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## Development and Commercialization of Apricot of Central Asian Origin

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### Abstract

Apricot production in the United States has declined over the past several decades. Changes in consumer preference from canned to fresh fruit consumption, and consumer dissatisfaction with "supermarket apricots" are possible reasons for this decline. Consumers desire higher quality cultivars than currently available. Central Asia is a center of origin for apricot (*Prunus armeniaca* L) and, recognizing this unique source of diversity, several breeding programs in the US have incorporated Central Asian germplasm in their apricot breeding strategies. In the mid 1990's I collected a wide diversity of apricot seeds over a very wide geographical range in Central Asia. This formed the basis of our selection and breeding program. Characterization and market testing from the diversity of this collection has led to commercial selections. High soluble solids (21-30° Brix) and complex flavors characterize our selections. Field trials of leading selections are underway worldwide. Commercialization efforts are beginning in California.

Apricot production in California has a rich history. Spanish explorers and the California Spanish Mission Fathers are credited in bringing apricots via seed to the New World. By 1792 major crops of apricots were reported in an area south of San Francisco. Following the California gold rush, and American occupation, the best French and English cultivars were introduced. In 1899, 40,000 acres (16,187 ha) were in production (3). By the mid to late 1800's, fresh, canned, and dried fruit were shipped to the United States East Coast, and also exported (3, 16). In the 1920's and 1930's, production peaked at 83,000 acres (33,589 ha) (4). Apricots were grown in a wide range of climatic zones, i.e., Southern California, the Central Valley, and especially the central Coastal Valleys.

In the 1800's, introduced European cultivars included: 'Large Early', 'Early Golden', 'Royal', 'Blenheim', 'Hemskirke', 'Peach', and 'Moorpark'. Cultivars also originated from selections of Californian seedling made by growers ('Newcastle', 'Hinds', etc.) beginning the enviable adaptation process (16). By the 1920-30's the 'Blenheim' cultivar produced 75% of production, while other cultivars included 'Hemskirk', 'Peach',

and 'Moorpark' (3). By 1950, 'Blenheim' accounted for 82% of production, with 'Tilton' being the other major cultivar (14). These two cultivars reflected the utilization of product: dried and canned. Only a small percentage of the crop was consumed fresh. In the 1970's the 'Patterson' cultivar was introduced and became the dominant cultivar for the canning industry, being grown primarily in the San Joaquin Valley. Coastal valleys (i.e., Santa Clara) experienced rapid urbanization, reducing 'Blenheim' ('Royal') production to very low levels.

Two major trends, which began in the 1970's, have caused a large decline in apricot production in California. Importation of Turkish dried apricots at prices under California production costs, coupled with the decline of the canning industries, has caused a rapid loss of apricot acreage. By 1998 the production area had dropped to 20,000 acres (8,094 ha), and by 2010 to 10,500 acres (4,249 ha). In 2006, the product utilization was: processed 72%, dried 8%, and fresh 20% (2). The trend to fresh market utilization has prompted interest in improved cultivars. Public and private breeding programs responded with the release of many new cultivars ('Apache',

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‘Poppy’, ‘Castlebright’, ‘Earlicot’, ‘Lorna’, ‘Robada’, ‘Katy’, ‘Helena’, ‘Tri Gem’, ‘Goldbar’, etc). Most significantly, some programs are breeding with introduced Central Asian germplasm (6, 9, 10, 11).

Cultivar development for fresh market consumption in particular, needs to focus on sweetness and flavor, in addition to agronomic traits. Consumers complain about hard (unripe), un-sweet, un-flavorful apricots in the markets, and desire sweet, ripe fruit (13).

Of the three recognized apricot “centers of origin” (Chinese Center, Inner-Asiatic Center, and Asia Minor Center) the Inter-Asiatic or Central Asian is considered the most diverse. The countries of Afghanistan, Tajikistan, Uzbekistan, Kyrgyzstan, Pakistan, Kazakhstan, and North-west China (Xingjian) comprise the approximate boundaries to apricot distribution. These groups have been further defined into the four eco-geographical groups: Central Asian, Irano-Caucasian, European, and Dzhungar-Zailij (8). The lack of diversity within the European group is leading apricot breeders to utilize material from the Central Asian group. While there is recognition of need to utilize diverse germplasm, adaptation of apricot cultivars to new areas is considered to be problematic (12, 15).

Beginning in the mid 1990’s, I collected seed in Central Asia from a very large geographical range under USDA permit and post-entry quarantine. After appropriate testing and quarantine release, trees were budded on peach rootstock and field planted in 2001. Data were collected beginning in 2003. The traits are generalized under the following categories from 32 seed families.

#### Flesh and skin color

There is a wide range of flesh color: green, white, cream, yellow, light orange, and dark orange. Skin color ranged from green, white, cream, yellow, and orange. Red over-blush is present on a significant percentage of the population.

#### Skin character

The degree of pubescence falls within

the range of pubescence to glabrous skin. There is a gradient to the degree of pubescence. A small percentage (<1%) of the population exhibited the degree of pubescence of California cultivars. The majority of the population was classified as “smooth,” with slight pubescence. The glabrous trait was evident in <10% of the population. Skin cracking is evident under rainy conditions, varying by family and selection.

