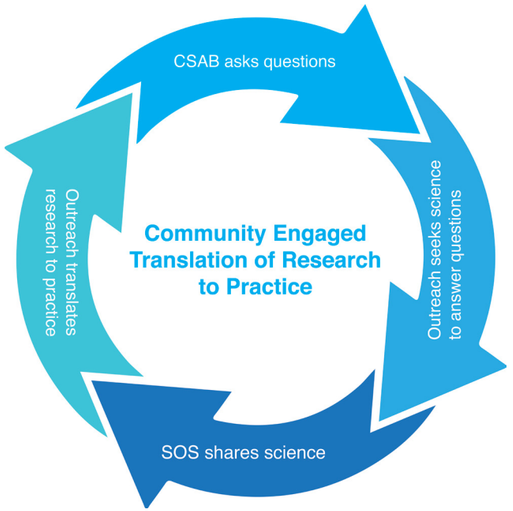

Figure 1. Cycle of research, outreach and the State of the Science Meeting.

The focus of this meeting was to bring together esteemed presenters to showcase research and outreach on the impact of SARS-CoV-2 on agricultural communities. Speakers discussed public health, economics, communication, sterilization of personal protective equipment, risk assessment tools, and addressed concerns and stressors on extension workers during the pandemic.

The virtual, two-part meeting allowed SCCAHS to broaden its speaker selection from different regions across the U.S. representing various fields to present current findings and begin the process of developing future research collaborations on global pandemics.

Objectives for State of the Science

Three objectives guided the development of the 2020 State of the Science meeting:

1. Identify effective prevention methods specific to mitigating the spread of COVID-19 in farmworkers, farm operators, farm owners, and others.
2. Address the economic impact of the pandemic and resources that can help mitigate effects on food supply chains in future pandemics.
3. Understand the effect of the pandemic on extension workers who often are the first source connecting farmworker, fishery, and forestry communities to information about available resources.

Methods

State of the Science 2020 was hosted virtually via Zoom on September 11 and 18, 2020. The two-day event ran for three hours each day, and consisted of seven sessions addressing the following key topics:

- SARS-CoV-2: Human Health and Transmission
- Risk Assessment and Mitigation e-tools: Modeling Physical Distancing and Exposure Control
- Best Practices for Personal Protective Equipment
- Communicating Science Resources
- Economic Implications of Pandemics
- Impacts of COVID-19 on Extension Agents

The expertise from 13 presenters ranged from medical, virology, mechanical engineering, diversity and inclusion, sociology, communications, and resource economics, as well as agriculture and natural resources fields. All sessions were recorded, transcribed, and made available on the SCCAHS website (http://www.sccahs.org/index.php/2020-sos-meeting/). More than 116 participants

attended State of the Science 2020 and all were given the opportunity to ask questions at the end of each session. Questions were moderated by members of the SCCAHS Outreach Core. These data were organized and summarized in this white paper.

Summaries of Presentations and Discussions

SARS-CoV-2: Transmission and Human Health

Presented by J. Glenn Morris, Jr., MD, MPH&TM, from University of Florida's Emerging Pathogens Institute and the Southeastern Coastal Center for Agricultural Health and Safety

Coronaviruses are a common cause of infection among mammals and birds. While some of these infections can be severe (and can cause severe infections, with economic consequences, in domestic animals), others are mild, or cause no symptoms. Among humans, there are four "benign" endemic coronaviruses which are widely recognized and which cause symptoms of the common cold, together with three viruses in the Betacoronavirus group that can cause serious and sometimes fatal infections: these include Severe Acute Respiratory Syndrome (SARS), first reported in 2003 and 2004, Middle East Respiratory Syndrome (MERS-CoV) in 2012, and Coronavirus Disease 2019 (COVID-19), which is caused by the SARS-CoV-2 virus. The phylogenetic tree of coronaviruses (Figure 2) shows how many of these viruses are intermixed with bat strains. It is likely that SARS-CoV-2 originated in bats, moved through some type of mammalian host and then moved into human populations.

The bulk of global spread of COVID-19, the disease caused by SARS-CoV-2, is in the Americas with more than 14 million infections reported by the World Health Organization (WHO) as of September 2020 and more than 27.1 million as of this white paper's spring 2021 publish date.

At the September meeting, Morris shared that in Florida, an upsurge of COVID-19 was seen in July 2020 with more than 652,000 cases and over 12,000 deaths after the easing of restrictions designed to mitigate against spread of the disease. At that time, the University of Florida was concerned with the uptick of cases among students with the opening of schools and bars where larger group gatherings pose a significant risk.

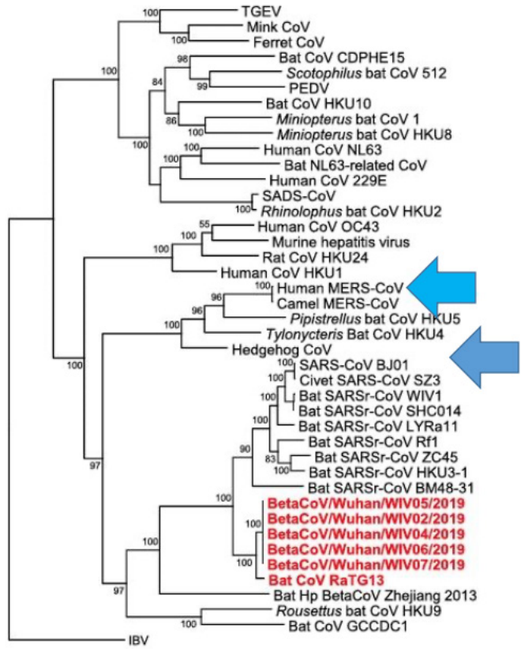

Figure 2. The phylogenetic tree of the SARS-CoV-2 Virus.

The virus is highly contagious. COVID-19 transmits through respiratory routes, with infected persons excreting infectious droplets/particles of various sizes. Respiratory excretion of the virus occurs with talking, particularly loud talking or shouting, and with singing. Large respiratory droplets containing the virus tend not to travel that far, "dropping out" of the air close to the person excreting the particles: the recommendation that people should stay six feet or more apart is designed to reduce the risk of exposure to these large droplets. However, infectious particles can travel more than six feet, depending on size, and can form aerosols, which can remain floating in the air for several hours and travel across rooms. It is these aerosols which appear to be responsible for "super-spreader" events, in which large numbers of persons in a room can be infected by a single person. Up to half of people who are infected do not have symptoms, but are able to transmit the virus and infect others. In fact, the highest rate of transmission of the virus can be in the 24 to 48 hours before onset of symptoms.

