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USDA Stone Fruit Breeding in the Southeastern United States

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Abstract

The Southeast produces about one-third of the freestone peaches in the US. The USDA breeding program formerly at Fort Valley and now at Byron, GA has been the major source of varieties for this industry. The program began in 1937, and has released 30 peach and 3 nectarine varieties, plus 2 peach rootstocks. These varieties have been the mainstay of southeastern peach production. As state breeding programs have been curtailed, the USDA program will be increasingly important in providing the industry with competitive varieties.

Introduction

Peach production in the United States is concentrated in three areas. California grows a third of the freestone peaches and nearly all of the nectarines and canning clingstones peaches. California also grows nearly all the Japanese-type shippyng plums and apricots. The southeastern states (mainly Georgia and South Carolina) grow another third of the freestone peaches. The northern states of New Jersey, Pennsylvania and Michigan grow most of the rest of the peaches. Few peach varieties are adapted to more than one region of our country, although some varieties are grown in both the highlands in the southeast as well as in the northeast. California varieties tend to lack cold hardiness and disease resistance in the east, plus the color may be too dark. Northern varieties tend to develop poor shape and retain green ground color when moved south. Southern varieties lack red color when moved west and lack hardiness when moved north. For these reasons, there have been peach breeding programs in many states, but most are now defunct. The concentration of plums, apricots and nectarines in California relates to similar climate and disease restraints found in other regions. USDA currently maintains 3 longterm stone fruit breeding programs: Fresno, California; Kearneysville, WV; and Byron, Georgia. This paper describes the impact of the Byron program.

Acreage in Georgia has been stable for the last 30 years but the number of growers has decreased as production has concentrated in the central part of the state. In recent years Georgia has had about 8000 ha of peach trees, with annual production of about 75000 MT. Most of the peach trees in the state are now located within 50 km of our research station, except for the small low-chilling industry in south Georgia. The local industry is in the hands of 6 large, third-generation growers each with a packing house. They control about 1.5 million trees and work closely together. The important peach varieties have changed over the last 30 years (Table 1). Only a few of the varieties popular in 1965 are still grown. 'Redglobe' (from USDA-Beltsville) is the only variety from that time that is still being planted. 'Dixiland' and 'Coronet' are still used, but are not being replanted. Of the other varieties listed as important in 1994, 'Junegold' and 'Surecrop' are not being replanted much. Most of the new peach varieties for our area are coming from government breeding programs in Louisiana and USDA-Byron. Few of the new patented peaches from private breeders in California are grown in the southeast. As of a few years ago, only about one-third of the trees in Georgia were USDA-Byron varieties, although over 50% of the trees planted in the last 3 years are.

Peach acreage in South Carolina has declined in the last 20 years, particularly

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Table 1. Variety evolution in Georgia.

Days	1994	1984	1976	1965
	Empress	**Empress**		
	Springcrest	Springcrest	Springcrest	
–50	Flordaking	**Flordaking**		
		Bicentennial		
	Sunbrite	**Sunbrite**		
	Goldprince	Candor		Hiland
45	Junegold	**Junegold**	**Junegold**	**Cardinal**
	Summerprince	Dixired	Dixired	Dixired
40	Surecrop	Surecrop	**Redcap**	**Redcap**
		Maygold	**Maygold**	**Maygold**
	Juneprince			
35	GaLa			
	Coronet	**Coronet**	**Coronet**	**Coronet**
30				
	Harvester	**Harvester**	**Harvester**	
25	Sunland	Sunland		
	Cary Mac	Cary Mac	Keystone	Keystone
20		Topaz	**Suwanee**	Suwanee
			Southland	**Southland**
15	**Redglobe**	**Redglobe**	**Redglobe**	Redglobe
10	Summergold	Loring	Loring	Loring
5	Cresthaven			
	Sunprince	Sunprince		
	Dixiland	Dixiland	Dixiland	Dixiland
		Blake	Blake	Blake
		Redskin	Redskin	Redskin
—0—			Elberta	Elberta
5			Rio Oso Gem	Rio Oso Gem
10				
	O'Henry			
+15	Flameprince			

Bold indicates most important varieties.

in the northern parts of the state, and may not be much higher than that of Georgia by now. Production has been concentrated in the Ridge area, which has conditions similar to that of central Georgia. Production is mostly in small-scale operations in the other southeastern states of North Carolina, Louisiana, Mississippi and Alabama. Variety turnover has been slower in South Carolina and Alabama, with USDA peaches making up about 20% of the population. Although recent figures are unavailable, trends suggest the proportion is increasing, particularly in the medium-high chill areas.

