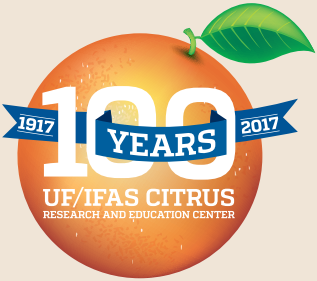
UF IFAS
UNIVERSITY of FLORIDA



THE 100-YEAR JOURNEY

of the UF/IFAS Citrus Research and Education Center

Dear Friends:

Anniversaries are a time to reflect on the past, celebrate the present and embrace the promise of the future. The 100th anniversary of the UF/IFAS Citrus Research and Education Center is an opportunity to do all of these things with pride and appreciation.

Our pride is rooted in the countless scientific breakthroughs and contributions discovered in the labs and groves, and in the relationships that led to greater production and unimaginable growth of the Florida citrus industry. The UF/IFAS scientists and staff of those early years could hardly imagine the impact of today's citrus industry across this state and the world. But their commitment and passion for changing the status quo was just as strong as that of the scientists who work at the center today.

Our appreciation rests with the hundreds of faculty and staff who built a global reputation for the UF/IFAS CREC over the past 100 years. Any breakthrough we proudly announce is only possible because someone spent hours and years working on building the body of knowledge surrounding citrus pathology, breeding, management, harvesting, etc. We are only as good as those who came before us, and we owe those who will come after us our best efforts in moving scientific knowledge forward.

Looking back, we know that we faced serious and daunting challenges in the past, just as we do today in the aftermath of Hurricane Irma and in the ongoing battle with citrus greening. Throughout all these challenges, one thing has remained constant — our mission to discover a treatment, breed a new variety, increase yields, reduce costs and find a way to a brighter and better future.

The UF/IFAS CREC will be different 100 years from now, just as it is dramatically different today from that first building, first lab and first plot. And while some things are ever-changing, our steadfast commitment to the citrus growers and citrus industry in Florida will never change.

Congratulations to all, and here's to the next 100 years.

Sincerely,

Jack M. Payne
Senior Vice President
Agriculture and Natural Resources

Dear Friends:

As I reflect on the significance of this 100th anniversary of the UF/IFAS Citrus Research and Education Center, I wonder if the first faculty and staff members who worked here could have envisioned this day. I wonder if they thought about what they did on any Tuesday or Thursday would make a difference in what we do today on any Monday or Wednesday.

Although how we conduct scientific experiments today may be dramatically different from what our colleagues did back then, some things are very similar. We probably have more things in common than we have differences. Sure, today we have different laboratories and advanced technology, but the scientific method, the quest for knowledge and the excitement of finding a breakthrough is just as relevant today as it was in 1917, 1947, 1987 or last week.

In fact, some things never change. The relationships among researcher, Extension agent and grower are as important as ever to our work. This center became a reality because of grower leadership and vision and a working partnership with the University of Florida and the State of Florida. Without the continued active engagement of our citrus producers, we would not be able to move our discoveries to implementation as quickly as we do. We have made it to this milestone because of the productive collaboration of the industry, the university and state agencies.

We will need these partnerships as we confront our current challenges of citrus diseases, natural disasters and changing communities. But despite recent hardships, we remain resilient and resourceful in our mission to support Florida's citrus industry and help it to remain the best in the world.

In the pages of this book you will learn the story of the CREC and the accomplishments of many individuals who built it into the premier citrus research and education enterprise in the world. It is a legacy that is both encouraging and inspirational. It is also a history that brings with it a responsibility to make the next 100 years just as productive and positive.

Thank you for your continued support of the UF/IFAS Citrus Research and Education Center. Together we will create a future that fulfills the great promise and potential of Florida citrus.

Sincerely,

Michael E. Rogers
Director
UF/IFAS Citrus Research and Education Center

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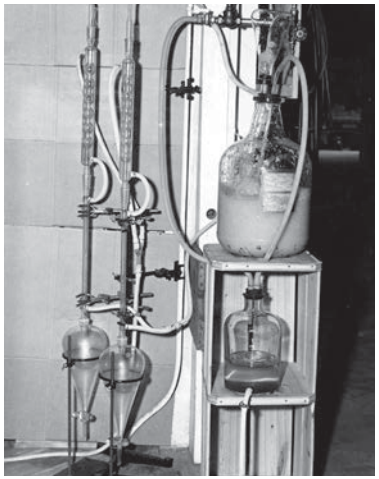
WE RESPECTFULLY DEDICATE THIS BOOK

to the hundreds of people whose efforts through the years have made the UF/IFAS Citrus Research and Education Center the world's premier source of citrus knowledge and know-how.



THE 100-YEAR JOURNEY

of the UF/IFAS Citrus Research and Education Center

The Center's Prehistory, Its Creation and Its Activities Through the 1930s

The Citrus Research and Education Center (CREC) is the world's premier academic research facility dedicated to a single commodity, and the oldest off-campus research facility operated by the University of Florida Institute of Food and Agricultural Sciences (UF/IFAS). Its existence traces back to June 4, 1917, when the Florida Legislature authorized the establishment of "a Branch Experiment Station in or Near Winter Haven, Polk County, State of Florida, to Conduct Field Research on Citrus Problems."

What follows is a brief history tracing the development of CREC to the present day. The circumstances that made CREC necessary existed long before 1917, and so this account must span more than 100 years' time to tell the story in full.

Opposite page: Men examine a citrus tree infested with aphids in Polk County, 1925.

Above from left to right: Exterior of the first on-site laboratory building; citrus grafting demonstration in Lake County; interior of a 1920s-era laboratory.

Prehistory

Spanish explorers introduced sweet oranges to Florida in the early 1500s, initially in the St. Augustine area. For the next three centuries, orange trees were planted around the state in piecemeal fashion, by accident or to provide small quantities of fruit for local consumption. The first U.S. grapefruit grove was planted in Tampa in 1823. Commercial citrus production was under way in Florida by the late 1700s but was not a significant economic force until about 1875, when a 20-year "boom" period began. During this time, the industry expanded and citrus fruit became one of the state's most valuable crops, along with field corn and tobacco. Commercial citrus acreage was concentrated in the northern part of the state,

which was far more populated than peninsular Florida and offered better soils.

Growers of this era were fiercely independent and citrus production was arduous work. Typically, fruit was produced on small, family-owned farms, packed into wooden crates and then transported by steamship or rail to major cities in the Northeast, where it was sold fresh. Canning and juice processing were still experimental technologies, years away from widespread use. On the farm, most tasks were accomplished with manual labor, although mules assisted with heavier jobs such as plowing and pulling wagons. Scientific advances were just beginning to shape citriculture; for example, by 1900 most growers preferred to use budded trees rather than growing trees from seed. From a business standpoint, oversupply was a perennial issue that held down farm-gate prices, marketing efforts were almost nonexistent and growers often had to rely on their own initiative and ingenuity to address production issues.

By the 1893-94 season, Florida growers were harvesting 5 million boxes of citrus, then disaster struck. A pair of freeze events, in December 1894 and February 1895, killed a large percentage of the state's citrus tree inventory. Yields plummeted; the 1895-96 harvest totaled 147,000 boxes. In response, many growers left the business and others moved south to the sandy "Central Ridge" area running through Lake, Polk, Hardee and Highlands counties. Production did not reach 1 million boxes again until the 1902-03 season.

At the state-run Florida Agricultural College in Lake City, the federal Hatch Act of 1887 had led to creation of a formal research division, the Florida Agricultural Experiment Station (FAES), which soon launched experiments on citrus production issues. In 1905, the college and FAES were folded into the academic portfolio of the University of Florida, which was then under construction in Gainesville. When UF opened its doors in September 1906, citrus research continued; fieldwork was conducted on campus and in privately owned groves downstate.

In 1912, Florida's first documented citrus canker outbreak was discovered. The bacterial disease caused heavy losses, prompting the Florida Legislature to create a new entity in May 1915, the State Plant Board of Florida, forerunner of today's Division of Plant Industry. Based at UF, the Board had four departments, one devoted to canker eradication and three assigned to long-term tasks: nursery inspection, plant pathology and entomology.

Creation of the Citrus Experiment Station

The year 1917 arrived. The canker outbreak continued and a severe freeze February 2-6 further reduced yields. In Polk County, a group of citrus growers grew increasingly dismayed and requested help from state leaders. On June 4, the Florida Legislature authorized the Florida Board of Control

First building constructed on-site, which initially served as CES headquarters.

A group of young men, possibly students, examine the surface of an unripe grapefruit.

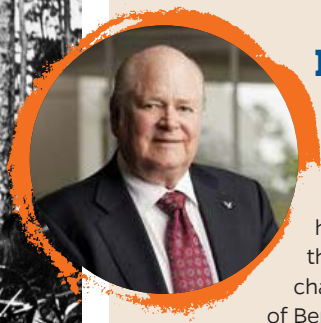
Flatwoods grove workers burn trees infected with citrus canker, part of the effort to eradicate Florida's first known outbreak of the disease, which lasted from 1912 to 1931.

to establish an off-campus research site for UF, initially called the Branch Experiment Station for Citrus Investigations. Conditions were attached: The facility had to be located in Polk County and construction could not begin until $10,000 in private funding was secured. In summer 1919, growers announced that they had raised more than the required amount. Soon after, UF acquired an 84-acre tract of land just north of Lake Alfred, which included 14.5 acres of established, fruit-bearing groves.