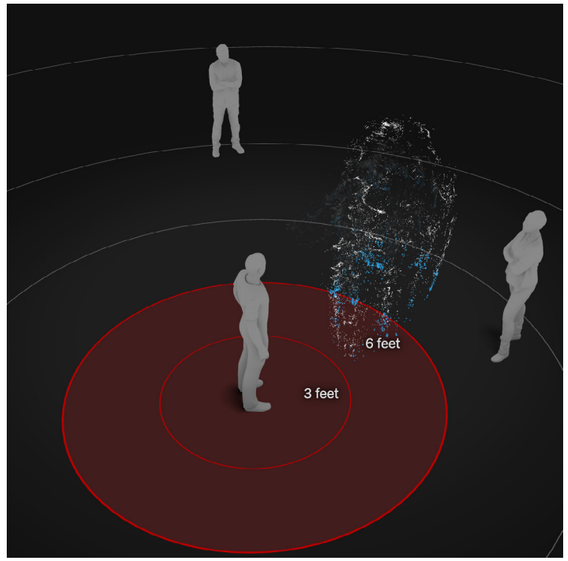

Figure 3. 3-D simulation via The New York Times shows why social distancing is so important.

In a study in 2017, a our research group demonstrated that benign, endemic human coronaviruses could be isolated from the air in the waiting room of the student infirmatory (Pan et al, 2017). In follow-up studies after the appearance of SARS-CoV-2, we showed that the virus could be isolated from the air of a COVID patient's room (Lednicky et al, 2020).

Clinical presentation of COVID-19 includes fever, cough, and the most characteristic symptom: the loss of taste and smell. Onset of symptoms usually occur within five days of exposure. From a clinical evaluation, it is not always possible to determine who has COVID-19 and who does not. Severe cases of COVID-19 are generally characterized by increased difficulty breathing and shortness of breath, requiring hospitalization; hospitalization, if required, occurs an average of 11 days after exposure. The virus can also affect the brain, heart, kidneys, liver, gastrointestinal tract, and the lining of arteries, and can increase a patient's risk for stroke and heart attack.

The risk factors for more severe cases of COVID-19 include:

- Age: 65 years and older (eg. 12 percent of cases, 86 percent of deaths, and 46 percent of hospitalizations were persons 65 and older in Florida as of September 2020).
- Strong evidence for increased risk of infection among persons with specific co-morbidities including cancer, chronic obstructive pulmonary disease (COPD), chronic kidney disease, obesity (body mass index over 30), immunocompromised state from solid organ transplant, sickle cell disease, and serious heart conditions like heart failure, coronary artery disease, or cardiomyopathies.
- Mixed evidence for increased risk of infection from co-morbidities like asthma, cerebrovascular disease, hypertension, pregnancy, smoking, and use of other corticosteroids or immunocompromising medications.

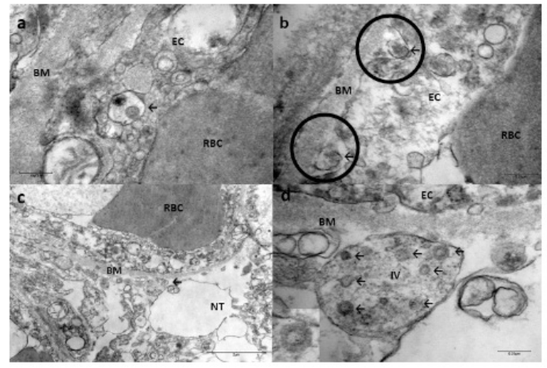

Figure 4: Photomitograph of the virus inside the cells lining arteries in the brain from autopsy sample.

Detecting the virus requires genetic approaches to decipher who is infected and who has the potential for spreading the virus. A test called RT-PCR remains the standard assay for the virus: it can be done on a deep nose swab, or on sputum. However, the test is technically difficult as it requires special instrumentation and operator safety precautions, and it may take several days to get results. An alternative approach is what is called Rapid Antigen Testing, which is less reliable that the RT-PCR test, but can give results much more quickly.

Alternatively, it is possible to gain information about possible prior infections with SARS-CoV-2 by screening for antibodies to the virus, which are produced by your body after an infection. These tests are not that useful to identify acute infections, and do not indicate whether you are infectious with the virus and can transmit it to others. However, they can be useful in documenting whether or not you have had the infection in the recent past, and may have immunity to infection.

Interventions for mitigating exposure to COVID-19 include physical distancing. The CDC recommends that people stay at least six feet apart, to minimize risk of exposure to large infectious particles carrying the virus. However, large infectious particles can travel more than six feet, and as previously noted, aerosols can cause infections on the other side of a room where an infected person is.

N95 masks are considered highly effective in blocking passage of the virus. Medical-grade masks can reduce infection by up to 85 percent, and cloth masks are still effective but less than the N95s and medical masks. Masks need to be properly worn to be effective and fully cover the mouth and nose. Neck sleeves, gaiters, and bandanas have been studied at the University of Florida and Duke University, and shown to be not effective at blocking the passage of the virus. Other effective interventions include hand washing; avoiding touching your eyes, mouth, or nose; and staying outdoors as much as possible, which minimizes the risk of infectious aerosols.

Controlling the spread of this virus requires testing and contact tracing, to identify infected persons as quickly as possible and make certain that they are in isolation so that they do not spread the infection further. For this approach to work, it is important to have rapid testing available to everyone (including asymptomatic people), so that those who are infected can be quickly identified, together with their recent contacts. In general, if more than 5 percent of people being tested are positive, the amount of testing being done is not sufficient to optimize control of transmission. And speed is important: if it takes more than 24 hours to get results and contact infected persons, the value of the testing and contact tracing drops substantially. An essential, but also exceptionally vulnerable population, are agricultural workers. Mitigating the spread of COVID-19 among the agriculture workforce requires grouping workers in cohorts and having the assigned cohorts share similar vehicles and reduce comingling with other groups. A significant barrier to mitigating spread among workers involves lack of enthusiasm for testing because if workers test positive, they fear missing several days of work and, thus, pay.

The risk of transmission is particularly high if workers are living under crowded conditions, including crowded sleeping areas, and are transported to work sites on crowded buses. As one example, our group at UF was involved in study of a group of over 100 H-2A workers in this region: after exposure to an infected worker from South Florida, 91 of the workers in the group were found to be positive for SARS-CoV-2.

Therefore, high infection risk areas in agriculture like housing, transportation and continuing to work while infected should continue to be studied to reduce the spread of COVID-19.

Development and Deployment of Farmworker Housing Simulator for COVID-19 Risk Mitigation

Presented by Leigh McCue, Ph.D., from George Mason University, Department of Mechanical Engineering

The COVID-19 farmworker housing simulator originated with a Lagrangian hydrodynamics point of view and uses simplified model computations that can account for statistical variations of risk for persons with differing baseline health, and at varying distances from each other.

