



**AGRICULTURAL
EXPERIMENT STATION
COLORADO STATE UNIVERSITY**

Research Centers 2018 Annual Report



Colorado Agriculture

OUR VISION

As the preeminent program at Colorado State University for research, extension, and engaged and participatory learning on agriculture, we sustain and grow Colorado-based industries and contribute to food safety, nutritional security and improved human health throughout our state and beyond.

OUR MISSION

Conduct research on the development, protection and production of crops and livestock, emphasizing environmental adaptation, to improve farm viability, benefit consumers, enhance economic growth and create jobs.

Advance knowledge in agronomy, entomology, water science, food science, horticulture, plant pathology, and plant and animal breeding and genetics, as each relates to the above, through interdisciplinary collaborations among researchers, producers, private sector advisors, and Colorado State University Extension.

Communicate advancements in developing, producing and protecting specialty crops, to farms, businesses, elected representatives, regulators and consumers.

Use the unique combination of facilities, faculty, and staff of Colorado Agricultural Experiment Station-Research Centers to provide participatory and engaged learning opportunities to a variety of clients and compliment educational programming at CSU main campus to help train the next generation of industry and academic leaders.

OUR PURPOSE

We aspire to achieve the following: 1) propel discovery and promote the synergy of disciplinary knowledge in the agricultural, biological, soil and water sciences; 2) extend scientific knowledge to sustain agricultural and economic development; 3) support sustainable community food systems, and 4) build, maintain and operate facilities that support and reflect the excellence of College of Agricultural Sciences (CAS) programs and people.



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From the Director

Colorado's agriculture is vibrant and remarkably diverse. Its diversity results from local adaption to widely varying precipitation, soils, growing seasons, elevation, and ecosystems. While many of the needs for agricultural research in Colorado can be met by efforts centered on the Fort Collins campus, the tremendous diversity in agriculture and the factors that impact it across the state create a strong need for locally relevant knowledge generation.

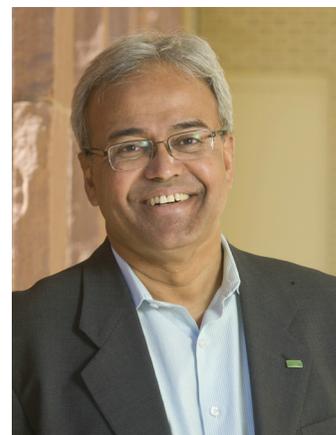
The need for agricultural research and extension abounds, offering opportunities for economic development and agricultural innovation that are crucial locally, regionally, nationally, and internationally. Broadly, a larger human population and rapid urbanization will put unprecedented demands on our food system. This increasing demand coupled with the impacts of climate change will require advanced technologies and methodologies that take full advantage of genomics, bioinformatics, systems biology, data and ecosystem science. Management systems must be devised and delivered to stakeholders that maximize these new technologies and provide safe and secure food.

Solutions to agricultural problems developed locally can have global impacts as the knowledge generated is applied worldwide. The need for locally relevant, research-based information will become increasingly vital in the future with the human population expanding to 9 billion or more, climate change impacting crop production and ecosystem health, increasing urban demands for water resources, and competition with other states and countries to develop more economical and environmentally sound agricultural production systems.

While increasing yield is essential, it is also critical to simultaneously reduce the environmental impacts of agriculture and to devise and implement safe and sustainable approaches to disease and pest management. We must develop better cultural practices, including soil and water management, planting systems and the ability to forecast how crops will perform under a variety of environmental and management conditions. We must conduct basic and applied research focused on improving livestock production efficiency and implementing new or adaptive production systems with minimal environmental impacts. In addition, we must contribute to training future scientists and the broader agricultural workforce to maximize our ability to address future challenges and opportunities. These immense possibilities contrast with the current public financial support for food and agriculture research, at a time when significant investments in faculty and infrastructure renewal are critical.

Food and agriculture in Colorado adds over \$40 billion annually to the state economy and employs an estimated 175,000 people. Research is essential to the success of these industries, and the College of Agricultural Sciences (CAS) provides critical information to the food production and processing sectors. CAS is recognized globally for research and extension in livestock production, plant protection, development of new varieties, optimum plant production systems, carbon cycle science, water management and strategies for detecting and mitigating microbial food contaminants. Opportunities for enhancing food and agricultural businesses across Colorado and the western U.S. abound, and CAS is strategically positioned to play a lead role in research and extension.