Site preparation and construction consumed the next two years, conducted under the supervision of Peter Rolfs, director of the Florida Agricultural Experiment Station. On Oct. 1, 1920, citrus grower and former UF gardener John H. Jefferies was appointed superintendent, becoming the facility's first on-site employee. One of Jefferies' immediate concerns was establishing a bud supply grove where growers could obtain budwood from top-quality scions; it would be stocked in 1921 after the U.S. Department of Agriculture gifted UF with what was described at the time as the second-best collection of citrus germplasm on Earth.

The facility was soon renamed the Citrus Experiment Station (CES). Reports from 1921 and '22 indicate that another 12 acres of CES property were cleared and planted with young trees and chemist R.W. Ruprecht utilized these groves for experiments investigating the physiological causes of dieback. In the older groves, Ruprecht determined optimal rates for potassium amendments, and compared the relative benefits of two nitrogen sources, nitrate of lime and nitrate

Q&A



BEN HILL GRIFFIN III

A member of Florida's most prominent citrus family, Ben Hill Griffin III began his long career when he was a boy, helping his grandfather care for trees in the 1950s. Today, Mr. Griffin is chairman and chief operating officer of Ben Hill Griffin, Inc. and below he discusses the Florida citrus industry as his grandfather knew it.

Q: What was the industry like in the 1910s to 1920?

A: The state was producing 8 million boxes of citrus a year, and the industry provided thousands of jobs. My grandfather started growing citrus in 1915 or 1920. I was 10 years old when he died, but I recall working in the citrus nursery spraying and hoeing trees. I spent holidays and summers working in the groves or the nursery.

Q: What were conditions like back then, working in the groves?

A: The trees were spaced out, 30 feet by 30 feet, and there was no straight line of trees. Everything was pretty spread out, so the sun would just beat down on you. It would be the 1950s before we started putting the trees closer together and in straight lines.

Q: What varieties grew in your groves?

A: We had Hamlins, Pineapples and Valencia oranges. We also grew Duncan grapefruit.

Q: How did the Citrus Experiment Station help growers during that time?

A: When the CES researchers informed us of the need for minor elements to fight deficiencies in trees, we were excited. My father, Ben Hill Griffin Jr., could see that this center would be instrumental in the future of the citrus industry. We knew then that we couldn't just rely on nitrate, potash and phosphate to feed the trees; we needed more, and those researchers at CES gave us the answer in zinc, manganese and magnesium. We were able to produce better quality fruit and stave off deficiencies in the trees.

of soda. Fertilizer experiments involving phosphoric acid were conducted in nearby commercial groves, and a study was launched in Gainesville to evaluate sour orange, rough lemon and grapefruit rootstocks.

The Florida Legislature appropriated $10,000 to the Station in 1924. That year saw the first on-site citrus breeding efforts and entomological studies of the green citrus aphid, an invasive pest recently detected in Tampa. In 1926, the first UF faculty member was stationed at CES full-time, plant pathologist W.A. Kuntz, who initially focused on a fungal disease, citrus melanose. By now, the Station had 63 acres planted for experimental work, as well as a laboratory building, a greenhouse and an insectary for rearing ladybeetles used in early biocontrol studies. In Gainesville, FAES entomologists developed a seasonal calendar of citrus pests and devoted considerable effort to three in particular — the citrus whitefly, purple scale and rust mite.

By the late 1920s, technological advances were changing Florida citrus production in myriad ways. Low-cost, synthetic nitrogen fertilizer became available. Motorized trucks, the latest transportation method, offered new competition to railways just when steamships were fading out. Henry Ford introduced a line of affordable tractors, and Florida growers developed modifications to help them traverse sandy grovelands. Economically, the state weathered numerous setbacks toward the decade's end. These included a land boom that collapsed abruptly in 1926 and hurricanes in 1926 and 1928 that killed thousands of Floridians. The state's first documented outbreak of Mediterranean fruit fly occurred in 1929 and untold thousands of trees were sacrificed to the eradication effort. Finally, like the rest of the nation, Florida was rocked by the Wall Street stock market crash of October 1929 and the economic depression that followed.

The first insectary built on-site, seen in 1926.

This 1928 photo probably depicts the cottage where John H. Jefferies lived.

Grapefruit blown off trees in Coral Gables by the 1926 "Miami hurricane."

An orange grove in Bartow after the Great Freeze of 1895.

This 1912 postcard image shows a grower hauling oranges to market.

Makeshift cold protection in a grove, 1905.

The 1930s

Despite this ominous prelude, the 1930s witnessed numerous advances and triumphs for Florida citrus, beginning with a record-breaking harvest of 35 million boxes during the 1930-31 season. Canned ready-to-drink orange juice and canned grapefruit sections began to win favor with consumers, providing growers with a way to utilize fruit with minor cosmetic defects. At CES, a second plant pathologist joined the staff in 1930 and helped develop control measures for the fungal diseases citrus melanose, stem-end rot and scab. In citrus nutrition, CES researchers published a 1930 assessment of soil acidity throughout the Central Ridge growing region and a 1931 bulletin evaluating the new synthetic fertilizers. A few years later, CES reached a milestone, demonstrating that applications of zinc, manganese and magnesium could improve yield. Growers confirmed the scientists' findings and micronutrient amendments soon became routine.

Attendees listen to a presentation at the Annual Growers' Institute at Camp McQuarrie in the Ocala National Forest. The event debuted in 1934 and was held annually until the early 1970s, sponsored by UF/IFAS Extension and supported by the Florida Citrus Production Credit Association. Camp McQuarrie was a 4-H camp built by the Civilian Conservation Corps and was named for C.K. McQuarrie, the first statewide agent with UF/IFAS Extension.

By 1935, CES had five full-time staff members. Three events that year ensured the Station's long-term survival. First, UF leaders decreed that all future citrus research would take place at CES. Next, the Florida Legislature okayed an appropriation of almost $47,000, ensuring adequate funding for expansion. Third, horticulturist Arthur F. Camp was appointed CES director and was the first director to work on-site, a factor that undoubtedly provided the Station with better-informed management decisions. Still another 1935 event would transform the industry overall — creation of the Florida Citrus Commission, which was formed to provide marketing, research and regulatory support, with the primary goal of raising demand for Florida citrus nationwide.

Harvests at the decade's end provided ample proof CES was a worthwhile investment — the 1937-38 yield was 40.2 million boxes of fruit, 1938-39 saw 40.9 million and 1939-40 witnessed a mind-boggling 56.7 million boxes. In 1939, citrus fruit's status as an iconic symbol of Florida was cemented by a widely distributed travel guide, "Florida: A Guide to the Southernmost State," which was produced in Washington, D.C. by the Federal Writers' Project. It emphasized the role of citrus in Florida history, and portrayed citrus fruit as the physical embodiment of vitality and outdoor fun. As these happy events unfolded, the possibility of U.S. involvement in World War II loomed in the background. Few could have predicted how dramatically the war would change Florida citrus production in the 1940s, or how long the changes would endure.

Worker tends a pile of burning canker-infected trees in Davie in 1922, part of the effort to eradicate Florida's first known citrus canker outbreak, 1912-1931.

THE 1940s & '50s

UF/IFAS Citrus Research and Education Center

World War II

On the morning of Sunday, Dec. 7, 1941, the Empire of Japan launched an unprovoked attack on U.S. Naval Station Pearl Harbor, killing 2,400 Americans and crippling the Pacific Fleet. On Dec. 8, the United States formally entered World War II. Almost overnight, industries retooled to produce items needed for the war effort and employers struggled to fill positions as workers departed for military service. In Florida, the citrus industry and the Citrus Experiment Station were not simply affected by the war, they were transformed.

After the record-breaking harvests of the late '30s, it appeared likely that Florida's annual citrus yields would continue to exceed 40 million boxes. This was a mixed blessing because oversupply had plagued the industry for decades. Canned products were gaining popularity but accounted for only a small fraction of the overall crop; by 1940, the U.S. per-capita consumption of canned citrus sections was 0.8 pounds per year and consumption of canned ready-to-drink citrus juices totaled about 3.25 pounds, according to USDA figures. World War II changed the scenario by creating demand. In early 1942, U.S. government officials sought a pleasant-tasting vitamin C supplement for military personnel and refugees in far-flung theaters of war, and determined that canned orange and grapefruit juices would meet this need. During three seasons, 1942-43 through 1944-45, the federal government purchased about 20% of all U.S. citrus. It was a seller's market and many growers used their newfound profits to expand their operations.

Growth at CES during this period encompassed land, infrastructure and personnel. In 1940, the Florida Agricultural Research Institute donated 40 acres to CES. At the Lake Alfred facility, a packinghouse research building was completed in 1945 and several buildings in 1947, including a library, administration building, processing building, housing offices and an auditorium. Also in 1947, UF established a citrus field laboratory (later to

Opposite page: Two Florida Citrus Commission researchers stationed at Lake Alfred go about their work in this 1950s-era photo. At left is C.D. Atkins, one of the primary developers of frozen concentrated orange juice, at right is R.L. Huggart.

Above from left to right: Grove worker suppressing weeds with a disc harrow; the administration building, completed in 1947; demonstration of a power pruning tool.

become Indian River Research and Education Center) on an 80-acre tract in St. Lucie County, which enabled the Station to serve grapefruit growers more effectively. Similarly, the Station's personnel roster grew from 10 on-site employees in 1943 to 30 in 1948. This was partly due to the arrival of Florida Citrus Commission scientists who had been researching post-harvest issues in Winter Haven and were relocated to CES at the behest of the Florida Legislature. Though many CES activities were scaled back during the war, several important initiatives began in the 1940s, including early international research on citrus tristeza virus and attempts to determine the cause of spreading decline, a mysterious and fatal condition that was apparently soilborne.