One simulation used a standard 737 flight, where the original iteration randomized how many people were on the flight, the number of sick passengers, seating locations, baseline health, and other variables. The statistical scenarios generated by the simulation were not to measure how many infections were possible, but to measure how effective interventions, like individual seat cleaning or elimination of middle seats, can be.

An analogue for the farmworker community would be transporting workers via bus. In a hypothetical simulation of an eight-ride sequence for a bus transporting workers, after running 10,000 iterations of the simulation, using this model 97 percent of the simulations resulted in more than 10 infections if aisle seats were used and no one disinfects their seat. Alternatively, if aisle seats are not used and everyone disinfects their seat, only 0.5 percent of simulations resulted in more than 10 infections.

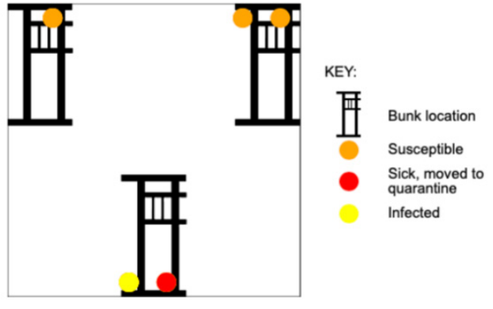

Figure 5. Farmworker Housing simulator example.

A similar simulator was developed for dormitory-style housing, commonly used for the migrant farm workforce. The dormitory simulations had two components, including an evening model that is proximity-based, similar to the airplane and bus models referenced above, and a daytime model that relies on a classic S-I-R-type model, a simplified approach to modeling infectious disease spread by considering subpopulations as susceptible (S), infected (I), and recovered/removed (R). In this manner, daytime interactions between workers as they go about their work and social activities are represented. One of the challenges with simulating statistical scenarios in farmworker housing is that sample sizes are small, and to overcome this, a modified S-I-R model was used to guarantee integer values for the number of workers who are susceptible, infected, or removed. The simulation uses a Gaussian distribution to characterize variability in asymptomatic periods for infected workers, and the calculations remove people from the model once they move from being asymptomatic to symptomatic.

The farmworker housing simulation model is to be used as an educational tool to support intervention settings. The simulation model is multilingual, and engineering language was removed to help with broader use.

The tool asks a series of questions regarding room size, dormitories having bunk beds or single beds, whether people are sleeping with their heads against the wall or alternating head to toe, and other variable assumptions, like types of viral spread mitigation strategies used.

The tool incorporates helpful illustrations of each question. Once people submit the required entries, the simulator provides an illustrative figure, outlines the statistical variations in the simulation's findings, and provides feedback on how to reduce risk.

To access the simulator tool, click here. This work has been supported by the Northeast Center for Occupational Health and Safety (NEC).

Facilitating Pandemic Preparedness in the Agricultural Industry via a novel COVID-19 Hazard Assessment and Mitigation Plan (CHAMP) e-tool

Presented by Melissa Millerick-May, Ph.D., MSC from Michigan State University, Department of Medicine, Extension, and Environmental Health and Safety

The agricultural industry is well-versed in identifying and mitigating risks pertaining to biosecurity and securing the food supply, but there has been little emphasis on securing the health of farm workers in the event of a pandemic. The COVID-19 Hazard Assessment and Mitigation Program (MSUE CHAMP) is a free tool that farmers and associated businesses in the agricultural industry can use to assess their risk for transmission of COVID-19 amongst workers and with the general public, and develop flexible and readily implementable mitigation strategies. The tool aims to identify effective task-specific mitigation options and through completion of integrated forms, facilitates creation of a

meaningful written pandemic preparedness plan that satisfies many state and local regulatory requirements. The tool consists of fillable templates that may be used for development of programs such as health screenings, tools for effective communication of new policies and procedures that may be used with workers or the public, and editable presentations that may be developed into worker training modules.

The CHAMP e-tool utilizes an agriculture-centric approach and was created by a team of cross-disciplinary industry experts. CHAMP is an easy to use resource that guides users through the process of conducting an operation-specific, task-based hazard assessments and utilizes a decision-making matrix to assist with the identification of effective and cost-conscious control measures aimed at mitigating disease transmission.

The e-tool is organized by topic that taken together comprise a comprehensive preparedness plan, and includes links to federal, state, and local orders, as well as guidance and best practice documents. Components include:

- Overview and Introduction to Pandemic Preparedness. Overview of the SARS-CoV-2 virus, how it's transmitted and rationale behind the development of a pandemic preparedness plan. Included is the ability for the operation to establish the tool as 'the plan' by completing fillable fields and designating a responsible individual to develop, implement, monitor, and routinely evaluate the effectiveness of 'the plan'.
- Employee Health Screening. Methods and approaches by which to conduct on-site and/or remote health screening are presented, and links to printable and electronic health screening questionnaires provided.
- Enhanced Cleaning and Disinfection. Approaches to establish enhanced cleaning and disinfection protocols are reviewed along with appropriate links to effective disinfectants and fillable forms that may be used to develop procedures by location or task (e.g. lunchrooms, restrooms, tools or equipment, public facing areas, etc.).
- Group Housing. Links and downloadable documents are provided to written and modifiable plans developed by state agencies that encompass key components of risk mitigation in group housing scenarios including social distancing (common areas, sleeping quarters), cleaning and disinfection, ventilation, and how to effectively isolate and care for sick individuals.
- COVID-19 Testing. State mandated testing requirements are presented as well as links to agency developed tracking forms (testing schedules and results) and links for assistance with scheduling testing at the worksite or other designated location.

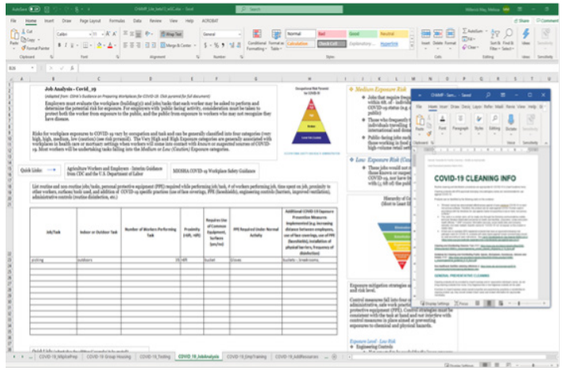

Figure 6. Michigan State University Extension CHAMP e-tool.

- Hazard Assessment and Mitigation Plans. Using the published OSHA guidance document as a framework, present concepts and rationale with ag-centric examples such that business owners are be able to conduct task-based hazard assessments to identify potential points of exposure/contamination and develop mitigation strategies following an established hierarchy.
- Training. Discussion of effective means of communicating risks and newly established policies and procedures with employees. Links to modifiable printable signs and worker training presentations are provided.
- Additional Resources. Includes links to videos and printables in multiple languages as published by federal and state agencies, ag-centric best practice documents organized by commodity type, available funding to support businesses during the pandemic, etc.

