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Carlos Fear - 2022 Wilder Medal Recipient

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Dr. Carlos Fear was presented the American Pomological Society's Wilder Medal, recognizing his "Contributions to *Rubus* Breeding and Genetics" at the Society's annual meeting August 2, 2022 at Chicago IL.

Early Background

Carlos grew up in a farming community in southern Iowa. Descending from family farmers, he developed a love for agriculture at an early age and one of his first responsibilities as a kid was keeping the family garden weed free. His first real job was selling vegetables from the garden, often peddling them around town by bike. During high school summers, he worked for a greenhouse and florist in a nearby town where he honed his interest in horticulture by learning to grow chrysanthemums and gladiolus for the florist business. He graduated from high school in 1971 and entered Iowa State University the following fall, initially to pursue a career in ornamental horticulture but later changing to a Botany and Horticulture double major. College summers were spent working in nurseries (Henry Field Seed & Nursery and Mount Arbor Nurseries) in southwest Iowa where he learned a lot about propagation and nursery production. One summer was spent working for the Iowa Horticulture Society. Near the completion of his B.S. at Iowa State, a hunger for more education led to a pursuit of an M.S. in fruit physiology at the University of Arkansas where he had the luck of being exposed to two inspiring fruit scientists, Roy Rom, and Jim Moore. Dr. Rom taught Carlos about pomology and Dr. Moore was an inspiration to learn more about plant breeding and genetics.

He attained his higher education with a BS from Iowa State University in Botany and Horticulture in 1975, an MS at the University of Arkansas in Horticulture in 1977 and a PhD in Plant Breeding at the University of Minnesota in 1983.

Professional Career

Dr. Fear had a very productive career in fruit breeding and has been one of the most innovative and forward-thinking fruit breeders in the private sector in modern times. He has had phenomenal impact in fruit breeding, particularly in caneberries but also in strawberries, peaches, plums, and apricots. His accomplishments in his thirty-five-year career are simply outstanding. He has developed or co-developed 50 cultivars of fruits. These include 20 red raspberry, eight blackberry, 13 strawberry, four peach, three apricot, and two plum cultivars. These developments have resulted in 50 US plant patents and more than 100 Plant Breeders Rights applications in the world. His most impactful contributions have been during his long career at Driscoll's Inc. where he led various projects in R&D management and cultivar development.

Dr. Fear began his employment at Driscoll's in 1989 when he was hired to direct raspberry and blackberry research and development. He took over a small, local red raspberry breeding effort and expanded it into a large program of worldwide significance. His efforts are most prominent in the development of an array of primocane-fruiting, low-chill, fresh-market cultivars. He initiated the Driscoll's blackberry breeding program in 1991 with a broad germplasm base with a focus on enhancing flavor for fresh-market cultivars, first for California and then for worldwide production. In 2002, he led an effort to diversify the Driscoll's blackberry germplasm to include the

innovative primocane-fruiting germplasm developed at the University of Arkansas, which lead to further major advances in blackberry breeding for Driscoll's.

In his initial Driscoll's appointment, he also established tissue culture propagation facilities and installed clean planting stock procedures to insure new cultivars with superior plants were placed with growers. Dr. Fear also enhanced the Driscoll's caneberry breeding efforts by installing breeding innovations including expanded population dynamics, diversifying the germplasm base, introducing new techniques of sensory and shipping potential evaluations, and implementing molecular methods. His molecular applications included testing of transgenic plants, investigating the early use of DNA fingerprinting of cultivars, and early molecular marker investigations. Finally, he also was responsible for strategic planning, budget management, procurement of intellectual property rights, and new germplasm acquisition at Driscoll's.

Following his 17 years with Driscoll's in California, Dr. Fear began leadership of plant breeding and cultivar development for Driscoll's in East Malling, UK. In this appointment, he was responsible for development of blackberry, blueberry, raspberry, and strawberry cultivars for northern and southern Europe. In this new position, he established office, as well as lab, glasshouse, and field facilities at Driscoll's main research location in the UK. He also initiated Junebearer and everbearer strawberry breeding programs for glasshouse, tunnel, and open-air production in northern and southern Europe. Further, he developed a network of trial sites for soft fruit research in Europe and North Africa. While leading this effort, he liaised with Driscoll's partner breeding programs in North America to import and evaluate soft fruit germplasm. A further expansion of Driscoll's research was his planning, staffing, and budget development at European and Moroccan trial sites.