Frozen Concentrate

For most of the decade, Florida-based scientists sought a method for producing frozen concentrated orange juice that could be reconstituted for consumption. They hoped to create a product so popular that it would prevent oversupply issues from re-emerging once the war ended and government purchases were scaled back. Work on the project mainly took place in Winter Haven at USDA labs and involved USDA and Florida Citrus Commission personnel; however, UF horticulturist Arthur Stahl was a member of the research team and performed some early work at CES. In 1948, the process was perfected, patented and made available free of charge to producers. When frozen concentrate reached supermarkets it was an immediate hit, assuaging concerns about oversupply and initiating a shift in Florida orange production away from fresh-market varieties and toward juicing oranges. In 1949, CES gave the fledgling orange juice industry a huge boost when horticulturists John Sites and Herman J. Reitz developed a sampling method that required only four oranges to assess the fruit quality of an entire tree.

The 1950s

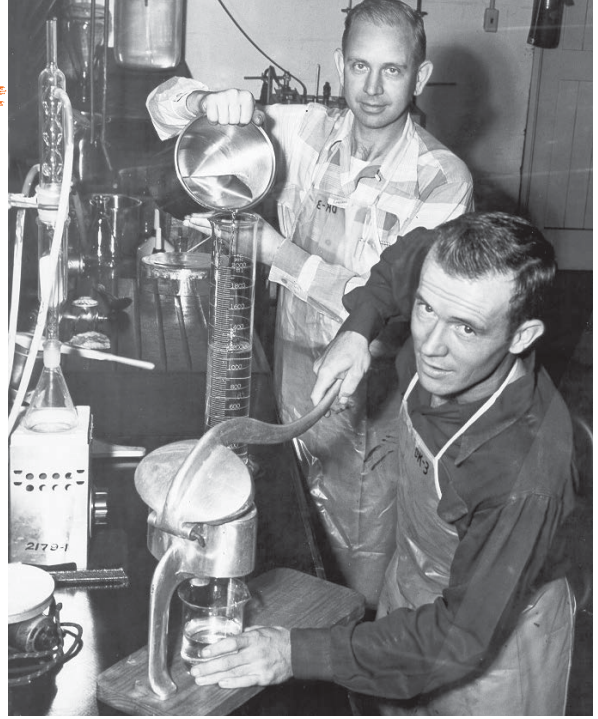
As the 1950s began, productivity reached new heights. The 1950-51 harvest was 105.4 million boxes, the first to top the 100 million mark. Almost half the 1950-51 orange crop was used in manufacturing frozen concentrate — Florida produced more than 30 million gallons of it that year, a three-fold increase from 1948-49.

Innovations were everywhere. Spray application research for pesticides began, including evaluations of spraying apparatus and the effects of parameters such as vehicle speed and application volume. In 1951, Robert Koo began a lengthy study of supplemental irrigation, previously used only to establish new plantings and help trees survive droughts. Koo demonstrated that supplemental irrigation could boost yields up to 40%. That same year, CES faculty developed a hedging machine to trim branches from trees, and a tractor canopy to protect drivers from pesticides. The Station had two other accomplishments in 1951 related to

Early citrus irrigation efforts often involved a "sprinkler pipe" as seen here.

Using an auger to obtain root samples, 1956.

Display showing experimental orange juice concentrator at the 1946 Florida Citrus Festival.



Work on commercialization of citrus by-products, as seen here, greatly benefited the industry.

environmental concerns — the launch of a research program on treatment of citrus wastewater and publication of the first reports concerning worker health and pesticide exposure. The following year brought another environmental advance, development of a de-greening process for fresh oranges that required far less ethylene gas than previous methods. In 1954, a team of CES and USDA scientists published a landmark document, "Recommended Fertilizers and Nutritional Sprays for Citrus," which was updated and used for two decades.

But the most remarkable advances of the 1950s concerned plant pathology. Yellow spot, a malady that had perplexed growers for half a century, was overcome when researcher Ivan Stewart demonstrated in 1952 that it resulted from molybdenum deficiency. Chelated iron supplements were developed at the Station the same year, offering a solution to iron-deficiency problems that commonly afflicted trees in groves where copper-based sprays were used frequently. In 1953, researchers made a breakthrough with spreading decline, determining that it was caused by the burrowing nematode. This discovery laid the groundwork for effective management in the 1960s, quelling one of the most serious disease threats growers had faced.

As the decade wore on, citrus yields continued climbing. The 1954-55 harvest was 136.9 million boxes, another record. Expansion continued at the Station, with the acquisition of 255 acres in nearby Davenport in 1955 and construction of a new entomology building that opened in 1958. There was also a change in leadership — Arthur Camp retired as director Dec. 31, 1956 and was succeeded on New Year's Day by Herman J. Reitz, a horticulturist who had been with the Station for a decade.

In the latter half of the 1950s, new innovations took hold. Nitrogen recommendations for Indian River grapefruit were developed and disseminated. Entomologist Martin Muma published extensive studies on the predators and parasites that reduced populations of Florida citrus pests. One of Muma's more noteworthy efforts was the 1955 biological control overview, "Factors Contributing to the Natural Control of Citrus Insects and Mites in Florida;" another focused on a parasitic wasp highly effective in controlling purple scale. Weed-control research began in 1956 and would expand during the next decade. In 1958, a research program began examining the feasibility of mechanical citrus harvesting, a cost-cutting measure. The same year saw a renewed interest in citrus breeding, motivated by the need for new rootstocks that were less vulnerable to the burrowing nematode, cause of spreading decline. In time, the Station would become the source of numerous rootstock varieties, many of them able to resist, or at least tolerate, otherwise industry-crippling diseases.

Q&A

EMORY MCTEER

As president of McTeer Farms, Inc. in Haines City, Emory McTeer doesn't just know citrus, he is also a seasoned blueberry farmer. Below, Mr. McTeer describes how his father, second-generation grower Harold McTeer, worked with CREC faculty to keep up with the latest citriculture advances.

Q: How would you describe your father's relationship with CREC?

A: He started that relationship — the best that my mother and I recall — in '56. It may have been '55, but somewhere along there.... And then, basically, all through his years until he passed, which was in 2011, he stayed in touch with CREC. I think they had a great relationship.

Q: What challenges did CREC help your father address?

A: You had the challenges of *Diaprepes* (*abbreviatus*, a root weevil), postbloom fruit drop, canker, greening — I think all of those were incredible challenges that growers had to face and we're still trying to overcome them today.... (My father) was a researcher at heart, and he would talk and communicate with people. He really enjoyed getting feedback and opinions and ideas from CREC as well as other growers. That doesn't mean he always agreed with them but he did value the opinions of the CREC scientists greatly.

Q: How did CREC impact your father's knowledge and your own?

A: The CREC scientists definitely helped us with the knowledge aspect of things. They did it through conferences and classes they held for growers, they did it by coming out to our groves and observing different conditions or issues, and they did it by sitting down at a table one-on-one, if we wanted, and gave us their time and full attention. That's how they did it and it helped steer us. The results were healthy trees, increased yields, water conservation, cold protection and insect control, among others — it just goes on and on.

THE 1960s, '70s & '80s

UF/IFAS Citrus Research and Education Center

The 1960s

Although the 1940s and '50s witnessed amazing growth, the industry's rapid expansion came with a downside. As statewide citrus acreage and annual yields increased, so did the significance of the challenges growers faced from the forces of nature. A 10% yield loss involved millions more boxes of fruit than it did decades earlier, translating to more lost revenue and hardships for many more workers. This principle was made abundantly clear in the early 1960s.

On September 10-11, 1960, Hurricane Donna struck northern Cuba and the Florida Keys, then moved up the Gulf Coast and crossed the state from roughly Sarasota to St. Augustine before traveling up the Atlantic coast to Maine. The storm killed about 365 people and destroyed half of Florida's grapefruit crop and about 10% each of the orange and tangerine crops. Prior to the hurricane, the predicted harvest for 1960-61 had been 145.5 million boxes of fruit; the actual harvest was 125.6 million boxes, and growers lost roughly $60 million in farm-gate revenues.

There was more to come: June 1962 saw a Mediterranean fruit fly outbreak that was declared eradicated in February 1963 and a severe freeze occurred Dec. 12-13, 1962, reducing yields for the next five years. In September 1964 came the first reports that the citrus root weevil *Diaprepes abbreviatus* had been found in Florida, a long-expected event.

But throughout the 1960s, researchers at the Citrus Experiment Station used disasters as starting points to develop scientific innovations and resolve stubborn production issues. For example, horticulturalist A.P. Pieringer and his team scored a decisive victory in the battle against spreading decline, Florida's most serious citrus disease in the 1950s and early 1960s, when they released two rootstocks that were resistant to the causal agent of the disease, the burrowing nematode. These new rootstock options, combined with cultural practices and nematicides, effectively suppressed spreading decline by the decade's

Opposite page: CREC expanded its mechanical harvesting research in the 1990s, in response to increased labor costs.