To access the CHAMP e-tool, click here.

Sterilization Technology: Fight Coronavirus with Corona Discharge

Presented by Ying (Sarah) Zhong, Ph.D., from University of South Florida, Department of Mechanical Engineering

In April 2020, the University of South Florida (USF) researchers Ying Zhong and Libin Ye received an NSF RAPID Award (#2030033) to develop disinfection technology for personal protective equipment (PPE) and the environment. Their work specifically used corona discharge, similar to cold plasma, as a disinfection technology for facemasks and surfaces.

A study conducted by the Massachusetts Institute of Technology (MIT), found that droplets smaller than 5 micrometers can travel meters while people are talking or sneezing. Masks are one of the most effective solutions to prevent the spread of COVID-19, but their efficacy varies depending on their material, manufacturing process and fit with the face. Cloth masks have relatively larger pore size and are hydrophilic, meaning that the chance of a virus droplet falling into the mouth or nose is higher. A surgical mask's pore size is much smaller and is considered hydrophobic, offering much better protection. For the general public, a new surgical mask is recommended to be used each day. N95 masks with filtration efficacy over 95 percent should be saved for frontline workers. A surgical mask is formed by three layers, including the outside hydrophobic layer to prevent the penetration of the droplet, the middle melt-down non-woven polypropylene filtering layer, and the inner layer. There are four major working mechanisms for masks to reach the required filtration efficacy: 1) inertial impaction, 2) interception, 3) diffusion, 4) electrostatic attraction. Most mask disinfection solutions including steaming, disinfectant spray/vapor, and ultraviolet radiation cannot recover the static charges, leading to deterioration of the filtration efficiency. The University of South Florida team of Zhong and Ye set out to develop a method to disinfect and recharge masks simultaneously to guarantee safe reuse.

In terms of the disinfection efficiency, the USF team used corona discharge to treat masks infected by

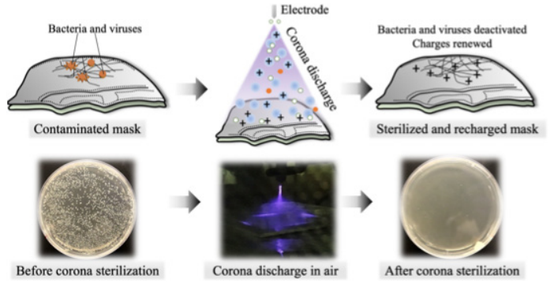

Figure 7. University of South Florida E.coli corona discharge sterilization.

Escherichia coli (E. coli). Detailed parameter studies were conducted to understand the influence of each factor, including treatment voltage, time, distance and environment. It was confirmed by the team that the disinfection effect against E. coli can reach up to 99.9999 percent. Its disinfection efficacy against SARS-CoV-2 is currently being validated.

In terms of recharging the masks, it was confirmed that the masks can get fully recharged after one minute of corona discharge treatment. The stability of the renewed charges can last at least several days to allow safe reuse. The filtration efficiency of corona discharge treated N95 masks maintained around 95 percent after 15 treatments, allowing multiple times of safe reuse.

In addition to disinfecting and recharging masks, corona discharge can also be utilized to disinfect various types of surfaces. The USF researchers aim to commercialize this disinfection technology by developing two types of portable and affordable disinfection devices (target: <$50):

- A portable device which can disinfect small objectives such as masks, key chains, and wallets
- A scanning disinfection gun or robot which can disinfect any surface

Fit Testing in Agricultural Respirator Communities

Presented by Charlotte Halverson, BSN, COHN-S from AgriSafe Network

AgriSafe Network looks at total farmer health and tries to find the most feasible solution to health and

safety concerns among the agricultural industry (CDC, 2020). Mitigating the spread of COVID-19 poses a significant challenge, but education and encouragement for personal protective equipment (PPE) use is the most feasible solution.

Knowing the kind and the extent of exposure we are trying to protect farmworkers from is needed for appropriate PPE fit testing. The most common exposures are mold, grain dust, pesticides, and handling animals, especially in confined spaces. Proper fit of PPE is essential to its effectiveness. An N95 respirator must fit tight to the face and allow no air leaks, be donned correctly, have a fit check performed each time it is worn, and be removed properly in order for it to effectively protect the person wearing it.

In many farmworker and PPE trainings, AgriSafe shares the United States Environmental Protection Agency particle size comparison image to help the wearer understand the importance of using PPE.

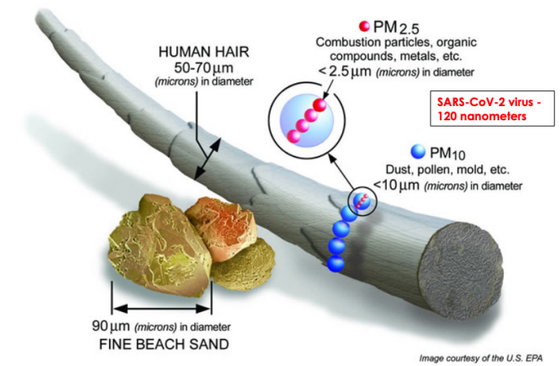

Figure 8. EPA particle pollution.

It depicts the size of common objects that we can compare with the size of a respirable dust particle, such as a strand of hair or beach sand. The figure shows that the size of the dust and exposures most farmworkers may face are about 10 microns in diameter. As a comparison, human hair is 50-70 microns in diameter and SARS-CoV-2 is 120 nanometers in diameter. It takes 1,000 nanometers to make one micron.

Per the United State Occupational Safety and Health Administration (OSHA) guidelines, fit testing is required if an employer requires the use of respirators and if employees are exposed above the OSHA permissible exposure levels (PELs) of a particulate or aerosol. If workers wear N95s with valve filters on a voluntary basis, no fit testing is required, but fit checking is encouraged.

The first rule of respirator fit testing is making sure that the same model, make, style, and size of respirator that will be used is tested. Best practices for clinicians include:

- Use OSHA medical evaluation guidelines (OSHA Standard 29 CFR 1910.134)
- Ask questions related to work environment, general health, history of respiratory, or cardiac conditions.
- Check blood pressure and pulse.
- In addition to basic fit test, the person doing the fit testing should observe the person being fit tested for his/her ability to walk around corners, ascend and descend steps, and move from high level light to low level light.
- Spend adequate time in care and cleaning education.

