The Schroeder Institute in Uzbekistan: Breeding and Germplasm Collections

Mirmahsud M. Mirzaev and Uri M. Djayavcynce
Richard R. Schroeder Uzbek Research Institute of Fruit Growing, Viticulture, and Wine Production, 700000 Tashkent, Glavpochta, ab #16, Republic of Uzbekistan

David E. Zaurov, Joseph C. Goffreda, Thomas J. Orton, Edward G. Remmers, and C. Reed Funk
Department of Plant Biology and Pathology, Cook College, Rutgers University, New Brunswick, NJ 08901-8520

Additional index words. germplasm, apples, walnuts, peach, grapes, plums, almonds, apricots, pistachios, breeding

Central Asia was largely isolated from the western world from the early 1800s until 1991, when the former Soviet Union was dissolved. During this time, many research institutions were established to work on economically important crop species and to amass large and unique germplasm collections, including the Uzbek Scientific Research Institute of Plant Industry (former branch of VIR) and Uzbek Scientific Research Institute of Cotton Breeding and Seed Production.

The Turkestan Agricultural Experiment Station (TAES) was established in 1898 in Tashkent Province, Republic of Uzbekistan (Fig. 1). Academican Richard R. Schroeder (Fig. 2) served as the director of TAES from 1902 to 1944. Initially, TAES focused on tree fruits; grapes (Vitis vinifera L.); various vegetables; fiber crops, such as cotton (Gossypium hirsutum L. and G. barbadense L.), kenaf (Hibiscus cannabinus L.), and hemp (Cannabis sativa L.). rice (Oryza sativa L.), cereal crops, and forage crops. Later, separate research institutes were established to focus on individual crops and initiate specific breeding programs. TAES was the first institute in Central Asia established for studies of genetics/breeding and the cultural management of fruits, grapes, and nuts.

Schroeder developed improved cultivars of cotton, rice, corn (Zea mays L.), and other crops (Schroeder, 1956). In tree fruits, he focused on improving cold-hardiness, resistance to diseases and insects, and yield. In 1911, Schroeder participated in the 7th International Congress of Arid Lands in the United States for cotton and orchard crops. While in the United States, he collected seeds of legumes, sorghum, and cotton cultivars and evaluated them in Central Asia. Shortly thereafter, Schroeder published an agricultural monograph that was widely distributed throughout the Russian Empire and, later, the USSR (Schroeder, 1913).

apple breeding program, and presently continues this work.

TAES was named after Richard Schroeder in 1929. At this time, the scientific program was expanded and awarded greater financial support by the federal government. In 1947 the organization was renamed the Richard R. Schroeder Uzbek Research Institute of Fruit Growing, Viticulture, and Wine Production (hereinafter as the Schroeder Institute).

Mahmud M. Mirzaev (Fig. 3) was appointed director of the Schroeder Institute in 1949 and served in this role for 51 years until his death in Aug. 2000. He focused on the interspecific hybridization of orchard species and development of improved grape cultivars. Mirzaev published over 300 scientific articles, books, and monographs, including Apricots in Uzbekistan (Mirzaev and Kuznezov, 1984), Ampelography of Uzbekistan (Mirzaev et al., 1984), Pomology of Uzbekistan (Mirzaev et al., 1983), Orchards of the Foothills and Mountain Zone of Uzbekistan (Mirzaev, 1982), and Vineyards of the Foothills and Mountain Zone of Uzbekistan (Mirzaev, 1980). In recognition of his voluminous contributions, Mirzaev was elected to both the Uzbek and Russian Academies of Science. His son, Mirmuhad M. Mirzaev, replaced him as Institute director.

From 1956 to 1957, branches of the Schroeder Institute were established in geographically various areas of Uzbekistan having different soil types and climatic conditions. The Schroeder Institute currently has five major satellite facilities: a branch in Samarqand Province devoted to orchard and vineyard crops, a branch in Farghona Province devoted to orchard and vineyard crops in mountainous regions, the South Uzbekistan Experiment Station in Surkhondaryo Province, and two branches in Tashkent Province, one specializing in wine production and the other in orchard crops. There are also three minor satellite branches: Tashkent Province, one specializing in wine crops in mountainous regions, Surkhondaryo Province, and two branches in Farghona Province devoted to orchard and vineyard crops.

The Schroeder Institute established an agribusiness college in 1995.

