

*A DECADE
OF EXCELLENCE*



2024 ANNUAL
REPORT



THE UNIVERSITY OF ARIZONA

Yuma Center of Excellence
for Desert Agriculture

2024 IMPACT REPORT

A DECADE OF EXCELLENCE

Dear YCEDA Investors, Partners, and Supporters,

As the Executive Director of the Yuma Center of Excellence for Desert Agriculture (YCEDA), I am thrilled to present our 2024 Annual Impact Report - A Decade of Excellence. This report reflects the passion, dedication, and tireless efforts of our investors, partners, supporters, and the YCEDA team. Together, we have built a unique hub for research and innovation through our public-private partnership model, which combines the University of Arizona's strengths with the agriculture industry's expertise, working together to advance desert agriculture with pioneering science and innovation.

YCEDA aims to safeguard agriculture using science and innovation to produce the safest and healthiest food. Over the past decade, YCEDA has supported research and innovation addressing agricultural challenges ranging from water efficiency and soil health to pest management and crop yield optimization. As new challenges emerge, YCEDA has continually refined its goals and research initiatives, ensuring they align with the evolving needs of our agriculture stakeholders. YCEDA's research projects have yielded transformative results, providing invaluable insights and practical applications that make a profound difference, empowering growers with vital tools and scientific knowledge.

One of YCEDA's greatest strengths is our collaborative spirit. We have created a vibrant knowledge exchange and resource-sharing network by building strong partnerships with growers, agricultural businesses, academic institutions, and government agencies. YCEDA's commitment to community engagement through our partnerships with Cooperative Extension and Experiment Stations remain cornerstones of our mission. These collaborations have amplified the impact of our research and fostered a sense of community and shared purpose that inspires us all.

Reflecting on the past decade, the YCEDA team is optimistic for the future. We are confident that YCEDA will continue to be a leader in addressing the pressing challenges of desert agriculture, which have driven progress and innovation. In the first ten years, YCEDA earned the reputation of being an "arid-land agriculture expert," leading to YCEDA playing a more significant role in global arid-land agriculture. To continue this

trajectory and build on Yuma being the epicenter for global arid-land research, innovation, and impact, YCEDA plans to expand partnerships, support, and infrastructure to meet the agriculture industry's demands.

As we look ahead to the next decade, several trends are shaping the landscape of desert agriculture. YCEDA's role in this evolving landscape will be more crucial than ever. Our ability to bring together experts from diverse interdisciplinary fields to develop innovative solutions will help ensure food security and human health in North America and beyond.

As we reflect on a decade of achievements, I am both honored and inspired by the dedication and passion of our team, partners, and community. Our success and progress would not have been possible without your unwavering support and commitment. With heartfelt gratitude, I extend my sincerest thanks to the YCEDA Investors, YCEDA Advisory Council, YCEDA Technical Committee, YCEDA Research Partners, agriculture associations, and everyone who has supported and continues to support YCEDA's mission. Thank you to Paul Brierley, YCEDA's first Executive Director, for dedicating over eight years to leading YCEDA with technical expertise and vision. Without his leadership, YCEDA would not be where it is today.

Together, we are making an indelible impact and creating a legacy of excellence in desert agriculture. Thank you for being an integral part of this incredible journey. The YCEDA team looks forward to working with you as we boldly venture into the future.

Sincerely,





The Yuma Center of Excellence for Desert Agriculture (YCEDA) is a **hub for research and innovation**, driving applied research in arid environments by providing the agriculture industry with actionable information that enhances food production systems improving human health. Through our **unique partnerships** between the research and industry communities, we gain visibility, increasing the opportunity to support innovative research while delivering results at the speed of industry demands. We are committed to fostering research, innovation, and the advancement of technologies through cross-disciplinary initiatives and active collaboration with industry, scientists, and engineers.

PURPOSE

To focus on **priority issues** that significantly impact the sustainability of food production in arid regions while maintaining food security and health on a **regional, national, and global level**.

MISSION

YCEDA is committed to bringing together industry and world-class scientists, offering resources, infrastructure, partnerships, and support to develop **cutting-edge solutions and innovations**. These efforts benefit stakeholders by addressing pressing industry needs and providing **actionable information** to enhance food production systems in arid regions and improve human health.

VISION

To be a world-class desert agriculture research, innovation, and advanced technology center by integrating and leveraging industry and academic resources, **translating research into impactful solutions**.

