75 years of citrus research

History of the Citrus Research Center

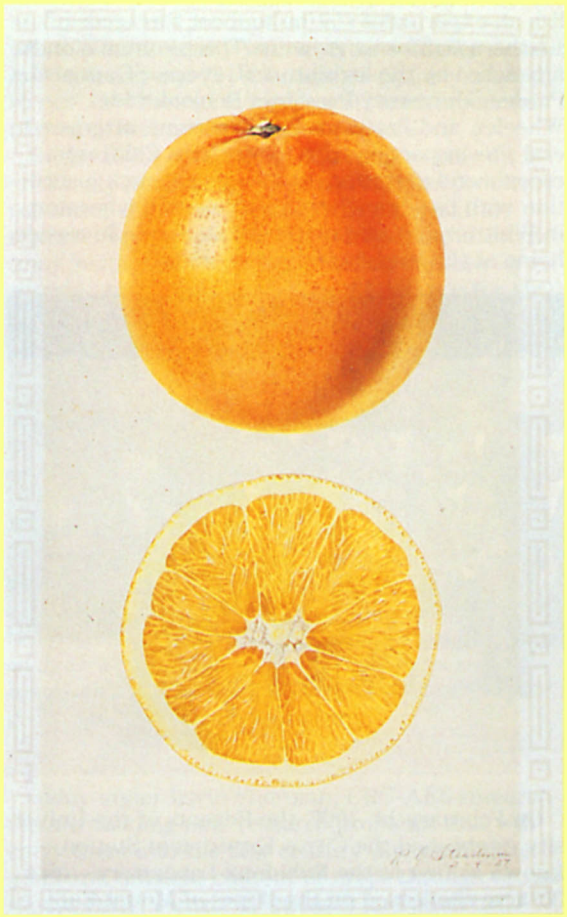
Lewis G. Weathers, Associate Dean of Research and Professor of Plant Pathology, and
Harry W. Lawton, Administrative Analyst, College of Natural and Agricultural Sciences

From the start of the California citrus industry in the 1860s, the pioneer citrus growers of southern California, many of them retired business or professional men from New England or the central states, showed an eagerness to explore every innovative method of production or marketing that might increase profits.

In 1886, Joseph Wolfskill, an early grower, conducted his own experiments with tent fumigation. In 1888, he joined U.S. Department of Agriculture (USDA) entomologist Albert Koebele in the first biological control experiments to test Vedalia beetles from Australia against cottony-cushion scale in his orchards. Within 18 months, the pest was almost eliminated in California. Growers Charles S. Teague and C.C. Chapman conducted their own fertilization studies. Citrus cooperatives investigated ways to halt fruit decay and tested new marketing concepts. Cold storage experiments were carried out by growers pushing for refrigerated boxcars to carry fruit across the continent by rail. In 1882, the California Fruit Transportation Company triumphantly announced sending a citrus shipment to London in 18 days, where Queen Victoria sampled an orange and "pronounced it palatable."

Citrus growers and their organizations have been credited for the vigorous lobbying that led to establishment of the Citrus Experiment Station in 1907. Yet one man's role in that effort has been almost forgotten. No buildings bear his name and no bronze plaques honor his memory—but John Henry Reed deserves credit as the founder of the Citrus Experiment Station.

A retired educator from Ohio, Reed arrived in Riverside in 1890 and began to grow citrus. He soon became a tireless advocate of scientific methods. In 1895, he founded the Riverside Horticultural Club—the first such club in the state. He helped found similar clubs in other cities, organized farmers' institutes, and was a leader in many activities related to the citrus industry. In 1896, he was chairman of a growers' group that conducted the first scientific experiments on orchard heating, despite public laughter at "heating the outdoors." He conducted many investigations on his own, including studies of citrus root systems and splitting in navel oranges, which were published by agricultural journals. Concerned about fruit decay in the long transit to market, Reed hounded the USDA until it sent G. Harold Powell to Riverside for six years of research that improved fruit handling and saved growers thousands of dollars annually. Later, he persuaded the USDA to send A.D.



A 1927 painting by R.C. Steadman for the U.S. Department of Agriculture of fruit from one of the original three Washington navel orange trees sent to Mrs. Eliza Tibbets and planted in Riverside in 1873. One tree is still alive at its original site.

John Henry Reed, founder of the Citrus Experiment Station.

Shamel to Riverside to conduct research on citrus breeding.

In 1900, at a meeting of the Farmers' Institute in Pasadena, Reed proposed establishment of a citrus experiment station. His speech struck an enthusiastic note among growers, and for the next five years, he pressed the issue up and down the state. He and a committee of Riverside growers took the proposal to the state legislature.