-Ajay Menon
Dean, College of Agricultural Sciences
Director, Colorado Agricultural Experiment Station





The Colorado Agricultural Experiment Station (CAES) was established in 1888 by action of the Colorado General Assembly. CAES's mission is to conduct research that addresses the economic viability, environmental sustainability, and social acceptability of activities impacting agriculture, natural resources, and consumers in Colorado. Research programs range broadly along the continuum from highly applied to very basic. However, a central theme recognizes that a strong Colorado agricultural sector is vital to economic health and development. Agriculture's footprint is an economic driver because of its sale of goods, purchase of inputs, and job creation. At the same time agriculture creates critical benefits to the state's natural resource, recreation, and tourism sectors. The CAES is administratively within the College of Agricultural Sciences, but provides programmatic support across seven of CSU's eight colleges.

The Colorado Agricultural Experiment Station is uniquely positioned to aid growers, producers, food entrepreneurs, policy makers, and other stakeholders through the strength of its faculty, extension staff, and rich legacy of scientific advancement in agricultural sciences. Our mission-focused research and extension centers on 1) Resource based sustainable and integrated food production systems, 2) Sustainable utilization of soil and water resources, 3) Development and increased utilization of appropriate technologies.

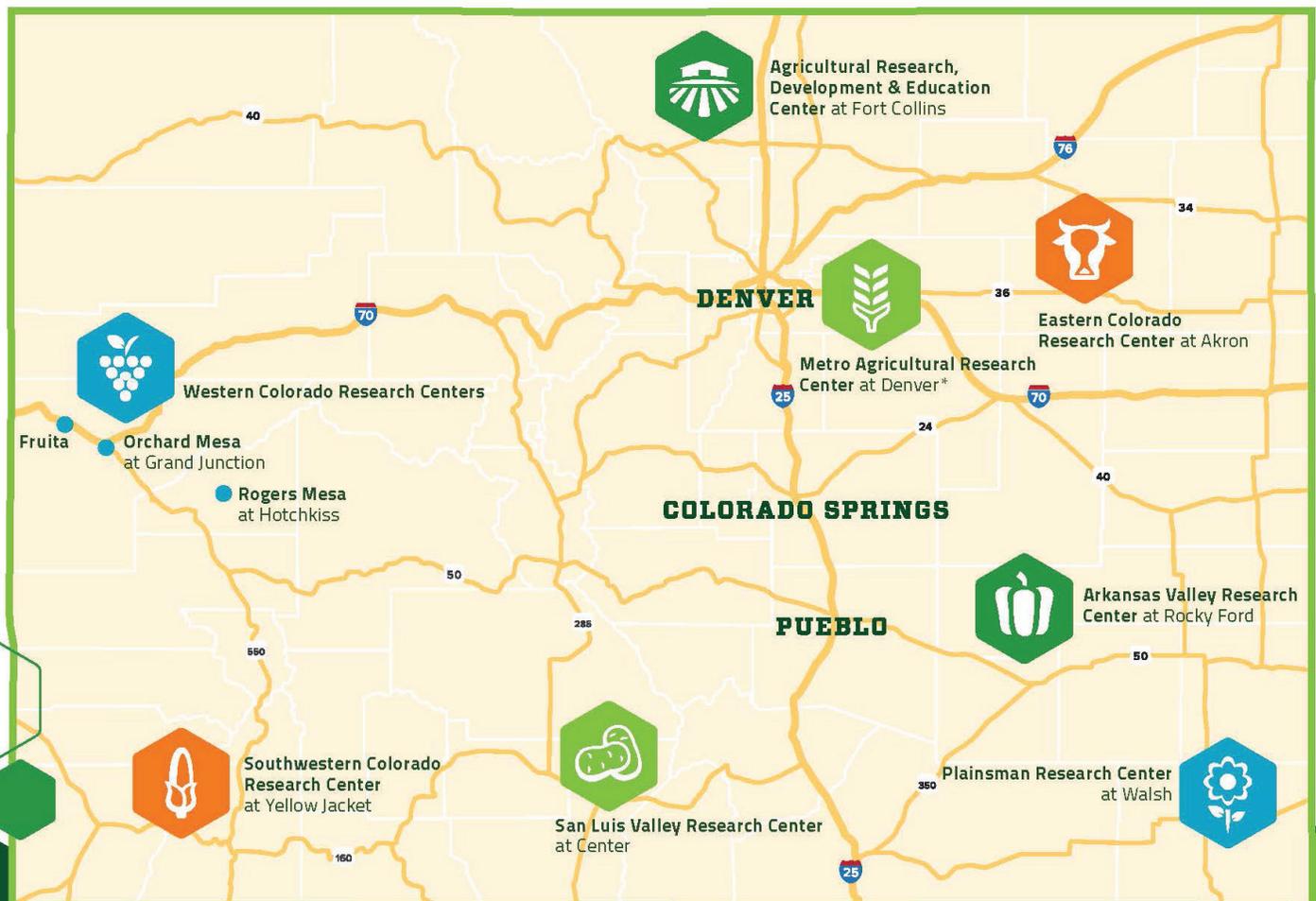
CAES Research Centers System (CAESRC) is considered "a one-stop shop" by clients due to the continuum of research from plant breeding, physiology, protection and production of crops to the development of value-added products—and the delivery of research-based information to stakeholders through extension programs. The faculty and staff base, geographical location, field and laboratory facilities and rich history of CAES make the CAESRC a logical choice as a portal for agricultural innovation and education in Colorado. In our research, innovation is not synonymous with invention. Invention culminates in the creation of new knowledge, but innovation encompasses the factors affecting demand for and use of knowledge in novel and useful ways. Specifically, innovation is the process by which we master and implement the sustainable production of goods and services that are new to our stakeholders. The integration of research, innovation, extension and education are key to our CAESRC activities.



