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LOW-CHILL PEACH AND NECTARINE BREEDING AT THE UNIVERSITY OF FLORIDA

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Abstract. **The low-chill peach breeding program at the University of Florida has evolved since its conception in the early 1950's into a program with worldwide recognition. Germplasm is on test in more than 80, and commercial production in more than 30 countries and territories with subtropical climates. Major events in the breeding program are discussed since the assimilation of the best low chill germplasm from the local varieties, the Hawaiian group from south China, and the seed importation from Okinawa. The use of germplasm from U.S. breeding programs, particularly the USDA program in Georgia, has and continues to supply genes for high fruit quality and early ripening. Other major events are the introduction of the nectarine gene, recognizing the relationship between red autumn leaves and early ripening, development of the fruiting nursery, breeding an adapted rootstock with root-knot nematode resistance and, the introduction of non-melting flesh into modern fresh market fruit.**

A peach testing program was initiated in 1949 and a breeding program in 1952 by Ralph Sharpe because Florida had the climate, land, and market window to produce some of the earliest fruit in the U.S. if varieties were available to produce quality fruit equivalent to market standards. Low-chill varieties available prior to breeding lacked size, color, firmness, flavor, and earliness (Sharpe et al., 1954). These low to mid-chill varieties originated as seedling selections of germplasm from the peento group of South China or as possible hybrids of the peento group with the descendants of peaches introduced as seed by the Spainards through St. Augustine (Floyd, 1920). These now obsolete varieties are represented by 'Jewel' and 'Waldo' that ripen in mid-May in north central Florida. Their early ripening characters and low chill requirements have been a major contribution in making Florida-bred peaches important throughout the subtropics of the world. Most new world Spanish peaches are medium-chill (450 to 600 chill units and would grow in north Florida), but are late ripening (in August during Florida's rainy season), non-melting flesh (processing flesh) genotypes and thus would not be adapted or fit into our market window. No remnants of the late ripening, non-melting flesh Spanish group introduced through St. Augustine are currently known in the north Florida area. It is possible that seed from South China, imported through Charleston, S.C., about 1870, gave rise to some soft flesh genotypes in Florida, but mixtures with the peento group are indistinguishable.

'Jewel', the principal variety for central Florida, and later 'Hawaiian' (germplasm from South China via Hawaii), were hybridized with the best varieties from temperate zone breeding programs, particularly the breeding program at the Southeastern USDA Research Station in Georgia, to incorporate improvements in fruit quality. This station has continued to let us use their most advanced temperate zone selections in our breeding program. 'Southland' was a major contributor in early breeding and much of our early ripening can be traced to the parent 'Springtime'. However, high resistance to bud failure and high fruit set in peach are traced to hybridization with 'Okinawa', a direct seed importation (Sharpe 1957) from that island. The South China race (Honey group) gave rise to some varieties in Florida, but they contributed little to our best modern day varieties and current germplasm.

The nectarine character was introduced into the breeding program in 1956 (Sharpe and Ailcen, 1971), at first from 'Panamint' but later from standard California varieties and selections from New Jersey. As was the case with peaches, high fruit set in flowers was obtained only when Okinawa was crossed with nectarines. The first variety, 'Sunred', gave impetus to the initial Florida industry (Sharpe 1969) and to the breeding of the modern low chill varieties of 'Sundollar', 'Sunraycer', 'Suncoast', and 'Sunmist' (Williamson et al., 1995).

Wayne Sherman joined the fruit breeding team at Gainesville in 1966 and became the principal stonefruit breeder when professor Sharpe retired in 1975. Paul Lyrene joined the fruit breeding team in 1977 and continues to make imput into the stonefruit breeding program.

The discovery by Sherman et al., (1972) that solid or variegated red pigment in autumn leaves was a reliable marker for early ripening genotypes [those with a short fruit development period (FDP)] and that the intensity of red was inversely related to the length of the FDP (Vileila-Morales et al., 1981) was instrumental in pre-selection for early ripening genotypes (<80 day FDP).

