

GENETIC TECHNOLOGIES

The year 2000 saw a tremendous breakthrough in plant science, as researchers completed the first genome sequencing for a plant, the species *Arabidopsis thaliana*, a member of the mustard family. Though genetic mapping and gene function research on plants had been progressing for decades, the completion of the Arabidopsis genome gave encouragement to researchers involved with innumerable genetic studies on other plants.

At the University of Florida, UF/IFAS faculty members have long been at the forefront of genetic research on a broad range of economically and environmentally important plant species, ranging from food crops such as citrus and strawberry, to loblolly pine trees used for lumber and paper production, to invasive plants that must be managed in natural areas, such as the aquatic weed *Hygrophila polysperma*.

Today, genetic research at UF/IFAS has advanced beyond numerous efforts to sequence food-crop genomes. Many projects are under way now to apply advanced genetic knowledge and develop methods for boosting yields, improving plant health and using crops in new ways. Some researchers have even launched successful start-up companies and found ways to apply genetic knowledge obtained from plants in the realm of human health.

NATURAL
RESOURCES



HUMAN
SYSTEMS



AGRICULTURE



Ongoing Research



PLANT GENE EXPRESSION IN SPACE

For centuries, scientists could only hypothesize about how gravity might affect plant growth. But a UF/IFAS research team has been gaining insights by sending plants into space and analyzing how they respond. Team leader Rob Ferl, a UF/IFAS horticultural sciences professor and director of the Interdisciplinary Center for Biotechnology Research, says many of the experiments have yielded a fundamental conclusion — plants have tremendous ability to adapt to novel environmental conditions. By studying patterns of gene activation initiated by exposure to space flight and low gravity, Ferl's team hopes to gain insights on producing plants that are more effective in coping with various Earthly environments, from greenhouses to deserts. The results could help researchers boost crop yields under a broad range of conditions.



PLANT GENOME ANALYSIS

The average plant genome contains 20,000 to 30,000 genes, but the functions performed by at least half of them are unknown. Determining how those genes operate, and inferring why they exist, will be one of the great scientific challenges of the 21st century, says Andrew Hanson, an eminent scholar and professor with the UF/IFAS Department of Horticultural Sciences. To help address this challenge, Hanson is leading a multi-institution team that has launched an online database for plant gene information. Called PlantSEED, it enables scientists to search for information on the genes they're studying and to predict their functions. Hanson's group is using PlantSEED to research the enzymatic pathways involved in B vitamin synthesis in plants, and the role B vitamins play in relieving crop stress damage.



PEANUT NODULES

As with other legumes, peanut plants harbor symbiotic, nitrogen-fixing bacteria known as rhizobia that form nodules on the plants' roots and provide nitrogen for the plant. Jianping Wang, an assistant professor with the UF/IFAS Department of Agronomy, leads a research team investigating the genetic processes that control nodule formation. Wang is investigating how rhizobia enter the roots, identifying peanut genes that control nodule formation, and learning how rhizobia stimulate nodule growth. Studies using mutant peanut plants that do not produce nodules will facilitate the process of identifying genes associated with nodule formation. Wang's ultimate goal is to provide critical knowledge to induce nitrogen fixation in non-legume crops, a process that could dramatically reduce the need for nitrogen fertilizer in agricultural production.

Research with Impact



MAIZE RNA MUTATION

Scientists once believed that the processes of cell differentiation and proliferation were regulated quite differently in animals than in plants. But research advances have uncovered many regulatory similarities, including one that may have implications for human healthcare. Mark Settles, a professor with the UF/IFAS Department of Horticultural Sciences, led a team studying genetic mutations in maize, *Zea mays*, that disrupted RNA splicing — an aspect of cell differentiation — and caused cells to proliferate excessively. In people, similar mutations are responsible for some acute myeloid leukemia cases and certain blood cell growth disorders. Settles' team is now investigating whether similar regulatory mechanisms govern both mutations to influence cell-growth disorders; the team's findings may lead to insights on how some cancers arise.



RAPiD GENOMICS

The past decade has seen incredible advances in genomics, the science of obtaining complete genetic sequences for individual organisms. The resulting knowledge has been applied to improve crops, fight disease and accomplish other goals. At UF/IFAS, Matias Kirst, an associate professor with the School of Forest Resources and Conservation (SFRC), co-founded a company called RAPiD Genomics in 2011 to commercialize innovations developed by the school's Forest Genomics Laboratory. RAPiD Genomics conducts fast, affordable, custom-tailored analyses to reveal the gene sequences controlling traits of interest in target organisms. Kirst formed the company with two former SFRC doctoral students; he reports that the volume of samples analyzed has grown by 50 to 100 percent each year.



SUGARCANE BIOFUEL

Sugarcane accounts for 70 percent of the world's table sugar production and is also globally the most cost-effective feedstock for biofuel. Fredy Altpeter, a professor with the UF/IFAS Department of Agronomy, led a team targeting the genetic improvement of sugarcane and its pre- and post-processing residues for biofuel applications. In one initiative, metabolic engineering increased the oil content of vegetative sugarcane tissues more than 80-fold, making sugarcane residues an attractive feedstock for biodiesel production. Altpeter's team also genetically modified the composition of sugarcane cell walls, improving the efficiency of fuel ethanol production from sugarcane residues by more than 20 percent. Novel precision breeding technologies were also developed for sugarcane to reduce the need for transgenic processes and speed regulatory approval of new varieties.

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