Research Center Overview (continued)

The CSU Research Center System has nine units throughout the state, including the CAES campus research programs. These units provide research centers for locally-relevant solutions to the critical problems facing agriculture throughout the state and the region. Program and infrastructural improvements that would transition CSU's AES Research Centers by fully integrating research, extension, education and engagement into what might be called "CSU satellite campuses" are a critical component to our mission. On local and regional scales, the interplay of several factors are elevating the importance and need for integrating the research and extension provided by CAES. The burgeoning interest in local food production and specialty crops coupled with proximity to large markets and recurrent droughts is creating unprecedented challenges and opportunities for Colorado producers. Colorado farms, with adequate water, favorable soils and climate, and available transportation infrastructure can capitalize on these opportunities and, in so doing, contribute significantly to the economy of Colorado.

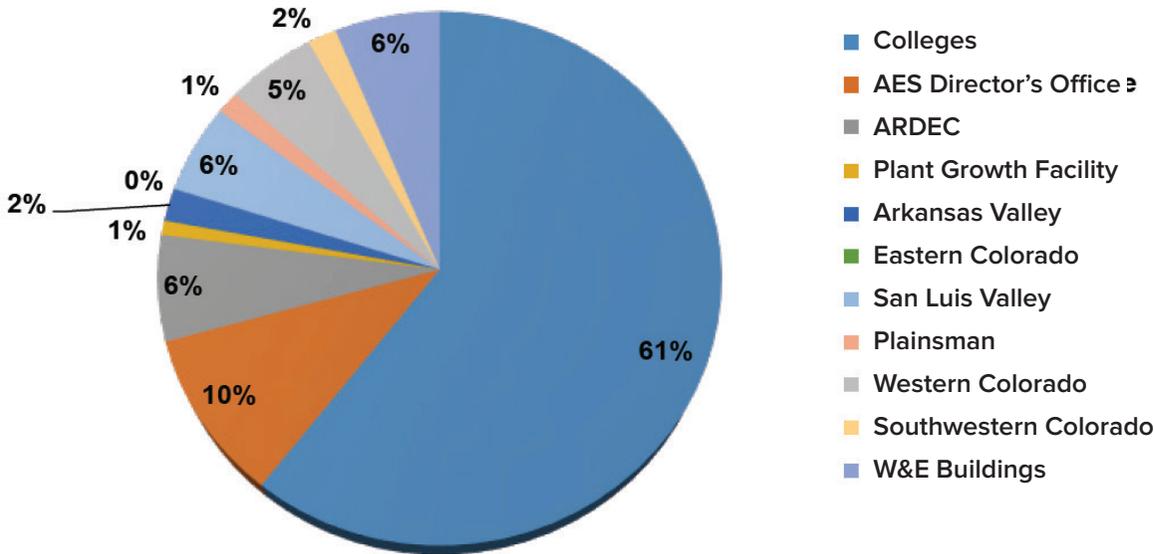
COLORADO AGRICULTURAL EXPERIMENT STATION



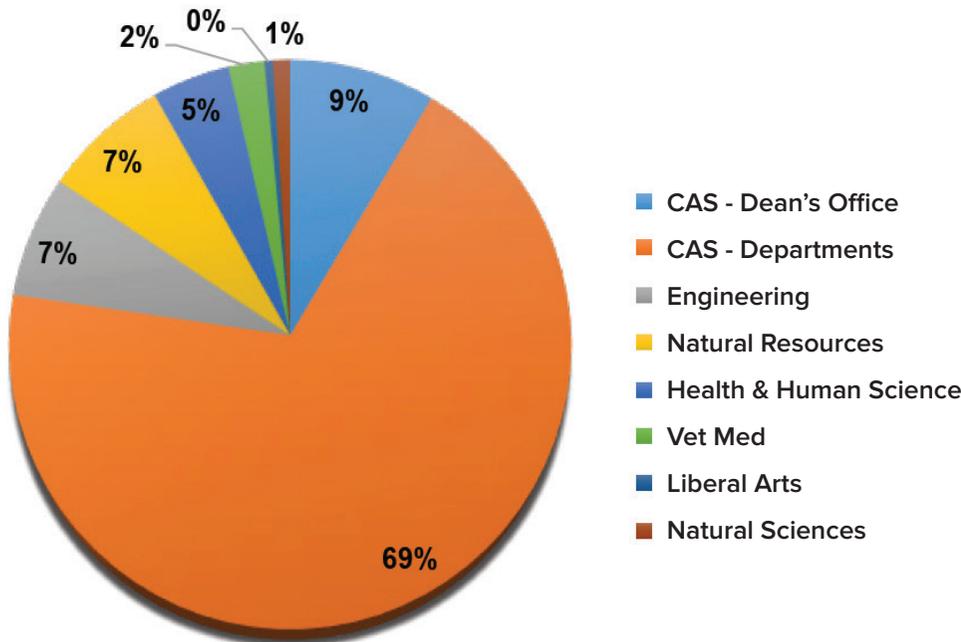
* Denver location opening soon



FY19 AES Budget Distribution



AES College Budget Distribution





Agricultural Research, Development & Education Center

ARDEC

The Agricultural Research Education and Development Center (ARDEC) is located in the Front Range of Colorado in a region that is rapidly urbanizing. The 960-acre facility is located approximately 4 miles north of the CSU Fort Collins campus. The center is designed as a teaching and learning facility with applied research in integrated cropping and livestock production systems and environmental stewardship/water quality. The ARDEC was officially recognized in 1993, although experiments on crops and livestock had been conducted for decades on research farms on and near Colorado State University main campus. Current research projects at the ARDEC include the development of new pest and disease-resistant crops, intensive livestock grazing and biological