The main Schroeder Institute in Tashkent Province includes 22 laboratories and greenhouses that are used for research in plant breeding, cultural management, mechanization, and physiology and biochemistry of crops. About 300 faculty and technicians are employed at the main facility. The Institute maintains an extensive and unique field gene bank of more than 2000 advanced accessions of apples and pears, about 1300 grapes, 260 citrus, 500 apricots (Prunus armeniaca L.), 270 peaches (Prunus persica L. Batsch.), 65 plums (Prunus domestica L.), 125 brambles, and 150 nuts (walnuts [Juglans regia L.], almonds [Prunus dulcis (Mill.) D.A. Webb.], and hazelnuts [Corylus avellana L.]). The Institute also has collections of dates (Zizyphus jujuba Mill.), figs (Ficus carica L.), persimmons (Diospyrus kaki L.), pomegranates (Punica granatum L.), and other fruits (Esenbaev et al., 1981).

The Institute has developed and released 150 cultivars of fruits, berries, and grapes. In addition, 58 advanced selections are nearing release. Cultivars developed by the Schroeder Institute have been widely accepted by Uzbek commercial growers: 80% of the apples, 60% of the pears, 69% of the grapes, 90% of the strawberries (Fragaria xananassa L.), 65% of the quince (Pyrus pyrifolia L.), 65% of the peaches, 90% of the black currants (Ribes nigrum L.), and 90% of the nuts in Uzbekistan are cultivars released by the Institute. Some are widely grown throughout the former USSR.

The present goals of the Institute include the following.

1. Develop new cultivars of orchard crops and grapes that produce high yields of fruit with improved quality under various climatic extremes, and also exhibit disease and insect resistance, cold-hardiness, and drought tolerance.

2. Develop cultivars for use on extremely poor soils (sandy, stony, salty, and/or dry soils).

3. Improve drying technology and storage methods for fruits and grapes (i.e., raisins).

4. Develop new farm machinery for orchards and vineyards.
**Breeding Strategies Used at the Schroeder Institute**

*Apricots*. In 1930, a systematic and comprehensive breeding program was initiated. Initial evaluations identified three cultivars, ‘Kursadik’, ‘Arzami’, ‘Ruhu djuvanon’, and two European cultivars, ‘Krasnoshokii’ and ‘Korolevskii’, as resistant to the widely fluctuating climatic conditions common in Uzbekistan, especially flower and fruit damage due to late spring frosts (Kovalev, 1963). Schroeder Institute plant breeders developed new apricot cultivars with late flowering and high fruit quality by selecting from hybrids between local landraces and European cultivars. Six frost-tolerant cultivars were developed and released: ‘Samarqandski ranni’, ‘Medovi’, ‘Uzbekistansky’, ‘Ubileini Navoi’ (Fig. 4; Table 1), ‘Samarqandat’, ‘Avicena’, ‘Zarafshansky pozdnii’ (Table 1), ‘Abadi’, ‘Nuravshon’, and ‘Mohir’ (Mirzaev 2000; Mirzaev and Kuznecev, 1984; Turakulov, 1993), that had a higher chilling requirement and were later blooming than the previous cultivars. They had, concomitantly, greater resistance to frost and consistently good fruit yields. The first bloom is at least 1 week later than the ‘Ubileini novai’ and ‘Kursadik’ cultivars (Mirzaev, 2000).

*Peaches and nectarines*. The peach-breeding program focused on the improvement of cold-hardiness and consistent yields. Using parents from various geographical regions, the first releases were developed via recurrent hybridization and selection. Although improved in cold hardiness and yield consistency, they lacked fruit quality, postharvest life, and fruit uniformity needed for canning.

Later cultivars with improved disease resistance [leaf curl (*Taphrina deformans* (Berk.) Tul.) and powdery mildew (*Sphaerotheca pannosa* Lev. f. persicae Woroich.]), cold hardiness, and high fruit quality were developed (Cherevachenko, 1960). The primary focus was on yellow-fleshed freestone cultivars. Characteristics of selected peach cultivars are shown in Table 2. Fruit of these cultivars were used in a variety of ways, for example, as fresh, dried, and canned. The Schroeder Institute has developed and released more than 70 new peach and nectarine hybrids having high fruit quality (Mirzaev, 1993).