Communication during COVID-19: Trust in Science, Vaccine Adoption and Cultural Implications

Presented by Lauri M. Baker, Ph.D., from University of Florida's Center for Public Issues Education in Agriculture and Natural Resources

The UF Center for Public Issues Education in Agriculture and Natural Resources (PIE Center) collected survey data at multiple points throughout 2020 to learn more about American's perceptions of COVID-19. The first public opinion survey was conducted from March 13-15, 2020; national agriculture and natural resources leaders were surveyed March 16 and April 21, 2020; a second public opinion survey was conducted from March 16-April 21; and a third public opinion survey was conducted from July 23-August 9. Surveys measured communication concerns and economic concerns, as well as preventive measures to protect against COVID-19.

Communication Concerns

- Respondents have shown a gradual growth in concern over the course of the surveys regarding access to information when asked if people had communication concerns about COVID-19 information for themselves, their loved ones, or others.
- 64.4 percent of agricultural leaders were concerned that agricultural/farm laborers are not getting accurate information about COVID-19.
- In the first round of public opinion surveys, people indicated they were concerned that others and the media were sharing inaccurate information.

Economic Concerns

- There are high levels of personal, state, U.S. and global financial concerns (more than 70 percent) since the beginning of data collection.
- Increased food price concerns were over 70 percent in the public opinion polls and 54 percent from agriculture leaders.
- Concerns on COVID-19's impact on small businesses, farmers, and ranchers were all over 80 percent in the public opinion surveys and more than 90 percent among agriculture leaders.

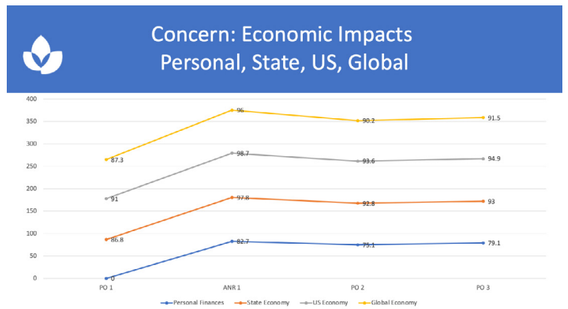

Figure 9. Economic concerns during COVID-19.

Other Concerns

- The majority of Americans and ANR leaders were concerned with undocumented workers not seeking medical attention.
- If a vaccine were available, more than 80 percent said they would get it and this largely related to people's attitudes toward vaccines in general.
- More than 80 percent of respondents said they practice social distancing
- 98.5 percent reported that they were able, and
- 99 percent of respondents are willing to comply with social distancing.

Recommendations for communicating about science during COVID-19 include sharing the scientific process, giving your credentials, encouraging your network to share, and sharing through multiple outlets so that a variety of audiences can access your message.

Farm To You: Necessity as the Mother of Invention

Presented by Danielle Andrews from the Florida Department of Agriculture and Consumer Services

Agriculture is an integral economic driver in Florida. Farm To You is a campaign with an interactive website created by the Florida Department of Agriculture and Consumer Services (FDACS) to keep the Florida supply chain strong during COVID-19. COVID-19's global impact on the agriculture industry involve points of disruption to the food supply like:

- Producers not being able to quickly switch between supplying to restaurants to stores and food banks
- Panic buying, high demand and loss of volunteers squeezing food banks

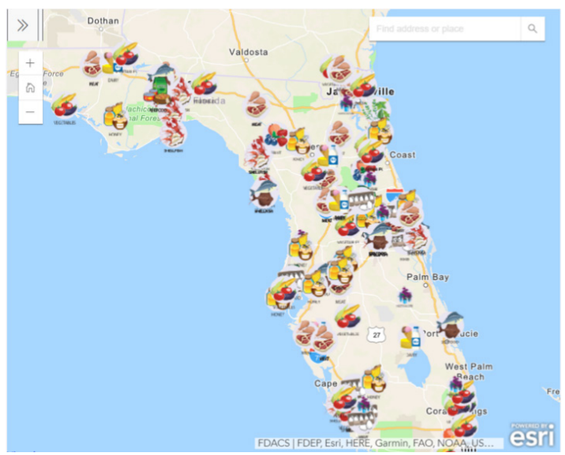

Figure 10. FDACS Farm To You map.

FDACS wanted to reduce the impact of COVID-19 on growers and producers, and developed Farm

To You to help connect growers and producers directly with consumers. The Keep Florida Growing campaign includes the Florida Farm to You Commodities List. For consumers, there is a list of food assistance programs, food safety guidance for consumers, and a U-pick farm locator. For agriculture producers, Farm To You includes food safety guidance for food workers, economic assistance for agriculture producers, and purchasing programs.

Farm To You includes resources for business and consumers, growers, and transportation services. It also includes a search filter by type of commodity (eg. seafood, alligator) and also by county.

COVID-19 and Resilience in Food Supply Chains

Presented by David Abler, Ph.D., from Pennsylvania State University, Department of Economics, Sociology and Education

Food supply chains have experienced significant impacts due to COVID-19. Dairy supply chains saw a significant drop from March through May 2020 due to both a collapsing of prices at the farm level, combined with scarcity and rising prices at the retail level. Meat supply chains suffered severe shocks in production, too, due to meat plants closing because of COVID-19 outbreaks among workers. Food service supply chains saw a collapse in demand due to the closing of restaurants and slow reopening with capacity limits or take-out options only. The closing of schools throughout 2020 also had a severe impact on bulk food supply.

While all of the supply chains have rebounded substantially since May 2020, as of September 2020, they had not yet reached 2019 comparable levels.

The pursuit of efficiency at the expense of resilience was felt significantly in separate supply chains between products going to grocery stores versus food service locations like restaurants, hotels, and schools. Different farms supplying one over the other, different processors, and differences in packaging and labeling made it difficult to repurpose food service items for sale at grocery stores.

Food supply chains were relatively stable prior to COVID-19 compared to others because people have to eat, but COVID-19 caused a level of disruption many supply chains were not prepared for. Many food supply chains had been optimized for efficiency with minimal inventory, a close matching of incoming demand and outgoing supply, stable buyer-seller relationships, and optimized truck fleets with minimal excess capacity before COVID-19. Lean inventory, stable sales forecasts, and close coordination with supply chain partners gave food supply chains little margin for error.

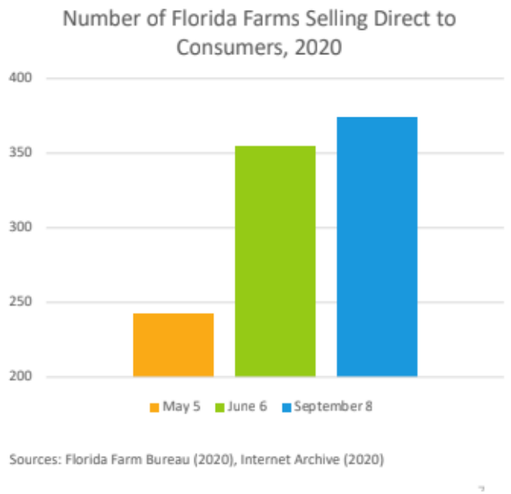

Figure 11. Number of Florida farms selling direct to consumers.