#### $^{\circ}$ Brix

A significant percentage of the population has sugar (TSS) concentration, as measured in  $^{\circ}$ Brix, above California cultivar levels. Most of the population measures 17 to 19  $^{\circ}$ Brix. A segment of the population have Brix levels of 22 - >30 $^{\circ}$ . There is a cost of high  $^{\circ}$ Brix, in that the fruit skin often shows “sugar spots” at full maturity. These spots are cosmetic (light brown patch), and may be related to fruit drying – beginning on the tree at full ripeness and possibly related to the fruit attachment trait. Flavors are more intense where fruit have “sugar spots.”

#### Complex flavors

There is a wide array of flavors. Most fruit are aromatic, ranging from mild to strong. Flavors range from plum-like to tropical undertones to intense apricot. Acids range from very low to very high, both in the skin and flesh. Particular combinations with high  $^{\circ}$ Brix are quite interesting. Some seed families showed objectionable flavors.

#### Size

On the whole, fruit sizes trend towards smaller than current California apricot cultivars. Size ranges: mini-fruit (<15 g), small (+/-30 g), medium (+/-50 g), large (+/-70 g), very large (>95 g). Most fall into the small to medium sizes. Seed families were usually uniform in respective fruit size.

#### Fruit shape

A full range of fruit shapes is found: round, round/flat, elliptic, ovate, triangular, and oblong.

#### Fruit attachment

The population has shown an almost uniform trait of strong fruit attachment, with variance between and within seed families. Fruit remains on the tree to full ripeness, even drying on the tree with a significant part of the population.

#### Non-melting flesh

While almost the entire population has melting flesh type fruit, a rare and unusual trait has been found, showing non-melting or crisp flesh (remaining post-harvest) with very high °Brix.

#### Fertility

Almost the entire population is self-infertile. We have identified only one selection to date that is self-compatible.

#### Bloom date / harvest date

In Modesto (Central California), bloom dates range from late February through March into early April. Thus we see both early and late blooming characteristics. Some families show extended bloom periods, probably related to higher chilling requirements than achieved in Central California. Harvest is between 95 and 105 days after full bloom, from late May to early June into late July.

#### Productivity

A wide range of productivity has been revealed, not only between seed families, but also within. There is heavy to good production every year on some seedlings, while many bear modest to light to very-light crops consistently. Chilling requirement and/or pollination may each contribute to productivity.

#### Growth and bearing habit

A full range of growth habits is found: upright, spreading, drooping, and weeping. Bearing habits include: primarily on spurs, but also on spurs and one-year-old wood in some families.

#### Kernel taste

All selections are found with sweet kernels.

Very early consumer feedback for cultivar

selection is required because of the unique and unfamiliar traits exhibited in the genetic material that is being assessed in the trial planting. As individual trees ripened, fruit was packaged in containers of eight or twelve fruits (depending on fruit size) weighing approximately one pound (454 g). Fruit (comprising 4 to 5 selections from individual trees) was taken weekly throughout the season to San Francisco to the CUESA Ferry Building Farmers' Market (5). This is a premium market. Fruit was sliced for sampling, and available for sale. Thus consumers "voted" for their preferences by their purchases. Fruit was premium priced at US\$5.00 per box. Invaluable feedback was obtained both from consumer oral responses and from purchase decisions.

After characterizing traits and consumer feedback, five cultivars were selected for commercial trial. In 2006, eight acres (3.2 ha) were planted in Waterford, CA, and the first commercial sales to consumers began in June 2009. The five selected cultivars exhibited a wide range of traits, but all showed soluble solids concentrations from 21 to 30 °Brix. Their ripening dates covered the month of June. The names of the cultivars in ripening sequence were: 'Honey', 'Anya', 'Yuliya', 'Eleni', and 'Misha'. In 2009 fourteen more acres (5.7 ha) were planted in Modesto, CA. From the commercial experience of the eight acres over four years, we have chosen two cultivars for further planting, 'Anya' and 'Yuliya'. These cultivars have demonstrated market acceptance, production and yield traits that are acceptable for commercial production.

'Anya' ripens in Modesto 7-18 June. Its shape is round; ground color is yellow with no blush; orange flesh; weighing 37-56 g; firm at full maturity/ripe; 26-30 °Brix; self-fertile; strong fruit attachment; and excellent consumer acceptance. 'Yuliya' ripens in Modesto 16-27 June. Its shape is elliptic; ground color is yellow with some red blush; orange flesh; weighting 60-75 g; firm at full maturity/ripe; 24-27 °Brix; non-self compatible ('Anya' pollinates); good

fruit attachment; and excellent consumer acceptance.

All fruit is marketed under the CandyCot® trademark and brand. Cultivars are chosen which meet a particular high level of sweetness and flavor at maturity. There are currently 100 acres (40 ha) planted in California, but these are not yet in production. Fruit is grown under contract by a few growers, and marketed and sold by CandyCot LLC. Intellectual property is protected under US Trade Secret law (7). Commercial cultivars are genetically fingerprinted for identification and protection purposes (1).

Breeding by controlled crosses is being carried out within the population, to provide additional cultivars under the CandyCot® brand. The germplasm base is sufficiently broad to breed for many novel traits.

Because commercialization of CandyCot® cultivars is in its infancy, much is unknown. Challenges include: fertility and pollination; adaptation and chilling requirement; optimal cultural practices such as pruning, nutrition, and crop protection; and post-harvest handling and packaging. It is exciting, however, to introduce to the US market apricots which exhibit consumer satisfaction and desire.

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