Peach growers need a sequence of varieties ripening from 60 days before to 30 days after Elberta (mid-July in Byron). The variety must be consistently productive or it will not be grown. The next major criteria are size, firmness and red blush. Fruit less than 7 cm in diameter and 70% red are no longer profitable in our market. Fruit coming from California is consistent in appearance all season long—big and red.

Nectarines have similar requirements except that attractive skin finish and improved tolerance to rain cracking are also needed. It is difficult to grow attractive nectarines in our climate. It is not likely there will be a large shipping industry anytime soon because of the risk to the grower of crop failure, and because he must have a season-long supply in order to break into the market. However, nectarine development for local use continues with the goal of attractive color combined with adaptability.

The consumer has little choice in our market system, because the fruit is bought from the farmer by buyers from the large grocery store chains. Most stores only carry one or two grades of peaches and one nectarine. Eating quality is generally fair to poor, depending on the season and variety. As a result peach consumption is decreasing. The eating quality is more dependent on the growing conditions and time of picking than on the variety. Breeders have made much progress in developing more attractive peaches and nectarines, with much red color. Progress towards better taste is more difficult. We are also developing some types of novelty fruit with different shapes, flesh color and skin color. If these can be combined with good taste, they can be marketed as a specialty product.

History — Peach and Nectarine Breeding

USDA stone fruit breeding in Georgia began in 1937 at the Horticultural Fruit Laboratory in Fort Valley, in the center of the main peach production area (3). John Weinberger was the peach breeder from 1937-1954, when he transferred to Fresno, California to begin the peach breeding there. Weinberger published some important papers about chilling requirements of peach varieties (7) in addition to naming several important peach varieties. Weinberger retired from USDA in 1973 but continued breeding peaches for a large private farm operation, SunWorld (then Superior Farming). He retired a second time in 1988 and unfortunately, died last year.

V. E. Prince continued the breeding in 1954. In 1964, the program was moved 20 miles east from Fort Valley to the newly opened Southeastern Fruit and Tree Nut Research Laboratory in Byron. Prince also developed many important peaches, in particular Springcrest(in cooperation with Weinberger in California). He also clarified some of the aspects of Peach Tree Short Life relating to winter injury and time of pruning (5, 6). Together Prince and Weinberger released 21 peaches, 1 nectarine and 1 rootstock. Only a few are still being planted. Prince retired in 1980. In poor health for many years, he died in 1984. To honor his efforts in establishing our research station at Byron, and to provide a "brand" name for growers, all yellow-fleshed peaches named since 1980 have used "-prince" as part of the name.

When Weinberger began breeding in Georgia, most commercial production was of high-chilling, white-fleshed varieties, with the exception of 'Elberta.' His releases changed the industry to yellow-

fleshed peaches, which were firmer and showed fewer bruises. These varieties provided redder, firmer peaches that were better suited to the climate of central Georgia, and in the case of 'Cardinal,' increased the earliness by about 2 weeks. In 1961 when Georgia was the largest eastern peach producing state, eight of the top ten peaches were Fort Valley releases. Similarly, with 'Springcrest' and 'Springold,' Prince again expanded the season 2 weeks earlier. By 1976, nine of the top twenty varieties were Byron-Fort Valley peaches. Springcrest, released primarily for use in California, became the most widely grown peach since Redhaven. It and its mutations (for example 'Maycrest' and 'Raycrest,' along with 'Queencrest,' a 'Maycrest' mutation) and progeny ('Crown Princess,' 'Crimson Lady,' 'Ambercrest') have dominated the early production there for two decades (2). It has also been important in Europe and South America. The maternal parent of 'Springcrest' has been an excellent progenitor. FV89-14 was also the parent of 'Springold,' 'Camden,' and 'Starlite' from Byron; parent of 'Fayette' and 'Flavorcrest' from Fresno; and grandparent of 'Flamecrest' and 'Goldcrest' from Fresno.