Guidance from recent research can improve food supply chain resilience via Garcia et al.'s (2020) multi-layer network model of supply chains, which includes different industries and service flows across sectors and locations. Currently, 41 sectors and 115 locations are being researched. Models of propagation in supply and demand shocks are estimated for each combination of sector and location. The sectors that exhibit the highest fragility risk and are more exposed to supply and demand shocks are largely food and agriculture sectors like animal feed, food manufacturing, live animals, meat, milled grains, and transportation. Medium fragility risk sectors include fertilizers, fruits and vegetables, and grains.

Abler recommends the use of Garcia et al.'s (2020) multi-layer network model and feels that it can be helpful for both businesses and government. In the future, businesses should:

- Develop a wider network of food supply chain partners, and more geographically diverse partners
- Have more flexibility to shift between grocery and foodservice markets
- Maintain larger inventories if possible
- Reduce exposure to shocks at each stage of the supply chain
- Conduct stress tests of supply chain resilience
- In the future, the government should:
- Provide financial support to develop and pilot-test supply chain initiatives that increase resilience
- Expand regulatory flexibility during crises to facilitate shifts between grocery and foodservice industries

Impact of COVID-19 of Florida's Agriculture and Marine Industries

Presented by Christa Court, Ph.D., from University of Florida, Food and Resource Economics Department

The size and scope of the agriculture, natural resource, and food system in Florida is vast. It is estimated that there are 200 to 300 different commodities produced in Florida alone, and some form of agriculture is present in all 67 counties. Florida is also nationally ranked in several categories of production agriculture and commercial fishing:

- #1 in commercially caught red grouper, spanish mackerel, yellowtail snapper, greater amberjack, spiny lobster, stone crab, and several other species
- #2 for vegetable, melon, potato, and sweet potato
- #2 for nursery, greenhouse, sod, and horticulture
- #3 for fruits, tree nuts, and berries

The Florida food processing and distribution sectors are robust, too. These sectors employ 76,146 people in food and kindred products

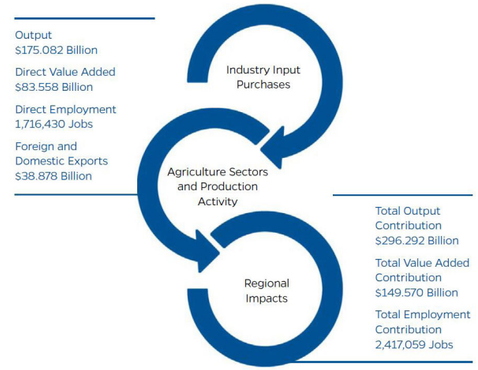

Figure 12. Total economic contributions of agriculture, natural resources, and food industries in Florida in 2018.

manufacturing and 1.24 million people in food and kindred product distribution.

Florida's food system was significantly impacted by the COVID-19 pandemic as public health measures aimed at mitigating the spread of the virus resulted in less money being spent on food away from home in places such as theme parks, schools, hotels, and restaurants. Producers whose product goes into the food service sector were hit especially hard (e.g. it is estimated that 80-85 percent of Florida grown tomatoes are sold into the hospitality and food service sector).

To put the scale of Florida production volume in context, Immokalee, FL, home to a significant portion of South Florida production, ships 400-500 semi-trailer loads of fresh vegetables out each day during their peak spring season (March through mid-May) - that is equivalent to 15 - 17.5 million pounds of vegetables shipped each day.

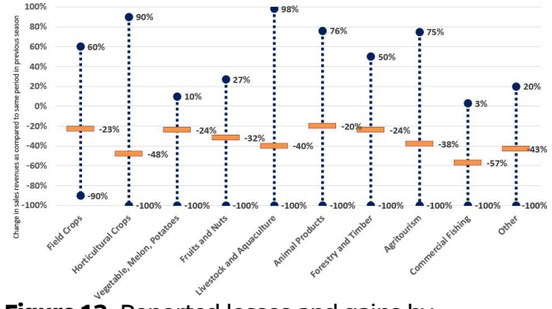

Figure 13. Reported losses and gains by commodity group.

A set of COVID-19 assessment tools was created to assess the impact of COVID-19 on Florida's agriculture and marine industries. Responses were collected from April 16-May 15, 2020.

	Total Annual Sales Revenues (5 year average, $millions)	% Annual Revenue March to Mid-May	Output at risk ($millions)	% loss from survey (average with 90% confidence interval)	Estimated Losses ($ Millions)
Field Crops	$720.36	10%	$72.04	**-22%** [-30%,-15%]	**$15.85** [$10.81,$21.61]
Horticultural Crops	$1,935.52	44%	$846.79	**-46%** [-54%,-39%]	**$389.52** [$330.25,$457.27]
Vegetable, Melon, Potatoes	$1,421.97	40%	$568.79	**-24%** [-38%,-12%]	**$136.51** [$68.25,$216.14]
Fruits and Nuts	$1,593.90	40%	$637.56	**-32%** [-39%,-24%]	**$204.02** [$153.01,$248.65]
Livestock and Aquaculture	$1,455.65	21%	$303.26	**-40%** [-46%,-34%]	**$121.30** [$103.11,$139.50]
Animal Products (Milk, Honey, Eggs)	$653.69	21%	$136.19	**-20%** [-32%,-8%]	**$27.24** [$10.89,$43.58]
Sum Total	**$7,781.09**		**$2,564.62**		**$894.44** [$676.33,1,126.75]

Figure 14. Total loss calculations for agriculture sector.

Each survey instrument collected information from different sectors: agricultural operations (729 responses); commercial fishing (319 responses); seafood wholesale dealers (71 responses); for-hire and charter businesses (326 responses); and marine recreation support (127 responses).

Findings include:

- Although reported changes in sales revenues varied significantly, the average change in sales revenue was down across all commodity groups and sectors assessed.
- Estimated sales revenue losses for production agriculture in Florida during the Marchthrough mid-May period total $894 million.
- Commercial fishing began to experience losses prior to other sectors; estimated sales revenue losses in this sector are $24 - $28 million.
- Charter/for-hire fishing, diving, and sightseeing operations also experienced significant impacts; estimated sales revenue impacts for this sector during the March through mid-May period total was $40 - $43 million.
- Seafood wholesale dealers experienced declines in revenue that ranged from ~60 - 85 percent depending on customer type.
- Marine recreation support businesses also suffered losses (~15 - 50 percent) from decreased tourist trips and expenditures but these losses were slightly muted by increases in marine recreation activity by residents.