*Apples*. The main objective of the apple-breeding program has been to develop improved resistance to cold temperatures during the spring, fall, and winter, and to high summer temperatures. The overall goal is the year-round availability of high quality table apples using a combination of early-, mid-, and late-maturing cultivars.

The apple-breeding program was started by hybridizing local cultivars and landraces resistant to cold temperatures with cultivars from throughout the world. Subsequently, crosses and backcrosses were made with the progeny of the initial hybrids and cultivars displaying the desired characteristics. Breeders used mixed pollen from U.S. and European cultivars to produce the hybrids with the assumption that selection pressure (e.g., low temperature) applied to a heterogeneous population of pollen will lead to more desirable fertilization events and subsequent hybrid plants. Open-pollinated progeny from these hybrids were then subjected to selection. As a result, 29 cultivars were released. The characteristics of the most notable apples are shown in Table 3 (Schroeder, 1993).

**Pears**. The primary objectives of the pear-breeding program have been summer heat tolerance, drought resistance, and high fruit quality. In the early 1940s, crosses were made among cultivars from several geographical regions representing widely divergent climatic zones. Individual trees displaying the best overall performance were selected and intercrossed, followed by further selection. The characteristics of the most notable Uzbek cultivars developed in this program are described (Table 4), Mirzaev et al. (1983).

**Grapes**. Uzbekistan is among the oldest grape-growing regions in the world. The best known grapes of Uzbekistan are cultivars used both as fresh table grapes and for dried raisins. The diversity of table grape/raisin cultivars maintained at the Schroeder Institute is considered to be among the highest of comparable organizations worldwide, the

---

**Table 1. Characteristics of late flowering and/or frost-tolerant apricots.**

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Avg fruit wt (g)</th>
<th>Fruit color</th>
<th>Years to fruit production</th>
<th>Yield (t·ha⁻¹)</th>
<th>Ripening time</th>
<th>Major end use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gulistan</td>
<td>33</td>
<td>Bright golden with ruddiness</td>
<td>4</td>
<td>10</td>
<td>Early June</td>
<td>Dried apricots</td>
</tr>
<tr>
<td>Navruz</td>
<td>40</td>
<td>Partly yellow, with dark red skin</td>
<td>5</td>
<td>10</td>
<td>Early July</td>
<td>Fresh and canned</td>
</tr>
<tr>
<td>Avicena</td>
<td>45</td>
<td>Light pink</td>
<td>5</td>
<td>10</td>
<td>Late June/early July</td>
<td>Fresh, canned, and dried</td>
</tr>
<tr>
<td>Zarafshansky pozdnii</td>
<td>40</td>
<td>Yellow with small dark streaks</td>
<td>5–6</td>
<td>13</td>
<td>Late July</td>
<td>Dried</td>
</tr>
<tr>
<td>Ubileini Navoi</td>
<td>45</td>
<td>Gold-yellow with large bright streaks</td>
<td>4</td>
<td>14</td>
<td>Late June/early July</td>
<td>Fresh, canned, and dried</td>
</tr>
</tbody>
</table>

---

**Table 2. Characteristics of selected peach and nectarine cultivars.**

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Avg fruit wt (g)</th>
<th>Fruit color</th>
<th>Years to fruit production</th>
<th>Yield (kg/tree)</th>
<th>Ripening time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malinovi</td>
<td>Up to 300</td>
<td>White with pink streaks</td>
<td>5–6 years</td>
<td>60–80</td>
<td>August</td>
</tr>
<tr>
<td>Nectarin jelti</td>
<td>70</td>
<td>Light yellow</td>
<td>2–3, full in 5 years</td>
<td>120</td>
<td>Late August</td>
</tr>
<tr>
<td>Podarok Uzbekistana</td>
<td>160</td>
<td>Golden yellow</td>
<td>3</td>
<td>120</td>
<td>Late July/early August</td>
</tr>
<tr>
<td>Farhad</td>
<td>Up to 400</td>
<td>Dark yellow</td>
<td>3</td>
<td>130</td>
<td>September</td>
</tr>
<tr>
<td>Shirin magiz (sauter shape)</td>
<td>150</td>
<td>Orange with pink streaks</td>
<td>3</td>
<td>130–140</td>
<td>July</td>
</tr>
<tr>
<td>Nectarin tashkentsky</td>
<td>65</td>
<td>Orange</td>
<td>5</td>
<td>115</td>
<td>Mid-July</td>
</tr>
</tbody>
</table>