In the 60 years of peach breeding over 120,000 seedlings have grown, resulting in the release of 34 varieties including 2 rootstocks. Nectarine breeding has continued about 25 years, producing about 10,000 seedlings and 3 varieties.

A recent joint project between USDA (mostly T. G. Beckman), University of Georgia (G. Krewer) and University of Florida (W. B. Sherman) has been developing moderate chill (500-700 hour) varieties for north Florida-south Georgia. The current approach is to select non-melting clings that are early-ripening (1). Releases from this project are forthcoming.

Peach and Nectarine Varieties

Dixigold. *Hiley op.* Released by pathologist L.M. Hutchins. Never important. 1937.

Dixigem. *(Admiral Dewey x St. John) x South Haven.* Important substitute for 'Redhaven' in areas of southern U.S. where 'Redhaven' not adapted; replaced by 'Coronet.' 1944.

Dixired. *Halehaven self.* Still popular in higher chilling areas of Georgia and South Carolina; important early variety in northern and midwestern U.S. and France; firm and well-colored but erratic set in low-chill areas. 1945.

Southland. *Halehaven self.* Standard for 20 years. Replaced by 'Redglobe' which was firmer and more reliable. 1946.

Cardinal. *Halehaven self.* Once important in southeast U.S. and France but replaced by newer varieties that were firmer. 1951.

Hiland. *Southland x (Hiley x Halehaven).* Very productive but too soft. Replaced by 'Sunbrite,' which was firmer and much more attractive. 1952.

Redcap. *Southland x Dixired.* Still grown in Georgia and South Carolina but not being replanted. Soft on tip some years. Button fruit a problem in some seasons. 1952.

Coronet. *Halehaven self x Dixigem.* Widely grown in Georgia and South Carolina but limited range of adaptability. Erratic cropper in some areas. Being replaced by 'Juneprince' and 'GaLa.' 1953.

Maygold. *Sunhigh x Southland.* Used mainly in south Georgia until replaced by 'Junegold.' Not firm enough, especially on the tip. 1953.

Keystone. *Newday x Southland.* Inadequately tested before release. Initially widely planted due to the season, but not replanted because of erratic cropping. 1954.

Suwanee. *J. H. Hale x (Hiley x Halehaven).* One of the founding varieties for the peach industry in south Georgia and north Florida. Little grown now due to lack of firmness and attractiveness. 1962.

Dixiland. *Halehaven self x Dixigem.* Very productive. Used to be processed as well. Lack of red color has caused it to go out of favor although a few orchards remain. 1962.

Sentinel. *Halehaven self x Dixigem.* Very high bacterial spot resistance Used in Texas some but not good enough for commercial use. Crops well but lacks red and has green ground color. 1966.

Springold. *FV89-14 x Springtime.* Grown on a small scale in Georgia but very small. Split pits a problem some years. Grown as a prelude to Springcrest. 1966.

Springcrest. *FV89-14 x Springtime.* It and its many mutations are widely grown in many countries. Good red color and firm, with round shape. Often shows blind wood on new twigs. 1969.

Summergold. *[(J. H. Hale x Valiant) op] x Redglobe.* Originally released for use in processing. In recent years production has increased because it ripens at a good time. 1970.

Camden. *FV89-14 x Springtime.* Joint release with Clemson. One of the earliest commercially grown peaches in Georgia and South Carolina, but small and splits badly some years. 1972.

Springbrite. *(Sunhigh x Southland) x Springtime.* Not much grown due to small size. Very attractive color. 1972.

Starlite. *FV89-14 x Springtime.* Excellent quality for the season. Earliest white peach for the south. Not used for shipping but grown for local markets.. Once popular in Europe. 1980.

Durbin. *NJN43 op.* Nectarine well adapted to humid southeastern climate. Has greenish ground color, giving skin a purplish cast. Less prone to crack and rot than California nectarines. 1980.

Sunland. *FV323-12 x Dixiland x Keystone).* Same season as 'Harvester' but not superior. Moderately widely planted. 1980.

Sunprince. *Redglobe x (Dixiland x FV240-J).* Very large and attractive, but lacks enough red color for current market. Replaced 'Blake' and 'Redskin' in Georgia. 1981.