\$31M

INNOVATION
COLLABORATION

\$7.4M

RESEARCH

FOR EVERY

\$1.00 OF AG INDUSTRY
INVESTMENT

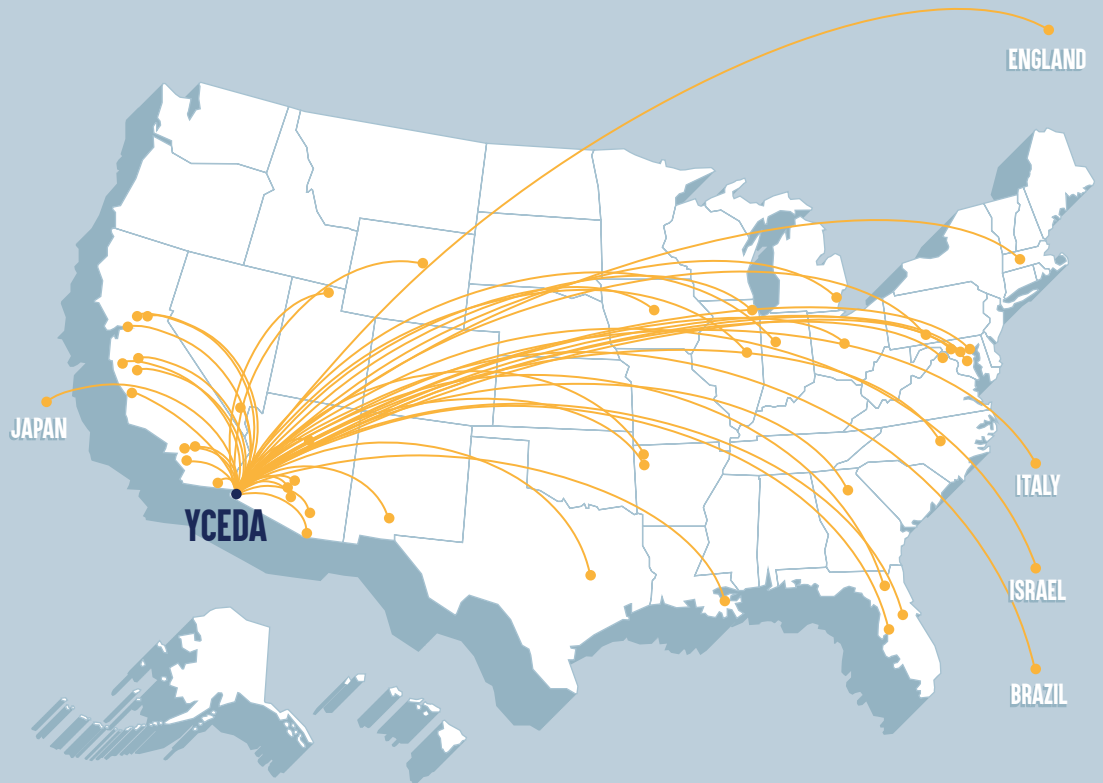
YCEDA GENERATED

NEARLY **\$11.00**

IN RESEARCH
AND INNOVATION

In-kind contributions by the growers, agency partners, and the university are not included in these numbers but significantly contribute to the value of the YCEDA's work.

YCEDA COLLABORATIONS



“Collaboration has been a fundamental part of YCEDA’s success. These efforts provide knowledge, skills, and personnel not available in-house, financial support, and expands advocacy and visibility for agricultural research in Yuma.”

- Dr. Andrew French

INITIATIVE LEADS



STEPHANIE
SLINSKI, Ph.D.

**PLANT DISEASE
MANAGEMENT**



ANDREW
FRENCH, Ph.D.

**EFFICIENT & EFFECTIVE
WATER USE**



JOEY
BLANKINSHIP, Ph.D.

**DESERT AG SOIL
HEALTH INITIATIVE**



CONNOR
OSGOOD

**AG TECH
INTEGRATION**



BRADLEY
SCHMITZ, Ph.D.

ONE HEALTH

RESEARCH & DEVELOPMENT INSIGHTS

Stephanie Slinski, Ph.D.

Associate Director of Applied Research & Development

Over the past decade, YCEDA's research support has evolved from supporting a handful of projects to managing a robust portfolio of initiatives. Initially, we focused on smaller projects supporting a few key priorities such as plant disease, food safety, and irrigation and salinity management. Today, we oversee ten comprehensive initiatives, each with a dedicated portfolio of projects. We have appointed leads for half of these initiatives and established expertise or collaborations to address the remaining ones.

We take pride in our achievements in research, collaboration, stakeholder engagement, and building a strong reputation. With stakeholder support, we have stimulated exciting research, such as transforming small irrigation efficiency projects into a multi-year, multi-million dollar initiative supporting Yuma's water use. Our early conferences and field trials have grown into a significant research

effort on Fusarium wilt of lettuce involving numerous researchers, lettuce breeders, and growers. During the pandemic, a generous donation enabled us to build a lab and launch a One Health program, enhancing safety in Yuma County. Additionally, we recently established the Desert Ag Soil Health Initiative (DASHI), which unites teams and raises research funds to advance desert agriculture knowledge and resources. We also hired a program manager to address Yuma's AgTech needs, further demonstrating our commitment to innovation and progress.

Looking forward, we have exciting projects planned and will continue to develop important initiatives to make a significant impact on our agricultural community.

YCEDA RESEARCH & INNOVATION INITIATIVES

YCEDA's goal is to safeguard agriculture in arid regions, emphasizing the great responsibility of producing safe and healthy food. Our efforts impact global arid regions, supporting sustainable practices worldwide. YCEDA's initiatives embody our mission, each uniquely organized around distinct areas of inquiry and stakeholder interests. They are designed to tackle critical challenges, strengthen national and global food security, and offer significant benefits to the agriculture industry.



1

Ensure healthier crops by **advancing disease and pest management**.



2

Sustain and improve **soil health** in arid regions.



3

Develop the most **efficient and effective water use** and soil salinity management in the world.



4

Address existing knowledge gaps in **food safety**.



5

Develop and integrate cutting-edge **technologies** for more effective and efficient production.



6

Develop and implement **One Health** research and technology to address critical issues.



7

Develop and implement climate-smart and **regenerative agriculture** practices for arid regions.



8

Enhance production efficiencies through improvements in **plant nutrition and genetics**.



9

Grow local food systems, foster resiliency, and stimulate the **bioeconomy**.



10

Close the agriculture **workforce skill gaps** through education, training, and workshops.



PLANT DISEASE & PEST MANAGEMENT

LEAD: Stephanie Slinski, Ph.D.

IMPACT

Plant diseases impact farmers by reducing crop yields, increasing production costs, and lowering produce quality and market value. Annually, 20-40% of global crop production is lost to pests and diseases, causing economic losses in the hundreds of billions of dollars. Farmers face higher expenses for disease management, and plant diseases threaten food security by decreasing staple crop availability, raising food prices, and increasing reliance on imports. Effective disease management strategies and support systems are crucial.