control of insect pests. Crop and animal breeding research at the ARDEC results in crops and livestock that carry the genes for higher yields, greater disease resistance and improved offspring. The ARDEC campus is a well-used resource for the college and CSU as a whole. In 2018 alone, the site hosted over 50 different research projects ranging from alternative crops such as industrial hemp to water use in turf grass to soil health under intensively grazed center pivot irrigation.



Also at ARDEC:

- 120 acres of foundation wheat seed is grown at ARDEC annually as the home of Agronomy Foundation Seed resides at ARDEC
- Home of the Colorado Seed Laboratory serving growers throughout the USA
- 200 head capacity Temple Grandin designed Feed Intake Unit for cattle feed efficiency data collection



While there is increased focus and interest in sustainable agriculture and natural resources, the long-term goal is to offer a diversity of classes, learning and engagement opportunities consistent with the CSU land-grant mission and vision while meeting the needs of the surrounding counties. In many respects, ARDEC is essentially part of CSU's Fort Collins campus serving as a primary field research site for many faculty and serves as a center for hands on learning for CSU students and for various outreach and engagement efforts.

Teaching and learning welcomes approximately **300** students weekly in 15 different courses offered within the College of Agricultural Sciences.





Arkansas Valley

Arkansas Valley Research Center

The Arkansas Valley Research Center (AVRC) was established in 1888 and is the oldest continuously operated agricultural experiment station (AES) in Colorado. Situated on 124 acres, the AVRC was established to serve the research needs of the irrigated farming areas of southeast Colorado. In addition to being an AES site, the AVRC is home to the Veterinary Diagnostic Lab administered by the College of Veterinary Medicine and Biomedical Sciences and the soon to be constructed CSU County/Area Extension Office. Further, the AVRC serves as a staging point for numerous off-site research projects originating from multiple Colleges across the University.