Juneprince. *[(Sunhigh x Southland) x Redcap] x Junegold.* A very attractive peach with good red color and short fuzz. Tends to bloom ahead of most 650 hour varieties, making it harder to crop except on better sites. Replaced 'Coronet' in much of the Southeastern U.S. 1985.

Fireprince. *[(Halberta x Fireglow) x Redglobe] x (Sunhigh x Southland)* op. An attractive peach released to fill the gap between 'Harvester' and 'Redglobe.' Not widely planted after initial release, but production slowly increasing. 1985.

Roseprincess. *Redking* F_3. White-fleshed parent probably a white nectarine from Virginia Tech program. A large nectarine with a lovely rose blush. Very good quality but somewhat tart or acidic. Firmer than older white varieties. Used for local markets. 1989.

Goldprince. *Loring x [Fairhaven x FV89-14) x (FV89-14 x Duke of Georgia)] FV89-14=(Hiley x Fireglow) x Fireglow.* Replacing Junegold, which has been difficult to market in recent years due to poor shape and color, and bad split pits. Smaller but has better color, firmness and shape. 1989.

Scarletpearl. *(Biscoe x Redgold)* F_2. A very pretty white-fleshed peach. Mostly red skin and medium firm flesh. Quality varies from year to year. Used for roadside markets. 1989.

GaLa. *Harvester op.* Released for areas where 'Juneprince' blooms too early. More ground color than 'Juneprince.' Reliable cropper. Increasing in popularity. Joint release with Louisiana AES. 1992.

Summerprince. *(Summerset x [(J. H. Hale x Valiant) op x Redglobe] x Merrill Fiesta)* F_2. Released to replace 'Redcap' and 'Dixired,' to which it is intermediate in chilling. Very round and nearly solid red. Sets heavily and blooms late so must be thinned early and hard in order to size. 1992.

Flameprince. *(Summerset x [(J. H. Hale x Valiant) op x Redglobe] x Merrill Fiesta)* F_2. Released as an alternative to 'O'Henry.' More resistant to bacterial spot. Not solid red like 'O'Henry' but has an attractive golden ground color. Hangs well on the tree. Less prone to premature fruit drop. 1993.

Sunsplash. *Sunlite x Armking.* A joint release from Univ. Georgia and Florida and USDA. Ripens after 'Flordaking' in south Georgia. Released as an attractive nectarine in 'Sungem' season. 1993.

Forestero. *[(Sunhigh x Southland) x Coronet] x Junegold.* Released jointly with INTA for use in Argentina. Ripens between 'Flavorcrest' and 'Redglobe' for the Christmas market. 1993.

Rubyprince. *Fireprince x (Redgold x Durbin).* Ripens with 'Junegold.' Extensive red blush. Very firm. About 800 chill hours. 1997.

Southern Pearl. *Roseprincess op.* Large, white-flesh peach with nice red blush. 'Harvester' season. About 650 chill hours. 1997.

Blazeprince. *O'Henry* F_2. Ripens between 'Harvester' and 'Redglobe.' Very attractive. Mostly red with firm flesh. Sizes well. Bacterial spot reaction susceptible. 1997.

Juneprincess. *Fantasia* F_2. Bright colored nectarine ripening in mid-season. Seems to hold up well in rainy weather. 1997.

Plums — History and Current Goals

V. E. Prince began testing plums in 1958 and started making crosses in 1964 after moving to Byron, Georgia. Much of the early seed for evaluating came from J. H. Weinberger in Fresno, who was also breeding plums at that time. This California plum germplasm was crossed with southern varieties such as 'Morris,' 'Methley,' 'Bruce' and the native wild plum. Unfortunately the large attractive California plums would not survive in the humid climate of Georgia. In 1972 J. M. Thompson took over the plum breeding. Before he retired in 1986, Thompson released 4 plums — 'Robusto'; 'Segundo,' 'Byrongold' and 'Explorer' — plus BY69-1637P plumcot. Two more plums, 'Rubysweet' and 'Black Ruby,' have been released since then. Sadly, Jim Thompson also died recently (July 1997).