Dr. Fear's final appointment in his career with Driscoll's was back in California where he was appointed Vice President, Research and Development from 2015 until his retirement in 2019. In this role, he reported to the Sr. VP of R&D and participated on the R&D Leadership Team to review R&D budgets, staffing, and strategy. He was also responsible for cutting-edge technologies including molecular genetics, metabolomics, sensory, and postharvest research groups. He also was involved with evaluation of next-generation breeding approaches including development of molecular markers, gene editing, and genomic selection. To further the Driscoll's mission toward superior flavor and quality, he established a chemistry lab to study the use of fruit metabolomics in breeding for improved flavor as well as establishing a 'Consumer Lab' to integrate activities of R&D with consumer focus. To fully implement the effort in flavor and quality, he started the use of focus groups to bring consumer input into cultivar development. He also organized flavor roundtable discussion groups for each crop to review flavor-related research.

Prior to his employment by Driscoll's in 1989, Dr. Fear began his employment in the private sector as a fruit breeder at Superior Farming, Bakersfield, CA. He directed a large and progressive stone fruit breeding program for proprietary cultivars. In his role, he was responsible for hybridization, selection, new germplasm acquisition, commercial evaluation, and making recommendations for commercial production. Dr. Fear extensively used in vitro techniques (embryo rescue) for development of early season types of stone fruit. His efforts resulted in nine cultivars.

Dr. Fear's initial professional appointment after completing his PhD was as an Assistant Professor and Extension Fruit Specialist at Iowa State University. His three-year appointment included responsibility for small fruit research and administration of extension programs for commercial fruit growers. His efforts involved the development of

a publication series for commercial fruit growers, a foliar analysis program for fruit crops, and small fruit and apple cultivar trials. He also researched strawberry renovation practices, effects of polyethylene bed mulches and evaporative cooling on day-neutral strawberry growth and development, and effects of calcium treatments on raspberry fruit rot resistance and firmness. He compiled a publication record of 28 research and extension publications during his academic appointment.

Greatest Horticultural Impact

As outlined above, Dr. Fear has had a broad and high-impact career in fruit breeding across continents. If one focuses on the largest impact of his efforts, that leads to his red raspberry breeding. Several commercially noteworthy cultivars resulted including 'Holyoke' and 'Isabel', but no fresh-market red raspberry ever developed has had the impact of 'Maravilla'. Simply put, 'Maravilla' thus far is the greatest success ever for red raspberry market impact. Driscoll's Chairman and CEO Miles Reiter remarked that 'Maravilla' made the Driscoll's Brand more than anything else except for the Trademark itself. Mr. Reiter also stated that 'Maravilla' was the cultivar that "checked all the boxes regarding post-harvest quality, fruit size, overall production, and plant architecture for easy harvest." 'Maravilla' was the first fresh-market red raspberry cultivar that made raspberries a worldwide business and has been grown in over 15 countries and sold in a much wider range of countries. 'Maravilla' became 75% of total Spring volume of fresh red raspberries for North America by 2003 and produced 430 million kg of fruit between 2012 and 2020. In 2020 it had sales of $470 million USD. The ease of management aspects of this cultivar has been important also, as it allowed the doubling of picking speed for pickers, allowing them to make much better wages. 'Maravilla' was also the first cultivar to be grown in North America as long-cane plants in substrate.

About The Cover:

Dragon fruit is a tropical fruit native to southern Mexico and Central America, but is grown in Asia, Israel, Mexico, Central America, South America, and the southern U.S. The fruit grows on vine-like, climbing cactus plants, and is also known as pitaya, pitahaya, and strawberry pear. The flowers open only at night. Fruit taste is similar to a combination of kiwi and pear. The fruit is also used as a medicinal herb because it is high in essential nutrients such as vitamins, minerals, complex carbohydrates, dietary fiber, and antioxidants. The plant is one of the most widely distributed members of the *Cactaceae* family and was previously thought to have at least 12 species in the genus *Hylocereus* and one species in the genus *Selenicereus*. In 2011, based on nucleotide sequences from the plastid gene region, all the species of *Hylocereus* were transferred to *Selenicereus.* Three commercially important species include *S. undatus*, which is the most widely cultivated species and has pink skin, white flesh, and black seeds; *S. megalanthus* has yellow skin, white flesh, and black seeds; and *S. costariscensis* has pinkish red skin, dark purple flesh, and black seeds. Photo by Richardo Goenaga.