YCEDA has developed a comprehensive program involving research and support for disease management projects including Fusarium wilt of lettuce, a persistent soil fungus that has spread widely in Arizona's lettuce-growing regions since 2001. YCEDA has hosted workshops, conducted field trials, and collaborated with universities, USDA labs, and international researchers to develop research focusing on soil health for mitigating disease, developing new management tools, identifying new pathogen races, and developing rapid diagnostic tests.

YCEDA's efforts have improved knowledge and resources for Arizona's agriculture industry, validating tolerant cultivars, providing early performance data, and deepening understanding of disease triggers. This integrated approach enhances crop health, yield, and the resilience of desert agriculture.

KEY OUTCOMES

Enhanced Knowledge and Resources: *Improved understanding and resources for managing plant diseases.*

Collaborative Research: *Developed multi-institutional, transdisciplinary research projects and partnerships including the formation of the Fusarium wilt of lettuce working group.*

Educational Outreach: *Workshops, conferences, and symposia have been convened to share knowledge.*

Secured Funding: *Acquisition of significant external funding for research and outreach.*

Support for the Ag Industry: *Development of programs to aid growers in improving crop health and yield. YCEDA's integrated approach has significantly contributed to addressing plant disease challenges, benefiting a wide range of stakeholders in the agriculture sector.*



1

Fusarium Wilt of Lettuce

Fusarium wilt of lettuce caused by *Fusarium oxysporum* f.sp. *lactucae* has a significant impact on the lettuce growers. Tools are needed to manage disease including tools for disease suppression, disease avoidance such as resistant cultivars, and remediation of infested fields.

Growers have been provided with knowledge about the tolerance levels of commercial lettuce cultivars, which can be compared over multiple years, and the efficacy of crop protection products. Breeders benefit from data on new breeding material performance that can be incorporated into breeding programs and independent evaluations of precommercial cultivars. Research efforts have built teams to address industry needs, increased research output, and continue to develop projects for funding.

2

Impatiens Necrotic Spot Virus of Lettuce

Impatiens necrotic spot virus (INSV) of lettuce is transmitted by an insect known as thrips and can survive in many host plants, including common weed species. INSV is a significant problem in California and in early 2021, the disease was found in a lettuce field in Arizona. Lettuce growers were concerned that INSV would have a significant impact on Arizona production.

A study to examine survival of the virus over the summer in weeds as a source of inoculum in the fall was initiated in 2021. In collaboration with Dr. John Palumbo and Dr. Samuel Discua, weeds were evaluated over multiple seasons and it was found that the virus was not detectable in the population by late summer. By testing transplants for infected thrips, Dr. Palumbo found that INSV is likely reintroduced into the winter desert production annually through movement of plant material from the Salinas Valley. INSV has since not been a significant problem in Arizona due to changes in transplant production, providing INSV-free plant material.

3

Downy Mildew of Lettuce

Downy mildew of lettuce (caused by *Bremia lactucae*) is a foliar disease controlled using pesticide applications and resistant varieties. The pathogen is highly dynamic, with new virulent strains emerging seasonally, and thus, resistant cultivars do not remain resistant indefinitely.

Many of the races found in Arizona and California are uncharacterized (novel). To help characterize the population of the pathogen in Yuma, we collaborate with Dr. Richard Michelmore at the University of California, Davis who routinely monitors isolates of *B. lactucae*, for their ability to overcome disease resistance genes and for insensitivity to fungicides.

A significantly greater number of samples have been analyzed from Arizona due to this project. As a result, the population of the pathogen is better understood, including which lettuce genes continue to provide resistance to the pathogen. This supports lettuce breeding programs and helps identify “novel” races that need to be characterized.

4

Corky Root of Lettuce

Corky root of lettuce caused by *Rhizorhapis suberifaciens* was first reported in Yuma in late 2023 and has since been found throughout the region. This disease was a problem in California 15 years ago and has since been managed with resistant cultivars, but it was never a problem in Arizona. Little is known about why corky root has become an issue in Arizona and what the impact on production will be. We are working to provide up-to-date information about the pathogen and management tools.



IMPROVE PLANT NUTRITION

LEAD: Charles Sanchez, Ph.D.

Updated Fertilizer Guidelines

Comprehensive fertilizer guidelines for Arizona vegetable crops have not been updated in decades, and data was lacking to support guidelines for newer vegetable crops introduced into the region during the past two decades. Updated guidelines are now available consolidating decades of research, incorporating historical databases augmented with relevant literature, and focused on the results of recent studies conducted over the last 25 years in the region.

KEY OUTCOMES

1. Updated guidelines for general fertilizer requirements in the region.
2. Guidelines for specific crops in the context of the most common cultural practices.
3. Guidelines for some of the less common cultural practices, supporting diagnostic protocols and tools, fertilizer management opportunities with emerging technologies, and a summary of some challenges due to imminent environmental regulation.

IMPACT

These updated fertilizer management guidelines will play an important role in helping the vegetable production industry reconcile economic sustainability with environmental stewardship.

PROJECT SUPPORT

These projects have been supported by the USDA/Arizona Department of Agriculture Specialty Crop Block Grant Program, the Arizona Iceberg Lettuce Research Council, The USDA-NIFA Specialty Crop Research Initiative, and the Israel Binational Agricultural Research and Development Fund. Stakeholder collaborators include JV Farms, Gila Valley Farms, Keithly-Williams Seeds, and YCEDA Investors.

WHAT'S NEXT?

We will continue to support our stakeholders by providing resources and access to information. Problems will be identified and addressed rapidly. We will continue to pursue management tools for Fusarium wilt, downy mildew, corky root and any pest and disease problem that needs attention.



Find the updated fertilizer guidelines on the YCEDA Website

Funding for the development of the webpages with the updated fertilizer guidelines was made possible by a grant/cooperative agreement from the U.S. Department of Agriculture (USDA) Agricultural Marketing Service. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the USDA.