The AVRC research programs are dedicated to the improvement of field crops, vegetable crops, and potential new crops (i.e. hemp). Thus, the AVRC has a long history of evaluating and introducing new crops and cultivars to the area as well as developing novel and environmental sound production techniques for those crops. These include sustainable pest management strategies, fertility management, enhancing the nutritional content of crops, and improving food safety.

One of the foundational ideals guiding the research programs at the AVRC is crop water use efficiency. Accordingly, the AVRC has sophisticated equipment to measure and test crop water use including two weighing lysimeters, drip irrigation systems, multiple weather monitoring stations, and a state-of-the-art linear move sprinkler system. To compliment that infrastructure, the AVRC is examining new technologies involving, drones, satellite imaging, and advanced water sensors.

The AVRC is heavily engaged with its constituents and the surrounding community and is highly responsive to the region's issues. Research and educational programs at the AVRC are guided by an active Advisory Board made up of growers and other stakeholders throughout Southeastern Colorado.



Eastern Colorado



Eastern Colorado Research Center

The Eastern Colorado Research Center (ECRC), was purchased by Colorado State University in 1952. The research center encompasses 3,760 acres of more than 35 fenced pastures of native and seeded rangeland, and 22 feedlot pens. Current research involves livestock feeding trials that compare the effects of the natural products versus the two feed additives in combination on the average daily gain, and average daily feed intake. Other trials focused on the effects of supplementing L-Lysine to beef cattle fed in confinement, observing cattle performance, feed efficiency, health, yield grade, and carcass quality of beef steers. In breeding studies, researchers compared the effects of two artificial insemination protocols on conception rates. We work collaboratively with public land management agencies to explore how grazing can be used to maintain or increase vegetation heterogeneity for wildlife management and improving overall grassland health. In our extension and education efforts we provide cattle for Northeastern Junior College Animal Science Labs and created a program to help local ranchers implement proper vaccination protocols.

The ECRC is the only research center completely devoted to livestock production with opportunities for research on both grazing and confined cattle feeding. It's location is representative of a high percentage of eastern Colorado's rangeland ecosystems.





Plainsman

Plainsman Research Center:

The Plainsman Research Center (PRC) is located in Southeastern Colorado near the town of Walsh. Research conducted in this area of the historic dust-bowl include full and limited irrigation using furrow, sprinkler, and subsurface drip irrigation, as well as tillage comparisons of no-till, ridge-till, conventional-till, and subsoiling. We aim to have producers adopt more efficient water management technologies and practices, such as drip irrigation, and switching from lower to higher-value crops – helping boost revenue within the limits of available water. In addition, we investigate synergistic soil, crop and water management practices that adapt irrigated cropping systems in the western Great Plains to drought that can lead to efficient use of water.



CSU research indicates that precipitation storage efficiencies of 40 to 60 percent is achieved when tillage is minimized or eliminated. The key to these improvements is maintaining crop residue on the soil surface and minimizing or eliminating soil disturbance. Weeds, just like cultivated crops, extract water, usually in greater amounts per unit of dry matter than field crops and are competitive for water and nutrients and problem weeds may differ from one farm to another. Current projects at PRC include, Comparing Alternative Herbicides and Tillage Controls of Glyphosate Resistant Kochia, Irrigation and Cropping Systems that Maximum Yield with Limited Water, and Using Grower Input to Develop Novel Row Spacing for Wheat and Sorghum Production. Development of alternative crops, crop rotations, and integrated livestock systems that are sustainable from both economic and ecological perspectives are on-going efforts by researchers at the PRC.

San Luis Valley



San Luis Valley Research Center

The San Luis Valley Research Center (SLVRC) is located near Center, Colorado. Beginning in 1940, the principal research activity has been focused on selecting potato varieties adaptable to the region. The research center has a continuing commitment to the people of the San Luis Valley and the State of Colorado to provide research information, conduct extension education and seed certification programs. Utilizing research from the SLVRC Colorado potato growers are known across the United States for their innovations in production, resource conservation and sustainability. The center conducts research and extension projects related to irrigation and water resources, potato breeding, crop management, pathology and postharvest biology. Current research activities at the SLVRC focus on establishment of cultivar specific management guidelines for the sustainable production of new and existing potato cultivars while minimizing economic inputs and environmental degradation. In addition, because potato is a perishable vegetable, there is a requirement to store potato tubers at a low temperature to prevent spoiling. We focus on identifying the genetic and physiological basis of processes that occur in cold storage that lead a deterioration of tuber quality.