Above from left to right: View of Clermont citrus groves from Florida Citrus Tower in 1964; Herman J. Reitz confers with biochemist Robert Koo; freeze protection became a pressing issue in the 1980s as the industry experienced five severe freezes.

end. Another example: Following the 1962 freeze, many growers relocated to Southeast Florida, establishing operations in flatwoods areas with poorly drained soils. To protect citrus trees from floods and moisture-loving fungal diseases, CES researchers worked with contractors to optimize grove drainage systems, reduce clogging within pipes and ensure acceptable flow rates. In 1964, CES began evaluating devices for heating groves; in 1967, researchers reported that sulfides formed in the soil by bacteria are an important cause of citrus root damage when trees endure flooding.

To help growers save money, CES advised them to stop using so-called "low analysis" fertilizer, which sometimes contained 50% sand by weight. New "high analysis" fertilizers contained less filler; growers who switched typically saved 50% to 75% on fertilizer costs. The Station also evaluated herbicides and made recommendations, laying a foundation for the industry's current weed-control practices.

Breakthroughs regarding pests and pathogens occurred as well. Research in the late 1960s revealed that the malady known as greasy spot was caused by the fungus *Mycosphaerella citri* and could be controlled by spraying trees with a petroleum-based oil, or oil plus copper, during summer months. In 1966, CES researchers released recommendations on the use of citrus spray oils. In 1969, a control program for Diaprepes citrus root weevil was initiated.

Expansion at CES slowed but continued during this decade, which saw the dedication of a pilot processing plant in February 1966 and dedication of a biochemistry building in January 1969. Another milestone in 1966 occurred when UF/IFAS Extension citrus specialist David Tucker was appointed to work full-time at CES; previous Extension citrus specialists had been based in Gainesville or in county offices.

The 1970s

In 1970, the state's citrus acreage reached 941,000 acres, an all-time high. Shortly afterward, the 1971-72 harvest surpassed 200 million boxes for the first time. In many respects, the 1970s were a golden decade for Florida citrus and provided proof that the years of hard work by CES researchers were paying off. By coincidence, the Station experienced a change of its own during this era — in 1971, it was renamed the Agricultural Research and Education Center (AREC), to comply with a university-wide policy change.

Innovations and solutions continued to come: Scientists gained a better understanding of the citrus rust mite, which had periodically impacted Florida citrus since the 1870s. By the late 1960s, researchers had determined that they could use the fungus *Hirsutella thompsonii* to control the mite. This was one of many natural enemies that were being studied by biocontrol pioneer Martin Muma. Another disease familiar to Florida growers, Alternaria brown spot, was found to be caused by a fungus. A brown spot outbreak in 1973 led to development of management recommendations released by Center plant pathologists in 1976; incidence of the disease rapidly subsided afterward.

Although Florida growers had been relatively unimpeded by cold weather since 1962, a hard freeze occurred Jan. 18-20, 1977. The 1976-77 harvest still topped 250 million boxes nonetheless, but the freeze served as a preview of weather woes the state would face in the upcoming decade.

The 1980s

The 1980s saw six severe freezes that devastated Florida's citrus industry, in 1981 (Jan. 12-14), 1982 (Jan. 12-14), 1983 (Dec. 24-25), 1985 (Jan. 20-22) and 1989 (Feb. 24-25 and Dec. 22-26). For years,

Operating a remote-controlled hedging machine.

Attendees at a Packinghouse Day event, 1972.

Adjusting the cutting height of a hedging machine.

Popularized in the 1980s, microirrigation remains the most commonly used freeze protection option for Florida citrus operations.

growers had used multiple methods to protect trees and fruit, such as oil-fired heaters, wind machines and even blankets. But in the 1980s, the Center began testing a less expensive and more effective approach, microirrigation.

Unlike the overhead irrigation systems that watered trees during droughts, microsprinklers emitted water at the base of each tree. In freeze protection, microsprinklers were used to generate a thin coating of ice on the tree's trunk and lower limbs. Due to a physics phenomenon called latent heat of fusion, the ice maintained coated tree tissue at about 32 degrees Fahrenheit, protecting it from lower temperatures.

Researchers at the Center began investigating microirrigation in 1981 and found it more efficient than other freeze-protection technologies. Within a decade, microirrigation had become the most popular freeze-protection method among Florida growers; it has been a major factor in minimizing wintertime tree mortality.

Also during the 1980s, UF/IFAS citrus researchers began devoting greater attention to sustainability issues. They studied the use of treated municipal wastewater for irrigation, demonstrating that it was safe for citrus groves. Center personnel helped plan the Water Conserv II project, the world's largest program using reclaimed water for citrus irrigation, which became operational in December 1986.

The 1980s marked several milestones for the facility, as well. In March 1982, Herman Reitz retired and in August Walter J. Kender was appointed director. In 1984, another policy change occurred, and the Agricultural Research and Education Center was rechristened the Citrus Research and Education Center (CREC), a name that better reflected its mission to educate the next generation of citrus scientists. The change was particularly appropriate because previously there had been no for-credit classes offered at the Center and no way for students to live on-site. That all changed with the construction of dormitories in 1986 and establishment of six graduate-level courses during the mid-80s.

Q&A

STEVE FARR

Active in the Florida citrus industry since 1980, Steve Farr is currently a vice president with Ben Hill Griffin, Inc. in Frostproof. Mr. Farr is a grove management expert and also helps his colleagues optimize their psyllid control efforts as a coordinator for the Citrus Health Management Areas program. For this publication, he recalled early experiences working with CREC faculty.

Q: What's your relationship been with CREC?

A: I started out at Florida Southern College in the citrus department and made several field trips to CREC at Lake Alfred, and I remember some of the faculty. Paul King showed us how the speed sprayers were operated. Richard Lee was studying blight, which we are still trying to figure out, and showed us what he was working on in the lab. In the 1980s, I was also fortunate enough to go on a trip with Dr. Al Krezdorn to Brazil. It always intrigued me how aggravated he would get when he didn't know a new variety or pathogen when we were in a grove in a foreign country.

Q: How did you and CREC work together on the citrus canker problem in the 1990s?

A: I met (soil microbiologist) Dr. Jim Graham in 1989 when canker was first found in one of the 400-acre blocks I was managing for Smoak Groves down in the Lake Placid area. It was the first time they had found canker in a mature block since the 1920s and '30s, so it was a big deal.

We also enabled Dr. Graham and other researchers to work in our groves at Ben Hill Griffin to study other pathogens.

Q: Do you feel that letting researchers work in the groves you managed was ultimately valuable?

A: No doubt, no doubt. We wouldn't have participated if we didn't.

We always liked to see the research in commercial operations versus the laboratory because there can be night and day differences in what you can expect or see in the lab and in the real world.

1990s to the PRESENT

UF/IFAS Citrus Research and Education Center

The 1990s

The string of freezes that began in 1981 ended when December 1989 came to a close, and the 1990s began as an era of rebuilding. The 1989-90 harvest was a mere 154.2 million boxes, but within three years, growers were consistently topping 200 million boxes again. Labor woes had led to greater interest in mechanical harvesting and sustainability was becoming a frequent topic of discussion.

Simultaneously, a battle was heating up between the citrus industry and an old foe — the bacterial disease citrus canker. Florida's first recorded canker outbreak had lasted from 1912 to 1933, and the disease was not reported again until 1986, when it was found in the Tampa Bay area, infecting a citrus tree in a resident's yard. Tragically and predictably, the new outbreak spread to a commercial grove; by 1990, citrus canker was well-established and would not be eradicated until 1994. Then in 1995, a new canker outbreak was discovered in Miami-Dade County and the battle resumed.

To fight canker more effectively, Citrus Research and Education Center scientists collaborated with their counterparts at USDA and the Florida Department of Agriculture and Consumer Services to improve control methods. For example, researchers learned to distinguish between strains of canker and discovered how the bacterium infects trees, a process exacerbated by damage from the invasive citrus leafminer. Scientists also learned how the canker bacterium spreads over large geographic areas. These insights helped inform state and federal policies designed to curb canker transmission.

Other pathogens made their presence felt in the 1990s and CREC scientists responded. They developed a reliable assay for citrus blight, a decline disease that had been present in Florida for a century. In 1995, the threat of citrus tristeza virus escalated with the first Florida report of the

Opposite page: Sweet oranges were introduced to Florida in the early 1500s by Spanish explorers who settled in the St. Augustine area.

Above, left to right: Jude Grosser is involved in numerous efforts to breed improved citrus scion and rootstock varieties; the invasive Asian citrus psyllid, which transmits HLB; William Dawson has developed management techniques for citrus tristeza disease and biotechnology applications for the tristeza virus.

brown citrus aphid, primary vector for tristeza. Consequently, growers began shifting from sour orange rootstock to varieties less vulnerable to the disease. In June 1998, the invasive Asian citrus psyllid was first reported in Florida; this discovery caused concern because in other parts of the world this insect transmitted a serious citrus disease known as huanglongbing, also known as HLB or citrus greening disease. However, Florida would not see its first reported cases of the disease until 2005.

New innovations came frequently. In 1995, CREC faculty collaborated with the USDA Agricultural Research Service to publish a handbook, "Nutrition of Florida Citrus Trees." It advocated sustainable fertilization and gave growers the tools to increase yields while protecting soil and water quality. That same year, an outbreak of salmonellosis cases linked to unpasteurized orange juice led CREC researchers to help develop a comprehensive food-safety program for fruit and vegetable juices, using the Hazard Analysis and Critical Control Points system.

Financial support of CREC reached a milestone this decade with establishment of the J.R. and Addie S. Graves Endowed Chair in Citrus Biotechnology by the Graves family of Wabasso, Florida. In 1992, citrus tristeza virus expert William O. Dawson was appointed as Graves Eminent Scholar. Toward the end of the decade, CREC had another change in leadership — entomologist Harold Browning was promoted to director in November 1996, following the retirement of Walt Kender.