In 1905, the California legislature passed an act authorizing the University of California to establish an experiment station to meet the needs of southern California growers. Three commissioners appointed by the legislature (Governor George C. Pardee, University President Benjamin Ide Wheeler, and Professor E.J. Wickson), after several site-inspection trips to southern California, recommended setting up a single research institution with two branches: a pathological laboratory in Whittier and an experiment station in Riverside, home of the Washington navel orange.

Original Citrus Experiment Station staff in 1916. Front row, from left:
C.O. Smith,
J.T. Barrett,
L.D. Batchelor,
H.S. Reed,
W.P. Kelley,
H.J. Webber.
Back row:
H.J. Quayle,
E.E. Thomas,
W.M. Mertz,
H.B. Frost,
H.S. Fawcett,
W.D. Drew,
R.S. Vaile.

On February 14, 1907, the Regents of the University established the Citrus Experiment Station—known at first as the Rubidoux Laboratory—on a 30-acre site leased on the slopes of Mount Rubidoux. Ralph E. Smith, a plant pathologist, was named administrator for both the Whittier and Rubidoux branches. A two-story laboratory was built in 1912 and today is occupied by the USDA Salinity Laboratory. The earliest work of the Citrus Experiment Station (CES) was concentrated on soil management research to improve citrus quality and productivity. A citrus variety collection was also begun at the Rubidoux Laboratory.

Rapid growth of southern California agriculture and development of new crops such as the avocado soon made it obvious that more research was needed to solve expanding production problems. In 1912, Thomas F. Hunt, Dean of the University's College of Agriculture and Director of the Statewide Agricultural Experiment Station, formulated a long-range plan for crop research in southern California. The title of Director of the Citrus Experiment Station and Dean of the Graduate School of Tropical Agriculture was created, and a search was begun to fill these posts.

Herbert John Webber, a professor of plant breeding at Cornell University, who had conducted citrus breeding studies from 1892 to 1897 in a USDA field laboratory in Eustis, Florida, was appointed to fill both posts. Webber proved to have a genius for administration and set a course for the CES that by the 1930s had made it the world's leading research institution in citrus and subtropical horticulture—a position it still maintains.

The great freeze of 1913 that devastated southern California orchards became an impetus to reorganization of the Rubidoux facilities. Alarmed growers launched a campaign to enlarge the CES. In 1913, the legislature appropriated funds for a new site and buildings. A fierce battle ensued in which San Fernando Valley almost seized the CES from Riverside. An 81-year-old John Henry Reed joined the struggle, urging the Regents to keep the experiment station at Riverside. On December 22, 1914, Webber and a prominent group of Riversiders made a last-ditch plea for the city and made their point: the Regents went into executive session and voted 14 to 4 in favor of Riverside.

The new site (475 acres) was established at the foot of Box Springs Mountains, about five miles east of the Rubidoux site. The main building, constructed in the so-called Spanish mission style, was dedicated on March 27, 1918.

Within a decade the staff Webber had formed was making significant research discoveries in irrigation, soils and plant nutrition, insect pest control, plant breeding, plant diseases, and horticulture. Webber also guided the growth of the largest citrus collection in the world at Riverside—1,200 species and varieties of trees—which have since produced more than 10,000 hybrids.

The first few years of the CES were marked by achievements that saved California agriculture millions of dollars. Research on black alkali soils in the 1920s provided the first complete explanation of their origin and nature, leading to the reclamation of thousands of acres of land throughout the world. CES entomologists were at the forefront of early studies in biological control. In 1927, when the citrus industry was endangered by citrophilus mealybug, a natural enemy was found in Australia that brought the problem under control. With the discovery that little leaf—a serious affliction of citrus—was caused by zinc deficiency, CES scientists went on to make numerous other contributions to the nutrition of citrus and other crops. The monument to the Webber era, begun in about 1930, was a massive two-volume work, *The Citrus Industry*, edited by Webber and Leon D. Batchelor and published in 1946. These volumes, summing up several decades of hard-won knowledge of citrus, became known as the "Bible of the Citrus Industry." The encyclopedic work has been expanded into a five-volume revision, four volumes of which have been published, to date, by the University of California.

In 1928, Leon D. Batchelor, a horticulturist, became the second director of the CES, following Webber's retirement. During his tenure, the experiment station expanded into many new research areas and began studying most of the major crops of southern California. One of the first agriculturists to realize the value of statistics and experimental plot design, Batchelor initiated many

long-term fertilizer experiments. Studies in citrus genetics and breeding led to new commercial varieties of citrus and the improvement of quality through the use of nucellar seedlings. Research in preharvest and postharvest physiology brought about the development of optimum conditions for storage of citrus and avocados. Investigations were begun into herbicides that would reduce losses from weeds. Increasing emphasis was given to breeding experiments with vegetables. During the Batchelor years, CES scientists also began the first studies of effects of air pollution on crops.