A patent is pending on a recently developed sterilization modification for potato seed cutting equipment that prevents bacterial, fungal and viral pathogens from a single tuber from contaminating entire loads of seed.



SouthWestern Colorado

Southwestern Colorado Research Center

The center located near Yellow Jacket strives to be a hub for regional cropping systems knowledge. The staff work collaboratively with local farmers, Extension groups, Natural Resources Conservation Service offices, U.S. Forest Service, and other stakeholders. The site contains 158 acres of dryland and irrigated crops.

The Southwestern Colorado Research Center (SWCRC) is dedicated to providing research data and demonstration opportunities to local growers for alternative cropping systems that will provide increased farm income and sustainable cropping systems for the region. These research initiatives are generally in collaboration with other CSU AES research centers and CSU faculty throughout the state. Research areas have included cropping systems that provide niche markets, reduced water usage, and sustainable methods that provide long-term benefits to soil and plant health. The current projects include: evaluating grain sorghum as an alternative rotation crop with alfalfa production, evaluating nitrogen fertilizer needs in small grain rotations, buckwheat and millet as alternatives to wheat rotations, dryland cover crop utilization in wheat/safflower rotations and evaluating the potential for hemp as an alternative to alfalfa under pivot irrigation. The SWCRC (AES) has an on-going collaboration with CSU Extension through the three acre research/demonstration orchard located at the research center. This orchard comprises 50 varieties of apples, five varieties of peaches, and four varieties of plums and pears.



The annual U-picks draw over 600 community members plus a number of organizations that take advantage of the fruit produced for hunger relief organizations. The demonstration orchard also provides an educational setting for K-12 students across a three county school district and 20-30 Master Gardener volunteers.

Western Colorado



Western Colorado Research Center

Agriculture and food production is undergoing rapid change in Western Colorado. Over the next few decades, these changes will become irreversible, due to the confluence of population growth, water shortages and climate change. With the majority of Colorado water rights held in agriculture, the food production sector faces challenges to increase the conservation and efficiency of water use in many forms. The Western Colorado Research Center is comprised of three sites.

Fruita: The Fruita site, located 15 miles northwest of Grand Junction, hosts variety performance trials of new/improved varieties of alfalfa, beans and small grains. Programs are being refocused to more specifically address Climate Smart Agriculture emphasizing optimal use of water amidst the pressures of municipal and industrial use, drought and climate variability, and shifting market demands. These efforts will be broadly collaborative among AES, CSU Extension, the Water Institute, and the Office of Engagement. Current projects mostly focus on new and/or alternative crops; conservation tillage practices; intensification of cropping systems with cash crops, forage crops, and cover crops for more efficient utilization of water resources as well as soil protection; management practices to enhance soil health and quality; and enhanced nutrient management practices. We actively collaborate with scientists and extension agents to perform high quality and multi-disciplinary research projects.



Orchard Mesa: The Orchard Mesa site is located 7 miles southeast of Grand Junction. The research conducted at this site includes tree fruits, wine grape production, dry bean variety increases, and ornamental horticulture. The Center's research and engagement goals will remain focused on the needs of the regional agricultural industry, but are expanding to better address engagement opportunities throughout the community. Current research in the Pomology and Viticulture programs are designed to gain a better understanding of environmental factors affecting productivity, harvest and postharvest quality of temperate tree fruits and grapes. Community engagement efforts now involve directing harvested fruit and specialty crops grown for research to hunger relief programs in the region (aes-wrcr.agsci.colostate.edu/community-alliance/) The food provided is part of a more comprehensive program of service learning, community engagement and family and consumer science.