WATER USE EFFICIENCY

Lead: Andrew French, Ph.D.

The Yuma area is one of the world's most productive cropping regions. Because this productivity is dependent on irrigation water from the Colorado River, effective and efficient use of water is of upmost importance for growers. Using water effectively and efficiently ensures that scarce supplies are not wasted, optimizes nutrient use, and minimizes threats from plant diseases. Intimately related is salinity control, which must be tracked and managed along with irrigation supplies to ensure sustainability.

Since 2016, the Yuma Center of Excellence for Desert Agriculture has led a collaborative, multi-institutional project to quantitatively track water use and salt balance. Advanced technologies, including electromagnetic surveys, eddy covariance systems, large aperture scintillometer instrumentation, drones with remote sensors, and satellites have been utilized to measure evapotranspiration (ET) and soil salinity.

The comprehensive data set generated from these measurements is being used to develop a knowledge base for optimal management of water and soil salinity and is a key component of DesertAgWISE, an online tool which will help growers optimize irrigation for crop growth and salt leaching.

KEY OUTCOMES

Support for Water Use: *Seasonal irrigation application efficiencies were found to be 80-90% for most Yuma-area vegetable cropping systems. Over 70% of production sites showed a salinity increase during the crop production cycle, demonstrating the need for pre-season leaching irrigation for sustainability.*

Technological Integration: *The use of advanced technologies has enabled precise measurement of ET and soil salinity contributing to a robust and validated database.*

Development of New Tools: *DesertAgWISE.org utilizes the compiled data to optimize irrigation and soil salinity management for growers.*

Policy Implications: *The findings provide facts needed to develop policies that support improving water use efficiency and sustainability. The emphasis on pre-season leaching and the benefits of the DesertAgWISE tool help guide policymakers.*

Grower Support: *The report supports farmers by providing critical data on efficient irrigation water use and salt management, helping them implement effective strategies to conserve water and maintain crop yields.*

Collaborative Efforts: *Collaboration with the USDA-ARS Salinity Lab and University of California, Riverside is providing leading research in the use of artificial intelligence for optimal water and fertilizer management. Agreements with USDA-ARS in Maricopa and Riverside provide salary support for Yuma researchers and students. The long-term collaboration with the United States Bureau of Reclamation is enabling national awareness of the quality and importance of agricultural research in Yuma.*

IMPACT

1

Delivered support for Yuma Growers

Established that Yuma growers irrigate with a high efficiency and optimally manage their salt loads. We demonstrated the paramount importance of pre-irrigation for salt leaching, and we are providing a software tool to enable growers to use best management practices.

2

Provided OpenET with a one-of-a-kind data set for vegetable crops

OpenET (etdata.org) is the pre-eminent web-based platform for monitoring crop water use across the USA using satellite remote sensing. This Yuma data set will enable the platform to more accurately estimate water used by desert agricultural crops.

3

Provided U.S. Bureau of Reclamation (USBR) with advanced tools that improve consumptive water use estimates.

USBR is the authority responsible for annual water use accounting for all irrigation areas along the Lower Colorado River. The new tools use satellite remote sensing that will enable the agency to improve accounting accuracy and speed their analyses.



PROJECT SUPPORT

Projects have been supported by the United States Bureau of Reclamation, USDA-ARS, Yuma County Agriculture Water Coalition, USDA/Arizona Department of Agriculture Specialty Crop Block Grant Program, Various Grower Cooperators, University of Arizona, Arizona Grain Research and Promotion Council, Arizona Iceberg Lettuce Research Council, Arizona Citrus Research Council, Cotton Incorporated, and NASA.

WHAT'S NEXT?

We recognize the importance of continuing research under this initiative, and we will continue to pursue collaborations, projects and funding to provide growers and policy makers with the information necessary to make well-informed decisions on water use.

IRRIGATION EFFICIENCIES OF VEGETABLE AND LEAFY GREEN ROTATIONAL CROPPING SYSTEMS IN YUMA ARE HIGH

80-90%

EFFICIENCY

PRE-SEASON IRRIGATING FOR SALT LEACHING IS OF PARAMOUNT IMPORTANCE FOR **SOIL SUSTAINABILITY**

DESERTAGWISE.ORG

A Tool for Improved Irrigation & Salinity Management

DesertAgWISE SUPPORT ABOUT US FARMS ACCOUNT

Manage your farms with Water Irrigation Soil Environment (WISE) decisions

DesertAgWISE combines a century of research expertise on desert crops, science-based intelligence, and the latest technology, to provide a desert-specific WISE (Water Irrigation Soil Environment) tool to optimize production efficiencies.

My Farms Learn More

The benefits are clear

- Precise Data-driven Recommendations**
Utilize desert-specific research and science-based WISE intelligence to hone your irrigation and soil salinity management decisions
- Soil Salinity Management**
Maximize crop production by closely monitoring soil salinity to achieve proper water salt balance
- Irrigation Management History**
Accurately track irrigation and rain events and receive reliable recommendations to make optimal irrigation decisions for WISE farming.
- Visualize your Farms**
Customize unlimited farms and fields for specific WISE management recommendations relevant to you
- Receive Notifications**
Informative text and email notifications suggest WISE action to improve sustainability (Future Feature)
- Assign Roles to staff**
Allow others assisting with field operations access to DesertAgWISE and oversee their contributions (Future Feature)

DesertAgWISE is a part of a three-point strategy to improve Yuma irrigation practices by:

- Measuring actual crop water use
- Developing locally calibrated crop coefficients
- Integrating these with heat units and FAO-56 soil water balance methodology

What information is required?