Impacts of COVID-19 on Extension Agents in the United States presented by

Sebastian Galindo, Ph.D., from the University of Florida and Southeastern Coastal Center for Agricultural Health and Safety

Athena K. Ramos, Ph.D., MBA, MS, CPM from the University of Nebraska Medical Center, Department of Health Promotion and Central States Center for Agricultural Safety and Health

Shannon Sampson, Ph.D., from the University of Kentucky, Department of Education Policy Studies and Evaluation and Southeast Center for Agricultural Health and Injury Prevention

A collaborative team, led by the Evaluation Program of the Southeastern Coastal Center for Agricultural Health and Safety (SCCAHS) at the University of Florida, was formed with experts in evaluation and outreach from the 11 Agricultural Health and Safety Centers that have been established across the U.S. territory with funding from CDC-NIOSH. This team sought to assess the impacts of the COVID-19 pandemic on the different audiences served by the Centers. As part of this effort, the team developed a survey to measure these impacts on Extension professionals.

Extension is a trusted community partner, and agents are often thought of as information first responders. The quality of the information shared by Extension is critical to maintaining that trust; thus, evidence-based information to help reduce community stress must be reliable and credible, particularly during a natural disaster or public health emergency. This study aimed to identify ways Agricultural Health and Safety Centers could address needs of the Extension professionals who inform and care for the community. The Central States Center for Agricultural Safety and Health (CS-CASH), the Great Plains Center for Agricultural Health (GPCAH), the Pacific Northwest Agricultural Safety and Health Center (PNASH), the Southeast Center for Agricultural Health and Injury Prevention (SCAHIP), and SCCAHS administered the survey to Extension professionals in 18 states from mid-May through late-August 2020, obtaining a total of 1,389 usable responses.
Extension professionals who responded to the survey covered a variety of roles, including agents, state specialists, multi-county or regional specialized agents, administrators, office staff, and others. Key findings included:

- More than 48 percent of respondents worked in agriculture and 35.9 percent worked with youth.
- Respondents' primarily learned about COVID-19 through formal guidance documents (39.7 percent).
- More than 52 percent of respondents felt they probably had the information required to protect themselves from contracting COVID-19 while 38 percent said they definitely did.
- Fact sheets (61.3 percent), emails (58.4 percent), and websites (52.7 percent) were respondents' preferred methods for receiving evidence-based information.
- Healthcare service providers were ranked as the most trusted source of information about COVID-19 prevention and treatment.
- Nearly 78 percent of respondents had not visited a NIOSH Agricultural Safety and Health Center's website for information or resources for COVID-19.
- Social media (49.7 percent), websites (37.1 percent), and professional networking (34.3 percent) were the top three media used by respondents for sharing information about COVID-19.
- Respondents noted that social distancing was the most common method used to prevent COVID-19 transmission in their communities.
- A significant proportion of respondents from SCCAHS (47.1 percent) and CS-CASH (41.5 percent) reported that face masks were in short supply in their communities.
- "Receiving medical care" and "Arranging childcare while schools are closed" were identified as significant stressors, with 61.7 percent and 52.1 percent of respondents, respectively, reporting feeling at least slightly stressed by these. Respondents with children of any age in the household experienced significantly more difficulty balancing working remotely and family needs (moderate to great extent = 61.3 percent) than respondents with no children (33.9 percent).
- Over 90 percent of respondents had a healthcare provider they could contact if they became ill.

Looking at the Extension organization as both a client and a partner, this study discovered opportunities to create resources and support services specifically for these professionals. For example, the SCCAHS hosted a series of Mental Health First Aid trainings and stress management modules to help respondents mitigate the stress that was reported in the survey. This experience also highlighted the opportunity to cross promote educational and communication resources between Agricultural Health and Safety Centers and Extension because audiences on both sides may not know about available resources. Understanding Extension professionals' preferences on how to receive evidence-based information gives Agricultural Health and Safety Centers the opportunity to reach out using the most effective medium. The results of this study can be used as an opportunity to advocate for more health and socially supportive types of policies for Extension professionals during the pandemic and beyond. This research study is an excellent example of how Agricultural Health and Safety Centers can collaborate to gather broad feedback, brainstorm solutions, and build sustainable data collection infrastructure for initiatives.

Poster Presentations

A Public Relations Perspective of the COVID-19 Pandemic: Exploring the Organization-Public Relationship Indicators of the CDC

Presented by Ashley McLeod-Morin, University of Florida

Before COVID-19 was declared a pandemic, the Centers for Disease Control and Prevention (CDC) became an influential voice in the response efforts of the disease and published more than 150 informational documents and toolkits related to COVID-19 throughout 2020. The purpose of this study was to explore the organizational-public relationship of the CDC during the COVID-19 pandemic. Results from the study revealed

strong public perceptions of commitment, trust, and satisfaction with the CDC. This study can be applied to support the importance of trust in influential organizations while planning strategic communication efforts during partnerships with grassroots organizations, such as local Extension, farmworker advocacy groups, and healthcare workers.

Public Perceptions Regarding Cultural and Racial Issues Impacted by COVID-19 in the U.S.

Presented by Valentina Castano, University of Florida

Americans are concerned by the impact of the current pandemic on race and cultural relations in the United States. This aligns with previous work highlighting the concept of intersectionality and the interconnected nature of identities that often amplify harm, discrimination, and disadvantage in marginalized communities.

- 56 percent of respondents said they believe COVID-19 is creating a cultural divide in the United States.
- 55 percent agree that COVID-19 is making race and cultural relations worse in our society.

Further research is needed to better understand how global health crises can inhibit underrepresented populations from achieving the American dream and make cultural divides worse, as well as how communicators can assist in discussing and presenting knowledge that highlights the multifaceted impact pandemics can have on marginalized communities.

Public Perceptions of Food Purchasing Habits and Food Safety Behaviors as They Relate to the COVID-19 Pandemic

Presented by Michaela Kandzer, University of Florida

A quantitative survey research design was used to identify food purchasing habits, local food purchaisng preferenes, and food safety behaviors of Americans during COVID-19. Preliminary research suggests that respondents' food purchasing habits and food safety behaviors were impacted by COVID-19.

- 86 percent have experienced an increase in food prices.
- 75 percent of respondents have some level of concern about food safety.
- 77 percent have looked for information related to food safety and COVID-19.
- 72 percent of respondents have purchased local food in the past month.

COVID-19 Safety Measures for Fresh Citrus Agricultural Workers and Training Needs

Presented by Christine Kelly-Begazo, University of Florida

The UF/IFAS Fresh Fruit training team in Indian River County disseminated a survey in June 2020 to determine the level of concern with coronavirus and learn about what protective measures are being implemented to reduce the spread of COVID-19 among agricultural workers.