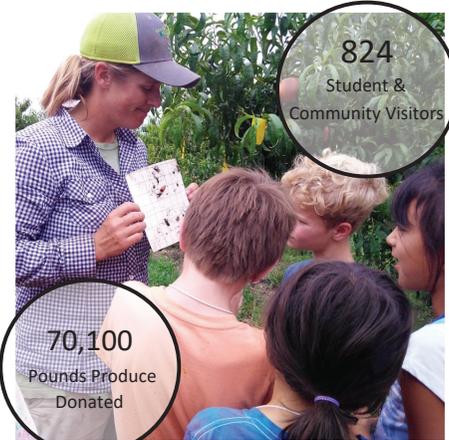


Western Colorado

Rogers Mesa: The Rogers Mesa Site is located in the North Fork Valley of Delta County, near Hotchkiss. That area has a climate that is conducive to the successful cropping of tree fruit and other fruit and is known for having the highest density of certified organic farms in Colorado. After being closed for nearly a decade, Rogers Mesa Research Center began a transition to reopening in late summer of 2017. The first year of re-opening has been spent bringing the facility back into shape. Neglected orchards and tree blocks have been removed, buildings repaired and upgraded, irrigation systems rebuilt, and orchards and vineyards have begun to be replanted and prepared. The center's overarching goal will be to compare conventional and organic production systems with research, expertise and educational support to create new, sustainable food production opportunities in western Colorado. Key to program function and success will be the development of a Research, Teaching and a Demonstration Farm Facility. Some specific projects for 2018-2019 include a table grape variety trial, root stock evaluations in peach and apples, a demonstration of heirloom and cider apple varieties, peach tree training trials, identification of critical temperatures associated with frost protection, and organic seed production.



2018 Numbers to Date



WCRC research technician, Emily Dowdy, teaching agriculture camp students about insect pests in the orchard.



On the Horizon

New Facilities for Research, Extension and Engagement



CSU Western Campus: In July of 2018, CSU and FCI Construction broke ground on the CSU Western Campus. These new facilities, located in Orchard Mesa, will provide administrative oversight and intellectual leadership for CSU's located in Western Colorado - Fruita, Orchard Mesa, Rogers Mesa and Yellow Jacket. Orchard Mesa will also house the CSU Extension Western Regional Office, the Western Veterinary Diagnostic Laboratory, the regional Colorado State Forest Service office, and the Regional Engagement Center. Serving as the front door to the university on the Western Slope this campus will feature a 7,717 square foot state of the art veterinary diagnostic laboratory and a 14,095 square foot combined office and classroom building with teaching kitchen, 100 person capacity classroom and multiple meeting areas.



CSU Arkansas Valley Campus: The CSU Arkansas Valley Campus will serve southeastern Colorado from its home near Rocky Ford. A groundbreaking on September 4, 2018 kicked off the construction of this site. The Arkansas Valley Campus will house the Arkansas Valley Research Center (AES), the existing regional Veterinary Diagnostic Laboratory, CSU Extension Southeastern Colorado Area office and Otero County Extension personnel. The design solution includes the re-use of the existing Utility Building/Old Office Building and will include reception for the campus, office space for Extension and Agricultural Experiment Station, a 60+ seat classroom/meeting room, teaching kitchen and multiple meeting areas.



Summary of Colorado Agricultural Experiment Station Research Center Biogeography and Facilities

CAES Research Center	Location	Miles from Campus	Elevation (feet)	Average Precipitation (inches)	Average Frost-free Days	Principal Soil Type	Acres	Building Square Feet	Research Foci
ARDEC	Fort Collins	11	5,152	15	150	Fort Collins Loam	997*	197,958	Diverse crop and livestock systems, plant breeding and seed increase
AVRC	Rocky Ford	230	4,178	12	158	Rocky Ford Clay Loam	124	18,337	Vegetable crop development and systems, Crop water use
ECRC	Akron	128	4,300	16	140	Valentine Sand	4300	22,419	Beef production, breeding and grazing management
PRC	Walsh	330	3,974	14	161	Baca Clay Loam	880	3,052	Dryland and limited irrigation cropping systems
SLVRC	Center	268	7,668	7	96	Norte Gravelly Sandy Loam	314	43,269	Potato breeding, storage and production
SWCRC	Yellow Jacket	482	6,950	15	120	Wetherill Loam	158	11,816	Dryland and irrigated crops, soil health and alternative crops
WCRC	Orchard Mesa	307	4,470	8	182	Mesa Clay Loam	80	24,676	Tree fruits and vines
WCRC	Fruita	314	4,600	8	143	Fruita Sandy Loam	94	14,168	Water efficient cropping systems
WCRC	Hotchkiss	296	5,800	12	150	Mesa Stony Loam	84	14,895	Tree fruit and vines, Cover crops

*Includes ARDEC South and North farms

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