- User-specified field bounds, soils & crops
- Weather-based reference evapotranspiration
- Locally calibrated crop-coefficients
- Daily tracking of water applied, consumed, and evapotranspiration

What DesertAgWISE Delivers:

- Water and salinity status at field-scale
- Irrigation recommendations
- Seasonal monitoring of soil salt profiles

How DesertAgWISE was Developed:

- Measured evapotranspiration from 90+ deployments of eddy covariance (ECV) since 2016
- Monitored water applied and changes in salt concentrations at all sites before planting and after harvest
- Compiled and optimized Yuma heat units and crop coefficients
- Developed crop coefficients from local weather and ECV data
- Implemented for lettuce, cotton, and wheat with more crops pending



AGRICULTURE TECHNOLOGIES

LEAD: Connor Osgood

Growers in the desert face increasing challenges due to rising labor costs and a growing emphasis on sustainable practices for water, pesticide, and fertilizer use. To help reduce these challenges, growers and the agriculture industry are integrating new agricultural technologies (AgTech) such as automated crop thinners, spray drones, and sensors. Advanced technologies require reliable broadband connectivity to function effectively. Drones, automated machinery, and artificial intelligence (AI) driven decision support tools depend on real-time data analysis and seamless wireless communication. As examples, fleets of automated equipment must synchronize their activities through uninterrupted communication, while AI-based predictive analytics tools need the ability to rapidly upload large datasets to the cloud for processing to provide insights to growers and crop advisors in real time. Many growers operate across multiple locations, and for new technologies to be practical, they must work reliably at all farm sites. New technologies must work every day and at all locations across Yuma County, ensuring consistent connectivity across Yuma's greenbelt, which is essential to supporting the adoption of these cutting-edge solutions and maintaining the region's productivity.

YCEDA has been instrumental in expanding technology opportunities, driving innovation by addressing these challenges, and fostering the adoption of advanced AgTech, which is critical in ensuring that growers have the resources and connectivity needed to implement these new tools effectively.

Significant investments in Yuma's economy are tackling these challenges head-on. In 2021, Yuma County was awarded \$31 million in federal funding through the American Rescue Plan Act (ARPA) COVID-19 relief funds to build a high-speed fiber optic 'Middle Mile' broadband network. This network aims to expand access to high-speed internet connectivity for residents and businesses across Yuma County. In a groundbreaking effort, YCEDA, in cooperation with Yuma County and others, is leveraging a \$6 million grant to build a rural broadband network exclusively for the local agriculture industry to foster AgTech adoption. The network will feature over 30 strategically placed towers connected to the Middle Mile, ensuring reliable high-speed connectivity for AgTech across the Yuma County greenbelt. This state-of-the-art enhancement of Yuma's infrastructure will improve efficiency, precision,

and sustainability in farming, boosting productivity and profitability. Once completed, Yuma County will be the first county to have all farms capable of being smart farms. This nearly 200,000-acre network will provide an ideal testing ground for new AgTech.

Transforming Yuma's Agricultural Future by Expanding AgTech Opportunities

1

Real-Time Data Collection and Analysis

Precision agriculture relies on real-time data from sensors placed throughout the fields to monitor soil moisture, temperature, and nutrient levels. Low latency and high-speed connectivity will enable immediate data transmission to cloud servers where it will be analyzed and processed. Growers will then be able to access this data in real time allowing them to make timely decisions on irrigation, fertilization, and pest control.

2

Automated Machinery and Drones

As autonomous crop thinners, spray drones and other implements increase in sophistication, they will require efficient communication with each other. High-speed and symmetrical upload/download rates ensure that commands are sent and received without delay, allowing for precise and coordinated actions. For instance, swarms of drones spraying pesticides must synchronize their activities to cover large areas effectively without overlapping or missing spots.

3

AI-Driven Decision Support Tools

AI-driven tools will analyze vast amounts of data to provide growers with actionable insights, such as predicting crop yields or detecting early signs of disease. These tools will rely on high-speed connectivity to process data quickly and deliver real-time insights. Symmetrical upload and download rates will ensure that field data is uploaded swiftly and analysis results are received without delay.



4

Remote Monitoring and Control

Remote monitoring and controlling irrigation systems, crop production systems, and environments using IoT devices connected via broadband and radio technologies provides farmers with a comprehensive view of their operations. Low latency will ensure that commands sent from a grower's device are executed instantly, while high-speed and symmetrical rates will enable continuous streaming of live video feeds and sensor data.



The University of Arizona Yuma Agricultural Research Center: AgTech Test & Demonstration Site

A partnership between the University of Arizona Cyber & Information Technologies, Sun Corridor Network, Yuma County, YCEDA, and other key stakeholders helped establish a wireless 'Smart Farm' at the Yuma Agricultural Center. At the 2024 conference, *The Desert Difference: A Showcase of AgTech Opportunities for Growing in the Desert* (attended by growers, technology developers and researchers), the Yuma Agricultural Center was announced as a regional AgTech test and demonstration site. With integration expected by 2026, this site will serve as an AgTech Smart Farm Innovation Hub, encouraging AgTech collaboration, creativity, and technological advancement. The 10g wireless system will provide connectivity across 150+ acres to serve as a testbed for innovative AgTech developers to test and refine their technologies in real-world desert farming conditions without relying on commercial farms for testing opportunities. This hub will provide space for new AgTech startups, researchers, students, and industry professionals to collaborate on inventive solutions for enhancing desert agriculture's sustainability and productivity.

5

Collaborative Research and Development

Research institutions and AgTech startups often collaborate to develop and test new technologies. Reliable and high-speed connectivity allows researchers to seamlessly share large datasets, high-resolution images, and video footage, accelerating the R&D process and facilitating the adoption of innovative solutions.

6

Farm Management Software Integration

Farm management software will integrate various data sources, such as weather forecasts, soil health reports, and equipment performance metrics to provide farmers with a centralized decision-making platform. High-speed and symmetrical connectivity will ensure that this data remains up to date, allowing farmers to plan and execute operations with maximum efficiency.