The 2000s

As the 21st century began, citrus canker continued to hold its dubious distinction as the most worrisome disease facing the industry. At CREC, researchers investigated the bacterium and Extension personnel launched a statewide Citrus Canker Education Program to promote public awareness and good sanitation practices.

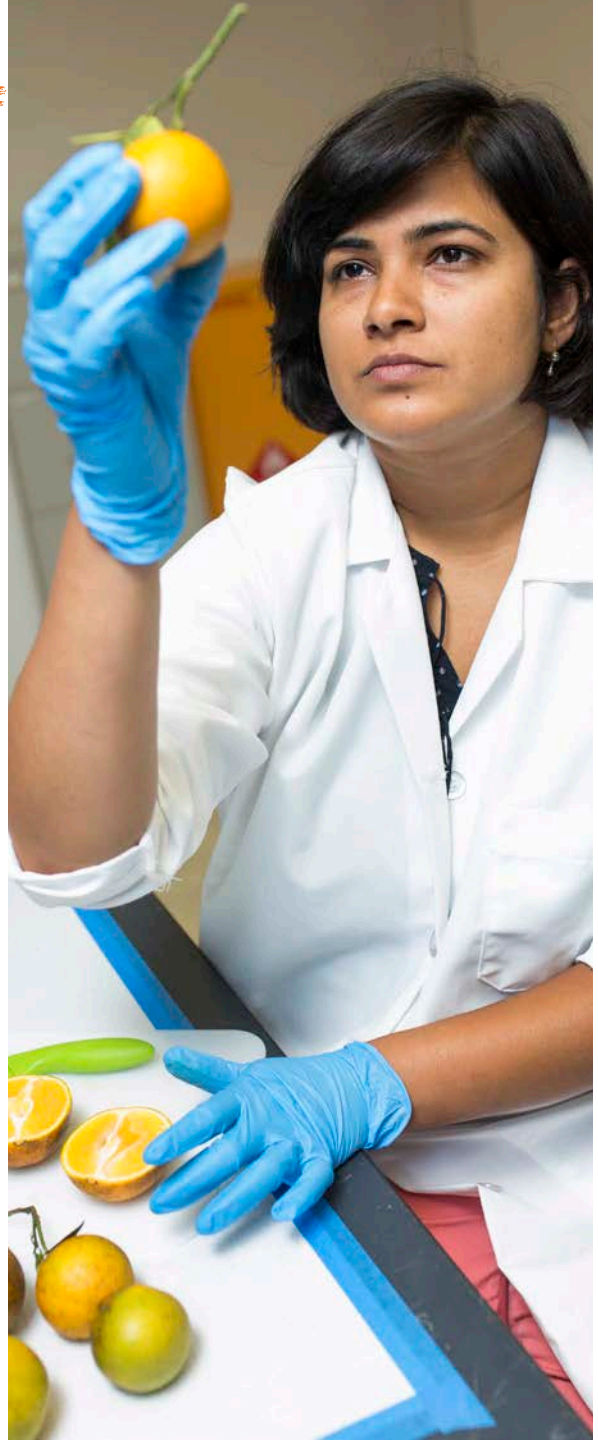
However, hurricanes in 2004 and 2005 spread the canker pathogen so extensively that in January 2006 USDA halted its eradication program. This move ended mandatory destruction of citrus trees located near infected specimens and was met with a mixture of relief and resignation from the grower community. In any case, the news was overshadowed by another recent development — in August 2005, Florida had its first reported cases of HLB-infected trees. This revelation gave HLB immediate status as the state's most dreaded citrus disease because, unlike canker, HLB was known to kill infected trees, making the situation more urgent and more desperate.

As word of HLB spread, CREC faculty worked together with other statewide citrus specialists to gather information about HLB outbreaks abroad and develop management recommendations

Plant pathologist Megan Dewdney works to improve the efficiency and effectiveness of copper-based sprays used against fungal diseases.

Research by Ed Etxeberria and colleagues demonstrated that HLB-infected trees could be diagnosed by measuring starch content in leaves.

Lab technician Nadine Cuyler prepares citrus leaf samples for analysis.



Tripti Vashisth, a citrus Extension specialist, helps growers optimize production in HLB-infected trees.

specific to the Florida situation. These included reliable methods for producing disease-free citrus nursery stock, procedures for scouting groves and identifying trees in the early stages of infection, and programs for using insecticides to reduce Asian citrus psyllid populations. CREC personnel also increased outreach efforts aimed at educating growers, industry personnel, policy-makers and the public on short-term management strategies needed to slow the outbreak as researchers sought to develop strategies for winning the long-term battle.

2010 to the Present

As 2010 dawned, HLB had already been the top concern at CREC for half a decade and would remain so, right up to the present day. The Asian citrus psyllid relentlessly spread HLB across the state's citrus-producing regions. According to one CREC study, grower estimates collected in March 2015 indicated that 80% of commercial citrus trees statewide were already infected.

Because HLB has a slow disease progression, infected trees may continue to produce marketable fruit for years. Therefore, yields were affected incrementally. Florida's total citrus harvest for the 2011-12 growing season was 170.9 million boxes; over the next five years, it declined to 156.2 million boxes, 124.0 million boxes, 112.7 million boxes, 94.2 million boxes and, finally, 78 million boxes in 2016-17.

At CREC, many of the decade's major HLB-related research and outreach efforts focused on methods of discouraging infections and minimizing damage to infected trees by optimizing tree health with innovations such as pH-adjusted irrigation water and use of frequent low-dose applications of water and nutrients to the root system. Other studies evaluated potential HLB treatments such

Q&A

JACKIE BURNS

Jackie Burns currently serves as UF/IFAS dean for research and director of the Florida Agricultural Experiment Station, but she was stationed at CREC for 27 years, including five years as director. From her current vantage point, Dr. Burns shared her thoughts about the impact of HLB on Florida's citrus industry.

Q: What was your impression when you heard about the first HLB cases in Florida, in 2005?

A: The reaction at CREC, from everybody, was 'uh-oh.' It was viewed as something that was of grave concern to all of us.

Q: How did this discovery affect you, specifically?

A: At the time, I was focused on mechanical harvesting. HLB didn't initially affect my job but then operations had to be changed due to sanitary concerns — we became much more strict about operations like moving plant material from one place to another, and clean-up procedures and handling of plant debris.

Q: You directed CREC from 2009 to 2014, how did HLB impact your work?

A: When I was director, HLB was the only concern I had, in many regards. It was our top priority.

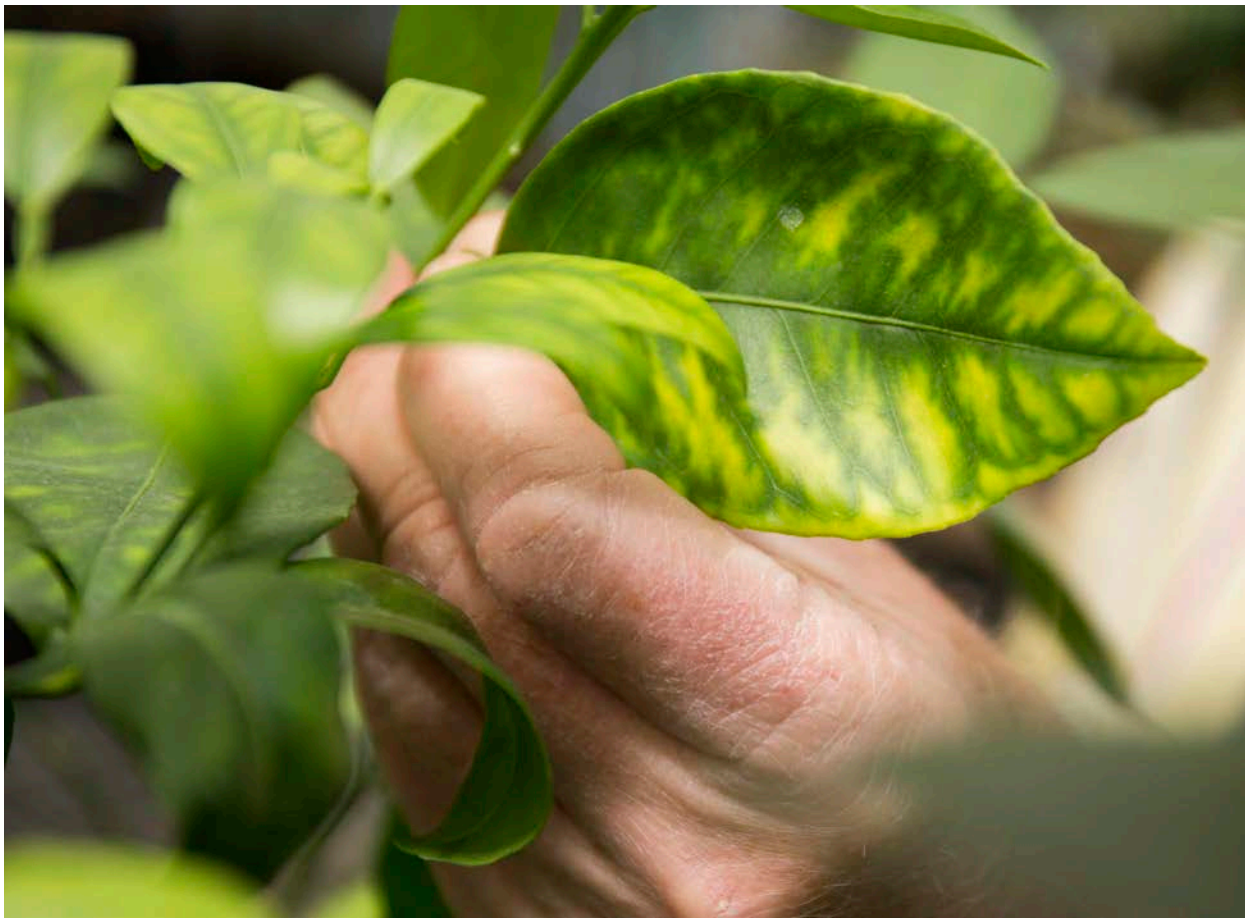
Q: What do you see as the outcome of the HLB crisis?