- 64 percent of respondents stated that they were extremely or moderately concerned about the possible spread of COVID-19 at their place of work.
- 25 percent reported that employees at their place of work had already had COVID-19.
- Nearly 50 percent reported some sort of hinderance for workers to get tested like lack of available testing, did not know where to go, or are afraid to get tested.
- 68 percent reported that hand sanitizer was more readily available at their place of work .
- 52 percent reported that face coverings were required at their place of work.

Fostering Herd Health in a Pandemic – A Look at Public Willingness to Receive a Vaccine for COVID-19

Presented by Shelli Rampold, Ph.D., University of Florida

The World Health Organization (WHO) ranked vaccine hesitancy among the top ten health threats of 2019, and with the development of a COVID-19 vaccine throughout 2020, this study aimed to examine the U.S. public's perceptions and experiences with vaccines during the early stages of the pandemic.

- The majority of respondents (80.3 percent) would get a vaccine for COVID-19 if one were to become available.
- Most respondents (82.9 percent) also believed that a vaccine for COVID-19 would be available within the next 12 to 18 months following the time the study was conducted (March 2020).
- Those who would get a COVID-19 vaccine had more positive attitudes toward vaccines in general, had a greater degree of health concerns about COVID-19, and had more trust in science than those who would not get a vaccine for COVID-19.
- The percentages of those who get the annual flu shot, get other recommended vaccines, have been diagnosed with COVID-19, and know someone who has been diagnosed with COVID-19 were greater among those who would get a COVID-19 vaccine than those who would not.

Stakeholders' Perceptions about Occupational Health and Safety in the Agricultural Industry

Presented by Beatrice F. Pierre, University of Florida

The COVID-19 pandemic offers a unique opportunity for training providers and extension specialists to revamp their services and to adapt their approach. It motivates politicians, decision makers, and business owners to strategize better when it comes to the agricultural system in general and affordable healthcare for all. Participants echoed education, financial assistance, and affordable healthcare as three pivotal points to help overcome the challenges associated with COVID-19. They also stressed the necessity to immediately start conversing with growers, using local radio stations, community leaders, and social networks. Barriers to mask wearing for health and safety include:

- Cultural
- Cost factors, including loss of income, decrease in profitability, and housing
- People's attitudes
- Temperature and concerns with heat related illnesses
- Cost for workers to fund their own masks
- Flaws in the CDC guidelines mechanism: recommendations vs. formal regulations and how to enforce recommendations.

Key Findings

Most of the research and information presented at State of the Science 2020 identified how pandemic stressors are impacting the agricultural industry and showcased what adaptations are needed in existing industry processes and systems for efficiency and survival.

Stressors identified include:

- Mental health and physical health concerns from Extension agents.
- Access to and training for personal protective equipment.
- Economic worries related to food pricing and food availability.
- Additional racial and cultural stressors because of COVID-19.
- Infection spread concerns at the workplace

Trusted systems identified include:

- Information from the Centers for Disease Control to slow the spread of COVID-19.
- COVID-19 vaccine willingness matches other vaccine sentiments.

Adaptability needed include:

- Living and transportation strategies in agriculture to reduce disease spread.
- Current and future pandemic planning that meets state and federal guidelines.
- Tangible touch points for specialized food supply chains to reach consumers directly .
- Establishing flexible inventory standards so that supply chains can shift during pandemics.
- Disinfection resuse interventions for personal protective equipment.
- Recommendation vs. formal regulation from federal sources and scientific community.

Recommendations

SARS-CoV-2 impacted the agricultural industry in a multitude of ways and afforded researchers a myriad of opportunities to address real-time concerns across the industry. A resounding effort is needed to build agile systems or processes in 2020 and beyond to better prepare, adjust and survive future pandemics.

Estimation, simulation and preparation tools like

the Farmhouse Simulator presented by Dr. McCue and the Michigan State University CHAMP e-tool presented by Dr. Millerick-May are examples of adaptable and agile systems that can help employers and workers in agriculture to mitigate the spread of a virus. Similar interventions should continue to be researched and existing tools should be promoted across the agricultural worker community to supplement existing safety compliance requirements.

Direct access to consumers and interventions to create opportunities for farmers to adapt their production and inventory during the pandemic is needed, too. Expanding programs like FDACs' Farm To You program can help producers connect directly with consumers, which in turn helps decrease waste and create broader access to certain foods that are often heavily reliant on hospitality spaces like hotels and restaurants that are often not placing the same volume of orders during a pandemic. Similarly, specialized supply chains collapsed during the COVID-19 pandemic and could not be readily repurposed for consumers at grocery stores; therefore, additional research and planning is needed on the creation and sustainability of flexible supply chain systems, better inventory systems to minimize waste, and establishing more diverse producers.

Addressing acute care needs as a result of the pandemic in the agricultural community and the state workers in charge of outreach and education should also be researched. Per the findings from the initial survey conducted by experts in evaluation and outreach from the 11 Agricultural Health and Safety Centers from across the U.S., there is a growing need for access to mental health care. It is recommended that Ag Centers partner with local community behavioral health providers to train Extension agents in mental health first-aid. Extension agents play a vital role in agricultural communities and in crisis often serve as frontline first responders. To effectively serve their communities, agents need to be at their best – both physically and mentally. Additional research on resource access to mental health care for workers would be beneficial too.

Personal protective equipment is and will always be a first line of defense in any pandemic, therefore, additional research on disinfection similar to the coronavirus discharge mask and surface sterilization products developed by the University of South Florida and presented by Dr. Zhong are needed. Adaptation of existing personal protective equipment training materials for required mask fit-testing safety protocols throughout the agricultural industry should include SARS-CoV-2 and other respiratory virus specifications.

Some additional programmatic recommendations as COVID-19 disparities continue to stress and impact communities include:

- Adapt disaster evaluation programs to be able to measure economic impact of COVID-19 and build sustainable plans for 2021 and beyond.
- Expand vaccine adoption research and address vaccine misinformation. As a COVID-19 vaccine passes final phases of implementation, science communicators must find practical and cost-effective ways to share the benefits of vaccine adoption. Departments of Labor and Agriculture should also prioritize vaccine access for workers.
- Acquire funding for vaccine adoption and access, as well as continued testing access and education.

Conclusions

As the pandemic stretches on into 2021, there is a need for continued learning and development, especially in regard to COVID-19 prevention measures: social distancing, access to testing, mask wearing and sterilization, vaccine adoption, surface and equipment cleanliness.

State of the Science 2020 proved to be different than previous years because research being conducted about COVID-19 was happening while the scientific method unfolded in real-time.

The drawback is that a more concerted effort is needed to standardize recommendations and share available resources across agricultural communities. Differences in enforcement for state-specific ordinances pose a significant threat to the health and safety of agricultural workers in some areas.

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