Photo Credit:
Leslie Hawthorne Klingler

WHAT'S NEXT?

AgTech Future Economic Impacts: A Vision for Tomorrow

Yuma's agricultural landscape offers an unparalleled opportunity to serve as a test site for AgTech implementation in specialty crops. The region's diverse climate and crop variety make it an ideal environment for testing and refining cutting-edge technologies. By serving as a testbed for innovations in specialty crops and arid agriculture, Yuma can lead the way in developing solutions that address the unique challenges faced by growers in similar regions around the world. The widespread adoption of AgTech will stimulate job creation and opportunities for workforce upskilling, advancing Yuma's workforce and encourage agricultural technology developers to enter the local economy by establishing operations in Yuma to focus on developing and selling technology for desert agriculture. Omnipresent wireless network availability across Yuma's farmland will supply wireless connectivity to local growers, enabling them to adopt new farming technologies to improve productivity and their bottom line.

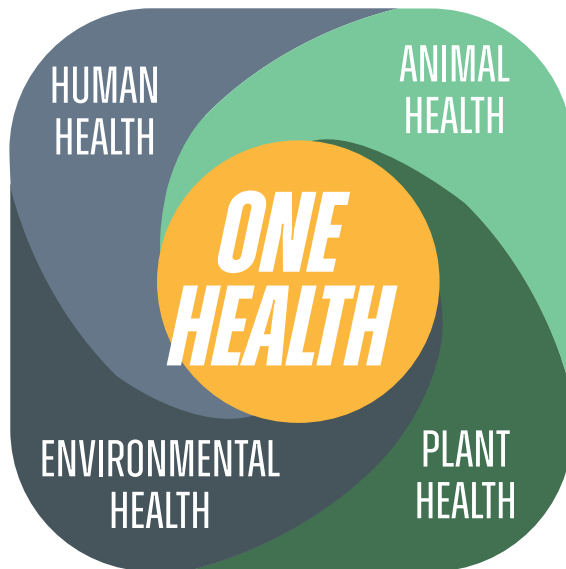
With these ambitious initiatives, YCEDA is responding to today's challenges and charting a course for a more connected, innovative, and prosperous future for Yuma's agriculture. Our commitment to empowering local growers through technology and connectivity will ensure that Yuma remains a leader in desert agriculture, driving progress and innovation for years to come.



ONE HEALTH

LEAD: Bradley Schmitz, Ph.D.

One Health is the intersection of human health, animal health, plant health, and environmental health. Understanding and creating action that transcends health boundaries requires a multidisciplinary approach for the betterment of all life. Our world is full of complex problems that are inherently One Health oriented, including diseases that directly infect us and animals, contaminants that can put our food and water systems at risk, climate change impacts that lead to disastrous weather events, and many others. The Yuma Center of Excellence for Desert Agriculture is based in One Health, engaging in activities to improve soil health, enhance conditions for food security, and using wastewater to understand disease dynamics and inform public health actions to minimize spread of disease.



Wastewater-based epidemiology (WBE), the cornerstone of the lab's efforts, is a non-invasive method that detects chemicals and biomarkers shed by humans and animals through wastewater. Unlike traditional health surveillance methods, which often rely on clinical testing or self-reporting, WBE provides an anonymized, community-wide snapshot of pathogen and chemical presence. This is particularly useful for monitoring diseases that have varying levels of symptomatic presentation, such as SARS-CoV-2, where many infected individuals remain asymptomatic but can continue to spread the virus unknowingly.



KEY OUTCOMES

1

Development of the BSL-2 Laboratory with State-of-the-Art Instruments

Laboratory staff have optimized protocols for detecting pathogens in environmental samples. The addition of new laboratory instruments has been integral in expanding our research capabilities, which include:

- Digital PCR – Transitioning from quantitative PCR to digital PCR technology has more accurate detection of targets. Integrating this new technology has allowed for a more standardized and precise approach to providing more reliable data for local municipalities regarding community viral loads.
- Illumina MiSeq Sequencing System – The introduction of the MiSeq sequencing system has allowed the lab to expand its scope to detecting a wide-array of fungal, bacterial, and viral pathogens, as well as antimicrobial resistance genes. These efforts provide the community with a more comprehensive understanding of the health risks in the region.

2

Wastewater-based Epidemiology to Protect Communities

In response to the COVID-19 pandemic, our team quickly mobilized to help the community avert disease outbreaks by setting up a near real-time wastewater monitoring program to inform public health of disease prevalence in the absence of clinical data. In collaboration with stakeholders throughout government agencies, wastewater municipalities, hospitals, schools, agriculture/food processing, and more, data from this program was used to enact disease interventions such as public outreach, mask mandates, antigen testing, and voluntary vaccinations. This program provides a blueprint for public health agencies and scientists across the world to integrate wastewater data into public health actions at multiple scales. To date, this program has received \$3.5 million in funding to protect public health initiatives and continues to expand to other pathogen targets of public health concern such as influenza, respiratory syncytial virus (RSV), enteroviruses, *Candida auris* (*C. auris*), as well as chemical agents.

3

Estimating the Prevalence of Diseases via Wastewater

Our team built a model to estimate the number of clinical disease cases in a given population based on the concentration of the pathogen in wastewater samples. These estimations were generated for six communities throughout Arizona and Florida. This model was also used to generate community-wide SARS-CoV-2 fecal shedding rates, filling an essential knowledge gap for the utilization of WBE throughout the world during the COVID-19 pandemic.