A: I see the Florida citrus industry surviving this, although it will probably come out the other end in a somewhat different form. For the immediate future, I think we'll continue to see growers following the practices that have been brought about by HLB — higher density plantings, more attention to root health and overall tree health, more precise input placements and shorter productive lives for the trees, maybe 10 to 12 years.

as bactericide injections and steam treatments intended to kill the pathogen within infected trees. The Citrus Health Management Areas (CHMA) program implemented by CREC helped growers reduce local psyllid populations by coordinating the timing of their insecticide applications.

Although many growers forged ahead, some chose to cease operations and sell their land. Ironically, land purchasers sometimes facilitated HLB's spread by leaving groves untended and creating "safe harbors" for psyllid populations, as demonstrated by a CREC study published in December 2010. Other discoveries by CREC researchers this decade included the fact that early-stage HLB infections cause significant damage to citrus roots, and the revelation that Asian citrus psyllid populations were developing resistance to commonly used insecticides.

Citrus leaf displaying symptoms of nutritional deficiency, one of the many side effects observed on HLB-infected trees where the compromised root system is no longer able to move nutrients from the soil to the tree canopy.

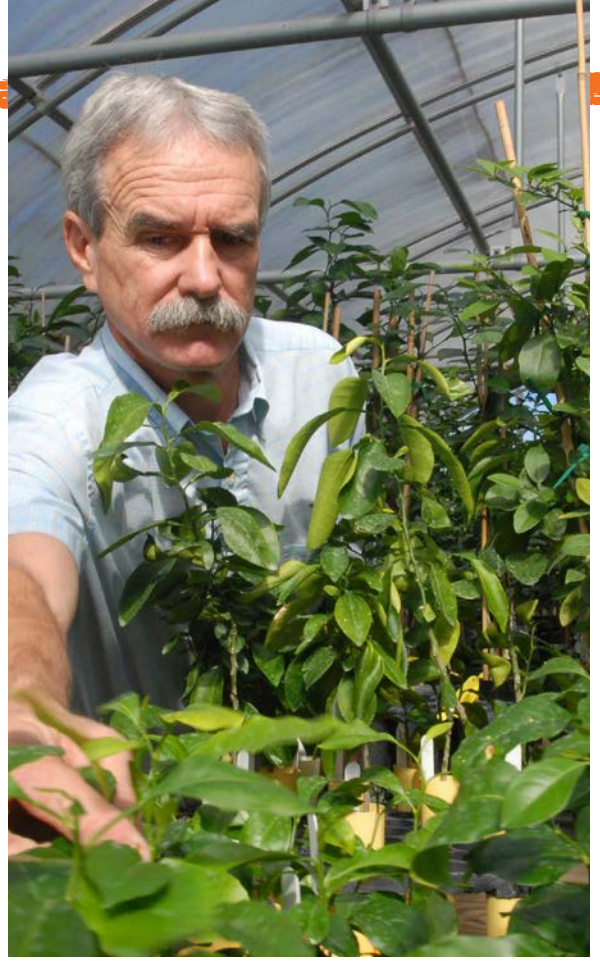


Despite their constant focus on the HLB crisis, CREC faculty and staff members made progress in other areas this decade.

Breeding efforts reached a new high, following the 2010 release of the first CREC-bred scion cultivar, 'LB8-9', also known as Sugar Belle®. Thanks to one pioneering citrus grower, it was planted commercially and has since proven to be the most HLB-tolerant citrus variety grown in Florida; consequently, it is grown more widely today. The first CREC-bred sweet orange release followed shortly thereafter with 'SF 14W-62', also known as Valquarius®, a mid-season orange with Valencia juice quality that ripens at least six weeks earlier than Valencia. Since that time, releases from the program have been accelerating, and more than 30 scion and rootstock cultivars are now available to Florida growers. These releases include many seedless and easy-to-peel mandarins, a grapefruit hybrid that produces sweeter fruit and does not interact with medications, sweet oranges to extend the season with very high-quality juice, several rootstocks that impart greater tolerance of HLB to trees, and lemons with improved processing attributes. Additionally, the breeding program has led the way in developing applications of citrus biotechnology and has spearheaded global citrus genome sequencing projects, to support the development of disease-resistant, productive and high-quality new rootstock and scion varieties. Since 2010, more than 1 million new citrus trees with improved rootstocks or scions have been planted in Florida and the number continues to increase rapidly.

In 2009, Harold Browning stepped down as CREC director and longtime colleague Jackie Burns was named interim director. Two years later, Burns became permanent director. When she was promoted to UF/IFAS dean for research in November 2014, CREC entomologist Michael Rogers took over directorship duties, and holds the position today.

The current CREC administration building is a far cry from the Center's original headquarters, a simple wooden structure.



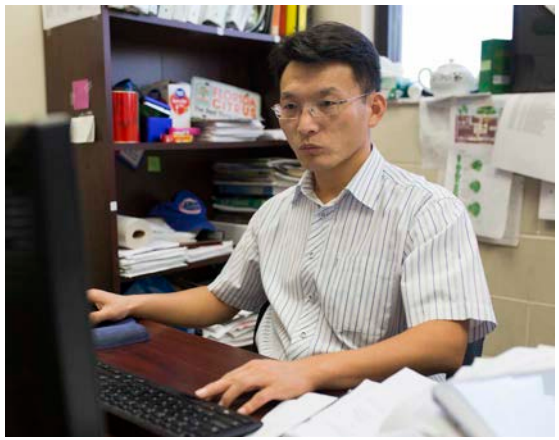
Soil microbiologist Jim Graham determined that HLB infections initially cause the greatest damage to citrus roots rather than leaves and shoots, as was previously believed.

Though HLB remains his top priority, Rogers is quick to point out that citrus canker remains a concern and that the gene-editing technique known as CRISPR (Clustered Regularly Interspaced Short Palindromic Repeats) has already been used by CREC microbiologist Nian Wang to produce grapefruit scions resistant to canker. This technology not only bodes well for Florida's grapefruit industry but could lead to development of an HLB-tolerant sweet orange scion. Citrus black spot, a fungal malady first detected in Florida in 2010, is another recently emerged disease that demands attention. Although currently limited to parts of Collier and Hendry counties, black spot is likely to spread to other citrus-producing areas; Center researchers are striving to develop effective controls for the disease, which has no cure.

Uncertainty has been a hallmark of Florida's citrus industry, and it is too early to predict whether HLB will be defeated during the remaining years of this decade. Nonetheless, Rogers and his colleagues remain optimistic about the future of the Florida citrus industry. Not only will they find solutions to address today's challenges, they are always poised to meet the challenges of tomorrow. This watchful, ready outlook has served CREC faculty and staff well for the past 100 years, and it will surely help Florida's citrus industry survive and thrive for the next 100 years and beyond.

THE FUTURE OF FLORIDA CITRUS

UF/IFAS Citrus Research and Education Center



Florida citrus producers in 1917 would surely gasp at the technical advances available to their counterparts today, including many devices, compounds, practices and plant materials that became available through the efforts of faculty and staff at the UF/IFAS Citrus Research and Education Center and its predecessors.

Michael Rogers, current CREC director, says he is simultaneously elated, motivated and intimidated by the Center's legacy of accomplishments. As director, Rogers feels a responsibility to uphold the Center's tradition of innovative teaching, research and Extension programs, and particularly its reputation for problem solving.

"When the year 2117 comes around and it's time to review CREC's second century, I hope people will look back on this time period and say, 'even with the HLB crisis, they didn't lose a step.' Every day, I try to make sure we're laying the foundation for another 100 years of success," Rogers said.

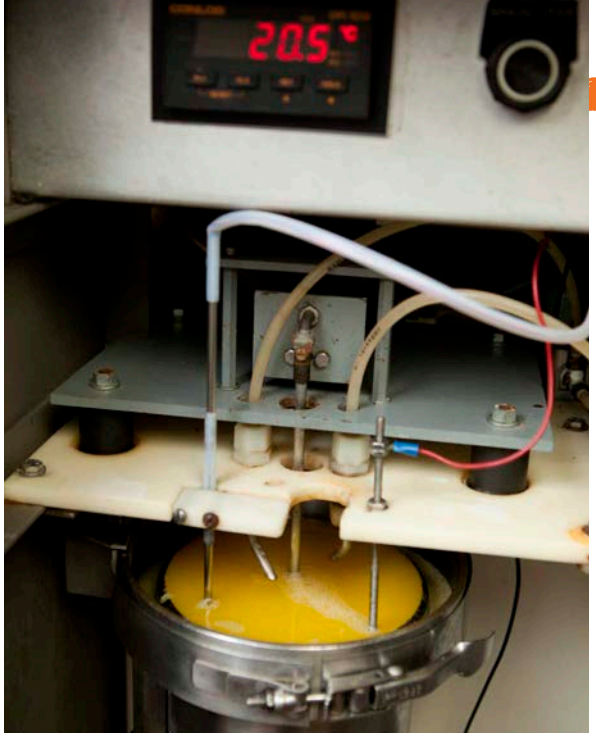
When asked how CREC will help shape the Florida citrus industry of 2117, Rogers says he's more comfortable offering general ideas than specifics.