The development of a high density fruiting nursery system for peach (Sherman et al., 1973) was necessary because of lack of land free from root-knot nematodes on which to grow new hybrids. A later analysis confirmed that early selection in the nursery system was an effective method to screen for chilling requirement, FDP, and fruit characters such as size, color, shape, and firmness, but not tree shape or for performance such as crop load (Rodriquez-A., et al., 1986), blind nodes, and bud failure. Production of more recent varieties and selections which are far advanced over earlier ones are examples of success in genetic advance using the fruiting nursery (Andersen and Sherman 1994; Sherman et al., 1988). This program is described by Sherman and Rodriquez-A. (1987).

The development of root-knot nematode resistant rootstocks 'Okinawa', 'Nemaguard', 'Nemared' in Florida and the U.S. was a major advance in peach production in sandy soils as found in Florida (Sharpe et al., 1969). This research gave impetus to our rootstock breeding and led to the development of 'Flordaguard' (Sherman et al., 1991) as the former root-knot resistant stocks began to be severely attacked by race 3 of *Meloidogyne incognita* (Sherman et al., 1981). This nematode in now thought to be a new species (A. Nyczepir-pers. communication). 'Flordaguard', a red leaf type, continues to have field resistance to root-knot in Florida.

While the breeding of melting flesh, fresh market peaches and nectarines was having high success in genetic advance-

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ment of large size, high color development cultivars, the per capita consumption of peaches and nectarines in North America was going down because fruit were being harvested before mature enough to have high flavor, in order to extend shelf life. Thus, the use of the non-melting (processing flesh) gene was introduced into our breeding program for fresh market varieties (Sherman et al., 1990). We have used three sources of non-melting flesh; the medium chill feral peaches of Spanish origin found in Zacatecas, Mexico; the low chill peaches from the breeding program in southern Brazil; and the non melting gene in the short FDP varieties in the U.S. like 'Springcrest'. Long FDP, high chilling, and absence of aroma and red skin pigments were characters associated with the non melting gene in moving it into our adapted germplasm. We have been able to obtain advanced selections without the off flavor found in most overripe canning varieties. Rubberness of flesh has also been modified to be less tough, and more recently we have obtained nonmelting genotypes with freestone character (Beckman and Sherman, 1996). We now have selections in advanced variety tests and 'UFGold' was recently released as representing this new generation of firm fruit for the fresh market.

Another obstacle in breeding non melting flesh for the fresh market has been the occurrence of a high percentage of blind nodes in the genetic background of these hybrids (Richards et al., 1994). However, response to selection against blind nodes has been good and we now have selections in variety tests with all the desirable characteristics we deem necessary for successful commercial production. To date, most of our attention in short FDP, low chill, non melting flesh has been with yellow flesh peaches. We have also obtained, from the Mexican cling population, genotypes with deep yellow or light orange skin and flesh. A few non melting flesh nectarines have been obtained and we now have the non melting flesh in breeding individuals with white flesh and peento shape. Additional refinements for size and filling in ripening windows will be necessary, but these will come with conventional breeding. We believe these non melting flesh varieties will provide a new generation of peaches and nectarines combining full tree ripe flavor and long shelf life.

Funding reductions in the 1980's resulted in the availability of the University of Florida fruit breeding germplasm on a paying basis to partially support our breeding program. The first restriction from free grower distribution of our advanced germplasm came in 1988 as a result of a contract with an overseas grower group for exclusive testing in a restricted area. This was the beginning of similar contracts for various subtropical testing locations throughout the world. Revenues from these testing programs are being used to help cover the costs of the breeding program, and are being supplemented with royalties from patenting of our variety releases with exclusive propagation licenses to nurserymen in various countries. These policies are likely to restrict the exchange of advanced genotypes among plant breeders who are competing for the same funding group or a competing group. This is especially true where several generations of breeding have been made to get a gene(s) into a desirable genetic background and a competing breeder could "catch up" in one generation of hybridizing or open-pollination.

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