5

Applications to Emerging Infectious Diseases

YCEDA partnered with scientists from Nevada and Utah to create a collaborative, multidisciplinary group that evaluated how WBE can be used to monitor *C. auris*, an emerging fungal organism defined as an urgent threat by the Centers for Disease Control and Prevention (CDC). We investigated wastewater across Southern Nevada and discovered that areas with confirmed *C. auris* cases showed higher detection rates, suggesting a correlation between wastewater and infection incidence. WBE technologies can be used for emerging pathogens to help understand pathogen dynamics and inform clinical and public health partners regarding novel diseases in relevant populations and evaluate the potential of interventions. Our lab conducts monthly *C. auris* testing as an early warning to detect the pathogen in Yuma County before the disease spreads.

4

Genome Sequencing Research

Utilizing sequencing technology, laboratory staff perform in-depth assessments of viral behaviors in Yuma County communities, particularly during peak agriculture seasons. This research allows for the identification of patterns in viral transmission and provides valuable data for public health responses to emerging and seasonal infectious threats. Our sequencing efforts empower local health officials to make data-driven decisions, warranting precise surveillance of viral outbreaks, optimizing resource allocation, and adapting public health interventions to the specific needs of Yuma County's diverse communities.

6

Mosquito Surveillance

In collaboration with the Yuma County Pest Control District, our lab has established a mosquito surveillance system, identifying West Nile Virus and St. Louis Encephalitis in mosquito samples collected throughout the community. These efforts have prompted rapid response and removal of positive-testing mosquito samples to mitigate the risk of human transmission, as well as the development of ongoing strategies for controlling mosquito populations and preventing future outbreaks in the region.

IMPACT

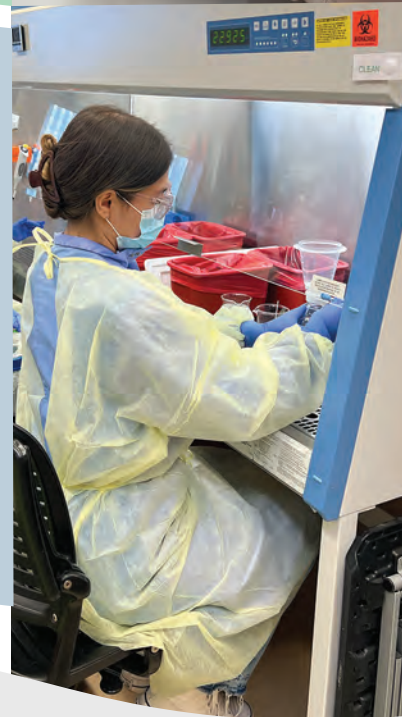
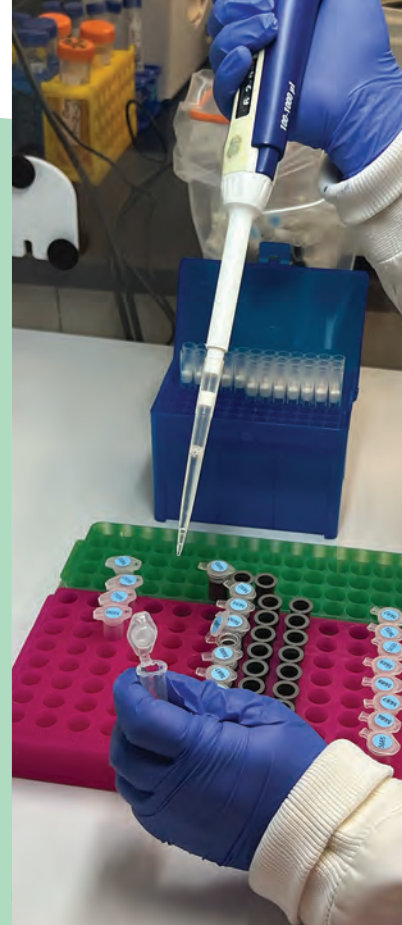
Our team utilizes wastewater-based epidemiology and other technologies to protect our community and workforce health in this important agricultural region, which also protects our food production and food security of the nation. We also contribute to the knowledge of using WBE for the science of One Health.

PROJECT SUPPORT

These projects are supported in part by the Arizona Department of Health Services (ADHS), Office of the Arizona Governor, Yuma County Board of Supervisors, T&P Farms, donations to YCEDA, and grants from participating investigators at the University of Arizona. Execution of wastewater sampling and implementation of public health preparedness and response actions are supported by wastewater municipalities, County/City/Town leadership and management, state and local public health agencies, hospital leadership, school districts, university administration and faculty, local businesses, and stakeholders throughout communities.

WHAT'S NEXT?

Continued support for research is needed to stay on top of emerging issues to develop and share knowledge, to inform public health interventions to prevent the spread of disease, to develop tools for One Health protection, and to train young scientists and professionals in our community. We plan to expand our lab capabilities to include chemical analysis. This will support our environmental health research.





SOIL HEALTH

LEAD: Joseph Blankinship, Ph.D.

Soil health science needs to address agricultural sustainability in arid and semiarid regions, both within the United States and globally. Current soil health assessment and management frameworks have been tailored to wetter climates, leaving the unique soils and environments of desert croplands inadequately addressed. The science of arid soil health is fragmented across institutions, disciplines, funding agencies, and stakeholder priorities, resulting in under-resourced and under-researched areas crucial to global food production.

Desert Agriculture Soil Health Initiative (DASHI): Building Resilient Desert Agricultural Systems and Communities from the Ground Up Through Soil Health

Although in its infancy stage, the DASHI research program has identified specific obstacles and knowledge gaps hindering desert crop producers' effective soil health management. It also has built a coalition of academic and governmental researchers in the Southwestern United States, equipped with diverse expertise across natural and social sciences, ready to address these gaps and challenges.