"Fundamentally, we'll keep looking for ways to be more efficient, to keep growers' costs down. I can tell you that much for certain," he said.

Also, having witnessed the rapid rise of technologies including the home computer, cell phone and the Internet, Rogers believes that future Florida citrus production will benefit from inventions that are scarcely even imagined today. "There's lots of potential for game-changing technologies that would be relevant to citrus and probably to ag in general," Rogers said. "Technology will continue to make agriculture even more efficient and environmentally sustainable — I'm confident that we'll see continued innovations and refinements in all aspects of citrus management, as well as citrus varieties, equipment and supplies."

Opposite Page: Oranges and grapefruit collected from groves for a study on the malady known as postbloom fruit drop, which is caused by a fungus.

Above, left to right: Nian Wang hopes to develop HLB-resistant citrus trees using the gene editing technique known as CRISPR; Fred Gmitter led efforts to breed the Sugar Belle® mandarin hybrid; citrus seedlings representing several varieties grow in a CREC greenhouse.



Today, high-tech analytical instruments are routinely used to help assess the sensory characteristics of citrus juices.

Nonetheless, having worked at CREC since 2004 and directed its programs since late 2014, Rogers has had many opportunities to contemplate just how the future might look. Below, he discusses issues and potential CREC innovations.

Huanglongbing (HLB)

Although the bacterial disease huanglongbing (HLB) has been the Florida citrus industry's primary concern for more than a decade, Rogers is confident that a solution will arrive in the next few years, in the form of resistant rootstock and scion varieties produced with transgenic procedures or the gene-editing technique known as CRISPR (Clustered Regularly Interspaced Short Palindromic Repeats), which enables scientists to permanently modify naturally occurring genes within an organism. Research on both methods has been under way for years at CREC and Rogers describes progress as steady, with both initiatives equally far along. "We have some varieties that appear to be fully resistant to HLB infection, but we are still evaluating those in the field," Rogers said. "One of our experiments is going to pay off, and when we have a resistant variety the industry is going to turn the corner on this situation. Until then, we have to make sure we focus on tree health, keeping trees as healthy as possible so that they're productive longer."

Other Diseases

With international travel and trade increasing each year, there's no doubt that exotic pathogens will continue to arrive in Florida, Rogers said. However, he expects surveillance and detection methods to improve. Current CREC research initiatives on machine vision have already led to methods for identifying HLB-infected trees with visual data alone; Rogers anticipates that similar technologies might be developed to facilitate early diagnosis of trees infected with other diseases. Another trend regarding international travel — Rogers expects to see more UF/IFAS research conducted in foreign countries, to investigate citrus diseases that have not arrived in Florida. He notes that the 1990s-era CREC program for managing citrus tristeza virus was partially informed by international research conducted a half-century earlier, in anticipation of the disease one day reaching the Sunshine State. "I believe that this type of research is extremely beneficial because it gives the scientists hands-on experience with the disease and it puts them in the relevant citrus production environment, where they can do field studies, record data, ask questions, you name it," he said. "This kind of international experience will give CREC a head start in developing new research tools to manage these diseases, should they arrive in Florida."

New Varieties

In the fresh-fruit market, mandarins have been enjoying a renaissance of sorts, spurred by consumer demand for seedless, easy-to-peel varieties. Rogers expects strong retailer interest in mandarins for at least a few more years, possibly much longer. "When our breeders talk to representatives of supermarket chains, they are told, 'don't even think about releasing any more seeded mandarins, we don't want them.' That's how serious this trend is," Rogers said. He notes that ongoing high demand for mandarins could reinvigorate Florida's fresh-citrus production and packing sectors and increase citrus production in North Florida, using cold-tolerant mandarin varieties. Best of all, he said, two recently released UF/IFAS mandarin cultivars are remarkably tolerant of HLB. Similarly, HLB-tolerant sweet orange rootstocks and scions are now available and more are expected in the coming years. These options could influence Florida growers' planting decisions in the near future, particularly if a reliable method for preventing or treating HLB infections does not emerge.

Another point to ponder, Rogers says — advances in plant biotechnology make it possible to speed up the development of new plant varieties in a safe and precise manner. In turn, these advances will enable citrus breeders to evaluate new crossbred plant lines far sooner and faster than was ever possible with traditional breeding. "In the future, I think we'll see current technology such as gene editing lead to the development of new varieties that are resistant to multiple pests and diseases affecting citrus while having improved flavor, nutrition, cosmetics and other desirable characteristics," Rogers said. "Today, many members of the public disapprove of transgenic food crops, but in the future, better science education will lead our grandchildren to shake their heads at this generation's failure to fully embrace biotechnology, the same way that we might chuckle at a family story about somebody who refused to electrify their home because they thought the current would jump right out of the socket and kill them."

Pest Management

Although a day may come when the major citrus pest problems have been resolved via development of pest-resistant citrus varieties, Rogers does not expect it to arrive soon, and furthermore he expects that there will always be some need for pest management. He is optimistic about biological control, the practice of reducing citrus pest populations with controlled releases of natural enemies. The citrus industry pioneered biological control practices, using them beginning in the late 1800's. In Florida, biological control was the main factor preventing pest outbreaks in citrus up until the HLB crisis began in late 2005. Rogers said that psyllid control efforts rely heavily on insecticide applications and, thus, biocontrol is not a favored option for growers at this time. However, Rogers expects that once the HLB crisis is resolved, biocontrol will again be the primary focus of Florida's citrus pest management programs. As new pests arrive in the state, scientists will undertake classical biocontrol research, searching for predators, parasites and pathogens that impact a particular citrus pest in its native range. Research of this type has led to effective, ongoing management of many citrus pests in the past, such as leafminers, whiteflies and blackflies and numerous scale insect species.

Precision Agriculture

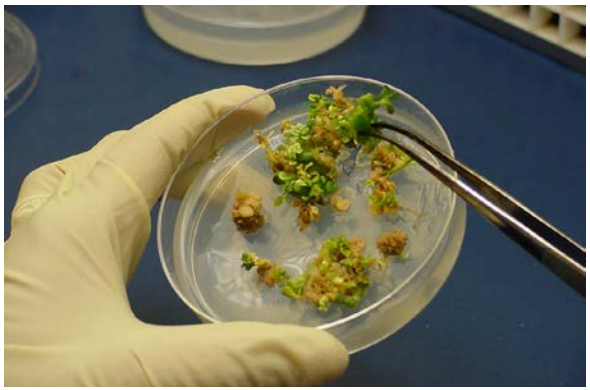
The term "precision agriculture" refers to an assortment of technologies including visual data sensors, Global Positioning Systems and variable-rate applicators, which enable growers to tailor their grove-care practices to the needs of individual areas. Rogers believes that precision agriculture will be especially important in enabling growers to minimize their use of natural resources. "In the future, I think soil moisture sensors might be more widely used, and there may be further developments that could monitor soil pH and the nutritional status of individual trees, and then automatically controlled fertigation equipment would deliver exactly the right amount of nutrients and water needed by the trees," Rogers said. If this kind of scenario became common, it would reduce waste and enable growers to raise their trees more efficiently.

In the realm of pest and pathogen control, precision agriculture could help growers minimize their use of inputs, by detecting areas where infestations are occurring and then applying only the needed amount of pesticide in the affected area. "Today, it's still fairly expensive for a citrus grower to get outfitted with a basic precision ag set-up," Rogers said. "But the costs are likely to come down and this is the kind of investment that can pay for itself over time, so I expect to see more use of precision ag for citrus."

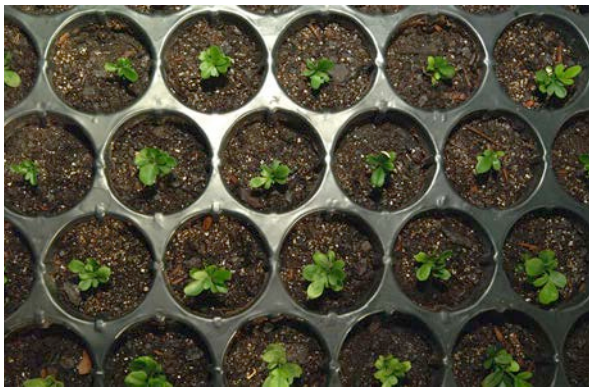
Altogether, Rogers says, there is plenty of reason to feel optimistic about the Florida citrus industry's next 100 years.

"Although we have seen some very tough times lately, with HLB and now Hurricane Irma, it reassures me to think that our growers overcame many disasters in the past, things like the Great Freeze of 1895 and the first medfly outbreak in 1929, and the fortitude that got them through those situations, it's still there," he said. "What's more, today we have a better citrus knowledge base and better growing technology than the industry had years ago, so we're in a better position to see this through and put an end to the HLB crisis. I expect to see it happen, and soon!"

Citrus tissue cultures grown under sterile laboratory conditions offer a faster way to propagate scions, compared with growing cuttings in greenhouses.



After they reach a minimum size growing in a nutrient culture medium, tissue cultures are transplanted to soil until they reach a size suitable for grafting.