Perhaps the most dramatic research of the Batchelor era was the successful fight against tristeza disease, which had wiped out much of the citrus industry of South America, South Africa, and Java. In the 1930s, tristeza began spreading rapidly in California, dooming hundreds of thousands of citrus trees. In 1946, CES investigators established that tristeza was caused by a virus, and that the sour orange rootstock was responsible. The industry was saved by development of a new disease-resistant rootstock—the Troyer citrange. In the 1930s CES researchers also began to investigate new compounds for controlling insect pests. Out of these studies emerged the first commercially successful synthetic organic acaricide as a weapon against red spider mites in citrus and walnut.

Beginning in 1952 under Alfred M. Boyce's leadership, the experiment station entered its period of greatest growth as research sought to keep pace with the tremendous post-World War II agricultural boom in southern California. New departments were added in research areas requiring increased specialization. With the appearance of the organochlorine and organophosphorus compounds, CES entomologists conducted research on new pesticides such as DDT, malathion, and parathion. They also played a leading role in studies of insect resistance to pesticides and developed a methodology for measuring insect residues—techniques that became widely used in obtaining federal approval for safe use of commercial pesticides. Among the major triumphs of the 1950s was the team research that halted the devastating march of the spotted alfalfa aphid.

In 1960, the Regents made U.C., Riverside, a general campus of the University and authorized formation of a College of Agriculture—which later became the College of Natural and Agricultural Sciences. CES was renamed the Citrus Research Center and Agricultural Experiment Station (CRC-AES) to reflect a broader scope of research. Boyce served as first dean of the new college, establishing an agricultural teaching component that was allied to the CRC-AES through joint faculty and research appointments. The college strengthened agricultural research through interrelationships that gradually developed between CRC-AES scientists and researchers in other disciplines of the biological and physical sciences.

When Boyce retired in 1968, W. Mack Dugger, a botanist, became dean of the college, and Boysie Day, a weed scientist, was named associate director of the CRC-AES. Soon afterward, Dugger also assumed the associate directorship when Day transferred to Berkeley. Under Dugger, applied research was broadened and basic research expanded into new disciplinary areas, such as molecular biology, integrated pest management, plant genetics, climatology, and environmental protection. The experiment station's program was redesigned to meet the unique research needs of an increasingly urbanized southern California. Main thrusts of the new program were: (1) subtropical and desert crop production; (2) urban and suburban plant industry with a stress on ornamental horticulture; and (3) scientific disciplines related to pest control and management, environmental planning, and environmental protection.

In the 1970s, the CRC-AES began to play an increasingly important role in research on problems related to growing crops in arid and semiarid regions. New crops developed for semiarid conditions include jojoba, better yielding varieties of sesame, and turfgrass with high tolerance for air pollution and salinity. The experiment station emerged as a leading research center in plant tissue culture. From its laboratories have come techniques for propagating disease-free plants for many food, fiber, and ornamental species. Soil scientists began addressing problems of waste disposal and nitrate pollution. New basic research showed the essential role of vitamin D in animal metabolism and indicated that further elaboration of crassulacean acid metabolism might lead to breakthroughs in drought-resistant plants. CRC-AES scientists also continued to address themselves to the perennial problems of agriculture, such as weeds, new pests, and plant diseases that have existed since man first embarked on crop-growing about 10,000 years ago.

Today under Irwin Sherman, CRC-AES researchers are tackling new research problems that will carry them into the 21st century: increasing the yield and nutrient content of crops through recombinant DNA; control of diseases and pests by tailoring chemicals and predators to act only on target organisms; improving weather forecasting; making photosynthesis more efficient through genetic manipulation and the development of light trapping devices; and restoring marginal soil to crop production through development of more toxin-tolerant plants and the removal and detoxification of wastes.

The CRC-AES has grown from a small, local research station employing two staff members to a major research center staffed by 846 people, approximately 300 of whom are engaged in both research and teaching. Total University of California research funding in 1981-82 was about $11 million, with private contracts and grants increasing the center's funding to $18 million. Research encompasses more than 150 agricultural commodities with 20 percent of the projects still devoted to citrus. The experiment station John Henry Reed envisioned has through the years repeatedly saved California citrus and other crops from destructive pests and diseases. It has paid for itself many times over in developing new crops and crop varieties and new methods of production.