KEY OUTCOMES

Workshops: *Hosted grower and researcher workshops enhanced the understanding of assessing and managing soil health, specifically in desert croplands.*

Interdisciplinary Research Teams: *Formed interdisciplinary and interagency research teams, collaborating with diverse stakeholders to address top research priorities. These include developing tailored soil health indicators for desert croplands, managing soil salinity with less water, ensuring food safety while managing soil health, and optimizing fertilizer use, plant nutrition, and crop nutrient density for enhanced human health.*

Outreach: *Accelerated state, federal, and international outreach efforts to raise awareness and secure funding for desert agricultural soil health research.*

Convening: *A Foundation for Food and Agriculture Research (FFAR) convening will be held in December 2025, focusing on Building Resilient Desert Agricultural Systems and Communities. The goal will be to unite academic and governmental researchers, crop producers, tribal communities, industry trade groups,*

vegetable buyers and retailers, federal funding agencies, and philanthropic foundations. The convening aims to create a strategic research program with broad consensus on research funding to enhance soil health and the overall resilience of agricultural systems and communities in arid and semiarid climates.

IMPACT

1

Improved Soil Health Understanding

DASHI programs have helped define soil health in desert croplands and identified obstacles and knowledge gaps hindering effective soil health management.

2

Research Collaboration

DASHI has built a coalition of academic and governmental researchers in the Southwestern United States, equipped with diverse expertise across natural and social sciences. This coalition is ready to address the gaps and challenges identified by desert crop producers.

3

Outreach and Funding

The programs have accelerated outreach efforts at state, federal, and international levels in support of research funding.

PROJECT SUPPORT

DASHI has received support from the USDA Natural Resources Conservation Service (NRCS), University of Arizona Office of Research, Innovation & Impact, University of Arizona Cooperative Extension, and industry donors, including Barkley Company of Arizona, Smith Farms Company, T&P Farms, JV Farms, Tanimura & Antle, Taylor Farms, Four Little Devils Farms, D'Arrigo Brothers, Nutrien, Fertizona, Gowan Seed Company, Green Valley Farm Supply, and RDO Equipment Company.





WHAT'S NEXT?

Provide a Tailored Suite of Soil Health Indicators for assessing soil health in desert croplands. These indicators are crucial for managing soil salinity using less water and ensuring food safety while managing soil health.

In Spring 2025, Dr. Blankinship is kicking off the inaugural **Yuma Soil Health Assessment** to evaluate a common suite of desert-tailored biological, chemical, and physical soil health indicators across the Yuma Valley and Mesa using a crowdsourcing approach. Dr. Blankinship will statistically analyze and interpret the results within the context of management practices, culminating with a presentation to participants at an upcoming DASHI Grower Workshop to obtain feedback for future iterations.

Develop Data-Based Soil Management Tools and Practices to help desert crop producers maintain or increase yield and quality with fewer external inputs, promoting economic and environmental sustainability.

Identify Regenerative, Climate-Smart, and Sustainability Practices relevant to Desert Agriculture. Desert agriculture can contribute to carbon sequestration, helping mitigate climate change. Identifying strategic cropping systems can capture and store carbon in soils and vegetation. Sustainable practices can improve the long-term economic viability of desert farms by reducing input costs, increasing crop yields, and providing ecosystem services. Desert regions are particularly vulnerable to climate change impacts such as droughts and extreme temperatures. Implementing climate-smart practices can help build resilience and adapt to changing conditions.

Determine Links Between Soil Health, Crop Nutritional Quality, & Human Health. There is interest in launching a comprehensive study to analyze the nutritional content of crops grown in healthy versus degraded desert soils. This research could identify specific soil management practices that enhance crop nutritional quality, ultimately improving consumer health outcomes.

Develop Education and Workforce Programs, including partnering with local schools, community colleges, and universities to create soil health education programs. These programs could include internships, apprenticeships, and hands-on training in sustainable agriculture practices, preparing the next generation of agricultural professionals to meet the unique challenges of desert farming.

Inform New State and Federal Policies to specifically support research and development in arid agricultural regions.



DESERT AG SMALL GRANTS PROGRAM

In 2019, YCEDA launched the Desert Ag Small Grants Program to fund small-scale research projects with the goals of:

1. Addressing urgent agricultural needs

2. Applying research to initiate large-scale research programs

3. Developing proof-of-concept projects for agricultural applications of existing or new technology

The Small Grants Program has awarded funding to address the key issues in desert agriculture, including pest and disease research, soil health, innovative technologies, food safety, and water conservation. Notable examples include evaluating bioinsecticides for organic cotton pests and exploring microbial strains to control Fusarium wilt in lettuce. The most recently funded project, by Dr. George Frisvold, updated the economic contribution analysis of Yuma agriculture. This report provides valuable insights into Yuma's economic impact benefitting academic research, policymakers, stakeholders, and industry participants and promoting sustainable agricultural development and economic growth in the Yuma area.

Since 2019, the Small Grants Program has provided nearly \$200,000 in research funds for sixteen projects by leveraging matching funds.



Scan for
More
Details
on this
Program

Why Invest in YCEDA?

YCEDA is a groundbreaking, investor-funded, industry-focused research and innovation center. Collaboration is essential to our effectiveness. Created as a public-private partnership between the University of Arizona and the Agriculture Industry, our unique structure drives crucial transdisciplinary applied research focused on the complex challenges of desert agriculture and enhances innovative solutions and discovery by uniting the expertise of industry leaders and world-class scientists. With your support, we will continue to leverage your tax advantage research investment to engage top researchers, initiate projects to tackle challenges faced by the agriculture industry, lead the integration of agricultural innovation, and provide usable results that will improve production efficiencies and maximize yields. Together, we can find solutions to desert agriculture's pressing problems and shape the future of agriculture! **INVEST IN YCEDA!** Contact Tanya Hodges at thodges@arizona.edu or Alex Strong at amstrong@arizona.edu.

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