Current goals in both plum and apricot breeding are to combine good quality, large, firm fruit with consistent production on a healthy long-lived tree. Resistance is needed to *Pseudomonas syringae* (bacterial canker), *Xanthomonas Campestris pv pruni* (bacterial leafspot and twig canker) and *Xyella fastidiosa* (plum leaf scald). Most of our selections are highly resistant to the first two but only tolerant of the last, which is the disease that finally kills them. Combined with a disease-resistant tree we need fruit that is large, firm and of good flavor and texture. Late blooming is needed to ensure a crop every year. Although we have a few good plums with all these characteristics, we do not yet have good ones for the entire season, especially the extremes. As new improved selections are made, many of the older selections once thought to be fairly good are seen to be sub-standard by the latest standards.

Since 1964 we have grown over 45,000 plum seedlings and named 6 varieties, or one variety per 7500 seedlings. This ratio is higher for plums than peaches because a greater percentage of plum seedlings regress back to a weak tree or wild-type poor fruit quality.

Apricot breeding has been a minor effort since 1964. Apricot seedlings are easy to grow but they don't live long and rarely fruit well. The desirability of locally adapted apricots drives the program. Only about 10,000 seedlings have been grown to date. It is difficult to make progress in breeding when the trees die young and rarely fruit. As Thompson put it, "We have not increased longevity, but we've lost size." Currently a few selections look promising as backyard varieties, but most of the seedlings have been a complete failure.

Plum Varieties

Robusto. *BY4-1537 (=Queen Ann x Barstow) x BY7-335 (=Ozark Premier x P. angustifolia).* Very vigorous tree. Eaten green like 'Bruce.' Quality is fair when ripe but fruit is too soft and juicy for shipping. 1980.

Explorer. *Queen Ann x Santa Rosa.* Attractive black plum but has not been a reliable cropper most years. Not grown commercially. 1980.

Segundo. *BY4-1236 (=Queen Ann x Santa Rosa) x BY7-335).* Similar to 'Robusto' — a "green" plum eaten firm. Ripe quality mild and watery. Very big tree. 1984.

Byrongold. *BY68-87 op (=Gaviota op x BY7-335).* Vigorous tree with golden fruit. Good eating quality if fully ripe. Mixed consumer acceptance for yellow plums. 1985.

Rubysweet. *Mariposa x Methley.* Bronze skin color is less attractive but eating quality is excellent. Locally popular in southeast U.S. 1989.

Black Ruby. *BY4-95 op (=Queen Ann x Santa Rosa).* Large, firm fruit on healthy upright tree. Slightly sour skin. New release. 1994.

Rootstock Breeding

Weinberger began the process of screening germplasm for rootstocks, especially focusing on resistance to root-knot nematode (*Meloidogyne sp*). As a result 'Nemaguard' was released in 1959. More recent work focused on tolerance to Peach Tree Short Life (primarily caused by the ring nematode *Criconemella xenoplax*) and culminated in the release (cooperatively with Clemson University) of 'Guardian®.' T. G. Beckman is continuing the search for resistance to peach tree short life is using our large collection of plum germplasm to find sources of resistance to *Armillaria* root rot and sources of dwarfing for peach.

Rootstocks

Nemaguard. Seed purchased as "P. davidiana" but resembles pure peach. Widely used in California as a root-knot-resistant rootstock. Not used much in the southeastern U.S. due to short life on replant sites. Joint release with USDA-Fresno. 1959.

Guardian ® (BY520-9). *(S-37 op x Nemaguard) F_4.* Rootstock for peach that is root-knot nematode resistant and provides much longer tree life on replant sites in southeastern U.S. (4) Released for further testing as a bulk seed line from a group of selected parents. Plant Variety Protection applied for, Replacing all other stocks in the South, as seed supplies increase. Annual demand near 1 million seed. 1993.

Conclusion

It is likely that over half the new trees being planted in Georgia and South Carolina are USDA releases. This is not surprising considering that stone fruit breeding programs in~most southeastern states are either closed, or have de-emphasized variety breeding. In the 1990s, there have been as many peach releases from USDA as from all other southeastern programs combined (LA, TX, SC, NC), and none from the state programs since 1992. The USDA program at Byron, including peaches, nectarines, plums, apricots, low-chill peaches, and rootstocks, is the largest stone fruit breeding program in the eastern United States. It is likely to have increasing importance to the Southeastern fruit industries.

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