Released by UF/IFAS in 2010, the Sugar Belle® scion is a mandarin hybrid that is more tolerant of HLB than other citrus varieties grown in Florida.

CREC TIMELINE

1917

Florida Legislature authorizes creation of UF citrus research facility in Polk County, June 4

1919

Group of Florida citrus growers formally announces that it has raised the required funds to proceed with development of UF Citrus Experiment Station (CES), circa June or July

The Florida Board of Control selects an 84-acre property that will be the site of CES facilities and activities, circa July or August

1920

John H. Jefferies appointed as CES superintendent Oct. 1; becomes first on-site employee

1921

First building constructed at CES

USDA donates to CES what is described as the second-best collection of citrus germplasm in the world, June 12

1923

The Florida Legislature makes its first appropriation earmarked specifically for CES, totaling $10,000

1924

Florida “land boom” begins as investors purchase properties and communities begin investing in infrastructure to meet expected growth

1926

W.A. Kuntz becomes the first UF faculty member to be stationed at CES full-time

An additional 63 acres of groves are planted at CES

Florida land boom ends, following “Miami Hurricane” of Sept. 18

1929

Wall Street stock market crash begins Oct. 24, initiates the Great Depression

1931

Packinghouse built

1933

Florida’s first citrus canker outbreak officially deemed eradicated (the outbreak was detected in 1912)

1934

Severe freeze Dec. 12-13 destroys an estimated 14 million boxes of fruit

Citrus blackfly detected in Key West; outbreak declared eradicated in 1937

1935

Arthur F. Camp appointed as first on-site CES director Dec. 15; John H. Jefferies remains on staff

UF administrators announce that all future UF academic research on citrus is to take place at CES

1937

CES researchers demonstrate the importance of micronutrients zinc, manganese and magnesium and describe deficiency symptoms

1940

Severe freeze, Jan. 27-29

The Florida Agricultural Research Institute donates an additional 40 acres to CES

1941

John H. Jefferies retires

The Florida Legislature authorizes the Florida Citrus Commission to launch a research program focused on post-production


MASS MEETING
of
STUDENTS & FACULTY
because of
AMERICA'S EMERGENCY

U.S. enters World War II Dec. 8; war effort leads to three years of federal government citrus purchases that boost the industry and fund expansion

1943

CES determines how trace elements contribute to fruit quality

1945

Packinghouse research building constructed

1947

UF establishes CES field station in Indian River, forerunner to today’s Indian River Research and Education Center

Florida Citrus Commission research scientists relocated to CES, July 1

1948

Technology for producing frozen concentrated orange juice is patented; research team includes at least one UF faculty member, A.L. Stahl

Administration building occupied

1949

Minimum standards for frozen concentrated orange juice established

1950

Florida citrus harvest reaches 100 million boxes for the first time

1951

CES initiates research on citrus irrigation

1952

Researchers at CES show yellow spot caused by molybdenum deficiency; treatment devised

1953

Hedging machine designed at CES unveiled

CES demonstrates that burrowing nematode causes spreading decline

1956

Arthur Camp retires as director, Dec. 31

1957

Herman J. Reitz becomes director, Jan. 1

"Handbook of Citrus Diseases in Florida" published by CES team

1958

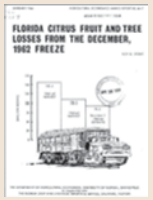
Research on mechanical harvesting begins at CES

Entomology building opens

1960

Hurricane Donna makes landfall in Collier County Sept. 10, destroys half the state's grapefruit crop

1962



Severe freeze, Dec. 12-13

1964

CES releases new rootstocks resistant to the burrowing nematode

Diaprepes citrus root weevil first reported in Florida, Sept. 25

1965

Hurricane Betsy strikes Southeast Florida Sept. 7, damaging 25-50% of state citrus crop

1966

First UF/IFAS Extension agent assigned to CES; previous citrus agents had been based in Gainesville or at county offices

1967

Orange juice named state beverage

CES study shows that sulfides formed in soil by bacteria are a significant cause of root damage in citrus trees that endure flooding

1969

Biochemistry building dedicated

1970

Florida citrus acreage hits all-time high, 941,000 acres

CES scientists develop chemical thinning agents to reduce number of fruit on trees and increase fruit size

1971

Facility name changed from Citrus Experiment Station to Agricultural Research and Education Center (AREC)

Florida citrus harvest reaches 200 million boxes for the first time

CES publishes comprehensive guide to the use of citrus spray oils

1972

AREC researchers determine that soil fumigation at citrus nurseries kills helpful micro-organisms and leads to stunted trees

1976

Alternaria brown spot management recommendations developed, issued

Citrus blackfly detected in Fort Lauderdale in January, subsequently brought under control with releases of two parasitic wasps

1977

Severe freeze, Jan. 18-20

1981

Severe freeze, Jan. 12-14

Research on microirrigation begins

1982

Severe freeze, Jan. 12-14

Herman Reitz retires as director, March 11

Walter Kender appointed director, Aug. 1

Ben Hill Griffin, Jr. Citrus Hall dedicated, Nov. 18

1983

Laboratory/Administrative Building completed

Severe freeze, Dec. 24-25

1984

Facility name changed from Agricultural Research and Education Center to Citrus Research and Education Center (CREC)

UF/IFAS CREC Timeline

1985

Severe freeze, Jan. 20-22

1986

Water Conserv II project begins delivering reclaimed water for citrus irrigation, in December

Student dormitory constructed

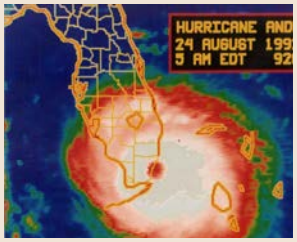
Second known Florida citrus canker outbreak begins in Tampa

1989

Severe freeze, Feb. 24-25

Severe freeze, Dec. 22-26

1992



Hurricane Andrew makes landfall near Homestead, Aug. 24

1993

Citrus leafminer first reported in Florida, in May

1994

Second known Florida citrus canker outbreak declared eradicated

1995

Brown citrus aphid (vector for citrus tristeza virus) first reported in Florida, in November

Beginning of third known Florida citrus canker outbreak

CES issues revised, sustainable fertilizer recommendations

1997

Walt Kender retires as director and Harold Browning named director, in November

1998

Asian citrus psyllid, vector for the pathogen that causes huanglongbing (HLB), first reported in Florida, in June

Florida Automated Weather System (FAWN) launched

2002

Citrus Canker Education Program launched

2004

CREC releases 12 rootstocks that resist or tolerate citrus tristeza virus infections

Hurricane Charley makes landfall in Lee County, Aug. 13

Hurricane Frances makes landfall in Indian River County, Sept. 5

Hurricane Jeanne makes landfall in Martin and St. Lucie counties, Sept. 25

2005

Sweet orange named Florida's official state fruit, May 24

In August, first reports of HLB-infected citrus trees in Florida, in Miami-Dade County

Hurricane Wilma makes landfall in Lee County, Oct. 24

2006

USDA announces plans to halt citrus canker eradication program, in January

2007

Citrus Health Management Areas program launched to help combat HLB

2009

Harold Browning retires as director and Jackie Burns named interim director, early in the year

2010

Citrus black spot first reported in Florida, in March

Sugar Belle® scion cultivar released

2011

Jackie Burns named permanent director, in April

2013

FAST TRACK cultivar release program launches

2014

Michael Rogers named interim director, in November

2015

Michael Rogers named permanent director, in July

2017

Hurricane Irma devastates Florida citrus industry, Sept. 10-11

New student dormitory completed, in October

1917 100 YEARS 2017
UF/IFAS CITRUS
RESEARCH AND EDUCATION CENTER

CREC 100th anniversary celebration, Nov. 28-30

CREC VITAL STATISTICS

UF/IFAS Citrus Research and Education Center

Among the off-campus research facilities operated by the University of Florida Institute of Food and Agricultural Sciences, the Citrus Research and Education Center (CREC) in Lake Alfred is unique. Not only is CREC focused on a single commodity, it is the oldest and largest of UF's 12 statewide Research and Education Centers. Over the years, CREC has expanded its acreage, facilities and personnel roster many times, to keep pace with the Florida citrus industry's growth.

CREC budget FY 2016-17

$18.7 million
funded by state, grant and private sources

The UF/IFAS CREC enterprise includes one main site in Lake Alfred, where facilities and personnel are located, as well as grove sites at the Lake Alfred CREC facility and nine other locations.

Grove sites

571 total grove acres

8 grove sites in Polk County, totaling **341 acres**

1 grove site in Highlands County, totaling **180 acres**

1 grove site in Hillsborough County, totaling **50 acres**

Facilities

219,890 gross square footage of building space

52 buildings

40 laboratories

20 greenhouses

Library

15,000+
volumes of academic citrus literature in the CREC library

People

About **250** employees on-site, including the scientific research staff of the Florida Department of Citrus

24 current faculty members, representing

7 UF/IFAS academic departments

18 emeritus faculty members

32 postdoctoral associates

41 graduate students

Master's and doctoral degrees offered in **8** disciplines

- Agricultural & Biological Engineering
- Entomology & Nematology
- Food & Resource Economics
- Food Science & Human Nutrition
- Horticultural Sciences
- Microbiology & Cell Science
- Plant Pathology
- Soil & Water Sciences

THE CREC MISSION STATEMENT: "CREC discovers and delivers innovative solutions that empower citrus and other agricultural interests to conduct responsible and profitable business. CREC fosters scientific excellence and efficient use of resources."

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