Citrus

Orange juice processing

Florida ranks first in the nation in the production of citrus, producing 68 percent of the nation's oranges and 73 percent of its grapefruit, totaling over $2 billion in cash receipts annually. A significant component of the industry is the production of sweet orange for the juice-processing industry. Approximately 80 percent of Florida's citrus acreage is planted with sweet orange, and nearly 95 percent of the crop is processed into juice. However, there also is a substantial fresh fruit industry based primarily on grapefruit and mandarin hybrid varieties. Nearly half of the grapefruit production is sold as fresh fruit, with the remainder processed into juice. FAES scientists have explored the full range of genetic improvement activities, from the most basic forms of genetic research to the ultimate tests of field performance in the groves of Florida citrus growers. It should be noted that traditional breeding methods are of limited success in citrus due to a unique reproductive trait possessed by many kinds of citrus, such as sweet orange and grapefruit, which results in the production of seedlings virtually identical to the mother plant.

Research and development at the Citrus Research and Education Center (CREC) from the 1960s through the early 1980s, under the direction of A.P. Pieringer, provided a basis for some of the current activities. Of particular value has been a collection of unique breeding parents used by current staff to understand the genetic control of important traits. This information will help develop the new generation of seedless, easy-to-peel fresh fruit varieties essential for the future viability of the Florida fresh fruit industry.

Bill Castle has been working on rootstock and scion variety improvement since 1974. Castle has established an exceptional network of diverse cooperative commercial testing sites for new rootstock candidates in Florida. In the mid-1980s, he was instrumental in the introduction of several new sweet-orange selections from around the world. With cooperation and assistance from a citrus grower in St. Cloud, Orie Lee, Castle evaluated the new introductions and selected a number of superior seedlings that produced fruit with exceptional color and flavor attributes, coupled with early maturity. These new varieties were released in 1999 to the citrus industry, and one of them, **Earlygold**, has been one of the top five varieties since its release with nearly 2 million trees planted.

In 1984, Jude Grosser began his work at the CREC, where he has been instrumental in bringing the power of tissue culture/cell fusion technology to bear on the problems of citrus genetic improvement. He has developed one of the most successful citrus improvement programs in the

Central Florida orange grove

world, exploiting a technique called somatic hybridization (which differs from the classical method of sexual hybridization, or crossbreeding). His program has produced somatic hybrid plants from more than 150 different parental combinations, and several of these are showing great potential as new rootstocks, with good disease resistance, high productivity, and the ability to control tree size for efficient management and harvest.

Fred Gmitter Jr. began his career at the CREC in 1985. He was the first scientist working in the program with training in traditional methods of tree-fruit breeding, citrus tissue culture, and molecular genetics. Together with Grosser and Gloria Moore, he established the first field trials of citrus trees regenerated through tissue culture methods, leading to the selection of the various kinds of somaclonal variants for scion variety improvement. He has focused attention in two directions: (1) genomic studies to clone genes for disease resistance and to develop molecular markers for streamlined selection in rootstock breeding; and (2) the breeding of seedless fresh fruit varieties. He published the first molecular markers for virus and nematode resistance in citrus, which has made possible the selection of resistant rootstocks at a very early age. He has employed several different methods for developing seedless varieties, such as mutation breeding to remove seeds from desirable but seedy varieties such as **Murcott**, and by crossing different types of citrus to create sterile, seedless varieties. Together with the CREC team, he will release a new tangelo variety this year that resembles the popular **Minneola** tangelo, an important variety for the gift-fruit industry; however, the new variety is earlier in maturity, of better quality, and resistant to a serious disease that plagues Minneola.

Together, Grosser and Gmitter have also exploited a phenomenon called somaclonal variation (the slight variations in plant performance found after tissue culture exposure) for scion variety improvement. They are currently evaluating many new sweet orange selections that possess the superior fruit color and quality of the premiere **Valencia** orange, but ripen substantially earlier or later than the standard variety. These new selections are expected to facilitate the shift in Florida orange juice processing from frozen concentrate to the more profitable and tasty NFC (not from concentrate) and to provide improved seedless fresh orange varieties.

The FAES team of citrus scientists has been recognized by the Florida citrus industry as an invaluable resource. In an integrated project funded by the industry (through the Florida Citrus Production Research Advisory Council), the labs are working together to address the most serious threats to the citrus industry. Collaborations with scientists at the USDA-ARS Laboratory in Ft. Pierce, Florida and with progressive and enlightened citrus growers are the cornerstones of the citrus-breeding and variety development program centered at the CREC.