---

**Table 3. Characteristics of selected apple cultivars.**

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Avg fruit wt (g)</th>
<th>Fruit color</th>
<th>Years to fruit production</th>
<th>Yield (t·ha⁻¹)</th>
<th>Ripening time</th>
<th>Major end use</th>
<th>Flavor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Afrosiabi</td>
<td>100–150</td>
<td>Golden-yellow with streaks of orange-red</td>
<td>4–5</td>
<td>15–17</td>
<td>1–10 July</td>
<td>Fresh</td>
<td>Acid-sweet with pleasant aroma</td>
</tr>
<tr>
<td>Borovinka Tashkentsky</td>
<td>140</td>
<td>Greenish-yellow with dark pink stripes</td>
<td>4–5</td>
<td>16–18</td>
<td>10–20 July</td>
<td>Fresh</td>
<td>Acid-sweet</td>
</tr>
<tr>
<td>Nafis</td>
<td>160–180</td>
<td>Greenish-yellow with slight pink patches</td>
<td>3</td>
<td>20–22</td>
<td>Early October</td>
<td>Fresh</td>
<td>Sweet</td>
</tr>
<tr>
<td>Pervenece Samargandat</td>
<td>90</td>
<td>Golden-yellow</td>
<td>3–4</td>
<td>15–17</td>
<td>Early June</td>
<td>Fresh</td>
<td>Acid-sweet</td>
</tr>
<tr>
<td>Saratoni</td>
<td>120–150</td>
<td>Light green with slight red flecks</td>
<td>4–5</td>
<td>14–16</td>
<td>1–10 July</td>
<td>Fresh</td>
<td>Acid-sweet with aroma</td>
</tr>
<tr>
<td>Hasildar</td>
<td>150–200</td>
<td>Light green with yellow shade</td>
<td>2–3</td>
<td>18–20</td>
<td>1–10 June</td>
<td>Fresh</td>
<td>Acid-sweet</td>
</tr>
</tbody>
</table>
yield in the range of 100 to 500 kg/tree, resulting in an average yield of 2.0 to 2.5 t·ha⁻¹. Walnut breeding research facilities are located at Institute branches in Tashkent (Bostandik) and Samarqand (Kalmikov, 1968).

Breeders at the Institute’s Bostandik branch have developed or selected the following walnut cultivars: ‘Bostandiksky’, ‘Rodina’, ‘Gvardiyski’, ‘Tenkoskorlupnii’ (Fig. 6), ‘Ideal’, ‘Uzbeksky krupnoploydii’, ‘Kazahstansky’, and ‘Panfilovec’. The above cultivars have high nut quality, high yield, precocious fruit maturation, resistance to diseases and insects, and cold hardiness (Kalmikov, 1968).

Almonds. Cultivated almonds are grown mostly in the Tashkent and Surkhondaryo provinces and are harvested from the wild in the Samarqand and Surkhondaryo provinces. The total land area of almonds in Uzbekistan is more than 2500 ha, ≈1000 ha of which is cultivated. The best trees have a yield of 20 to 30 kg/tree of dried nuts (Kalmikov, 1968).


Pecans (Carya illinoinensis Nutt). Pecans were introduced into Uzbekistan in 1934. Institute breeders have developed new pecan cultivars with superior qualities, specifically with 60% to 66% nut oil content. The best of these cultivars are ‘Urojainii’, ‘Uzbekistan’, and ‘Pamyat Shroedera’. However, pecans are not currently widely grown in Uzbekistan (Kalmikov, 1968).

Table 4. Characteristics of selected pear cultivars.

Table 5. Characteristics of selected grape cultivars.

Table 5. Characteristics of selected grape cultivars.

Table 4. Characteristics of selected pear cultivars.
nut breeding programs worldwide. The fruit breeding programs at the Schroeder Institute have used local cultivars, landraces, and at times, U.S. and European cultivars, to develop breeding lines and finished cultivar releases with increased disease resistance, cold-hardiness, and high quality. These cultivars, as well as the other genetic resources maintained at the Schroeder Institute, will be useful to develop novel genotypes with even greater tolerance to biotic and abiotic stresses in the future. Scientists interested in gaining access to these genetic resources should contact the Schroeder Institute.

Literature Cited


