Plant Genetic Resources and Scientific Activities of the Uzbek Research Institute of Plant Industry

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The Uzbek Research Institute of Plant Industry, located in Tashkent Province of the Republic of Uzbekistan, was established in 1924 by the renowned Russian plant collector and geneticist Nikolai I. Vavilov (1887–1943). As director of the extensive Leningrad Institute of Applied Botany, Plant Genetics, and Breeding, Vavilov recognized that Central Asia was an important center of origin of many crop species and subsequently developed the Central Asian Branch of the institute. Since then, Academician Nikolai I. Vavilov, Konstantin I. Pangalo, Galina M. Popova, Pavel A. Baranov, Alexander M. Negrul, Yakov F. Katz, Klavdiya F. Kostina, Nikolai V. Kovalev, and many others have organized an expansive worldwide collection of tree fruits, grapes (Vitis vinifera L.), melons (Cucumis melo L.), vegetables, forage, and fiber crops at the institute. In addition to germplasm collection, the institute has conducted evaluations of breeding, and research of wheat (Triticum spp.), cotton (Gossypium spp.), maize (Zea mays L.), melons, and grapes, as well as other promising food, forage, and fiber crops.

The main goals of the early institute were the collection and storage of seeds, the evaluation of plant genetic resources from around the world under the various climatic zones of Uzbekistan (Fig. 1), the organization of seed production, and the development of improved agricultural practices for the region. In the 1970s, under the leadership of Academician Mirza Ali V. Mukhamedjanov, the institute’s role within the academic system of the former Soviet Union was expanded. The institute’s scientists trained graduate students that went on to earn advanced degrees from recognized research institutes and universities within Uzbekistan and other Commonwealth of Independent States countries. Since the institute was organized, eighty-five graduate students successfully defended PhD dissertations and were granted degrees in the field of plant breeding and genetic resources. While serving as director, Mukhamedjanov also made many important contributions to the genetic resource holdings of the institute and breeding programs flourished during his time.

In 1992 the institute was renamed to its current title, the Uzbek Research Institute of Plant Industry (UzRIPI), after Uzbekistan became an independent country (see Table 1 for a chronology of the institute’s names). At present, UzRIPI occupies 140 ha of arable land, including 74 ha of orchards with the remainder used for grain, melon, and vegetable crop research. UzRIPI also oversees experiment stations in Andijon (Farghona Valley) and Surkhondaryo provinces where they conduct evaluations of cultivars and other plant populations under different climatic conditions (Fig. 1). UzRIPI houses the following departments and support laboratories: Plant Introduction; Field Crops; Industrial Crops; Vegetables, Melons, and Potatoes (Solanum tuberosum L.); Fruits, Berries, and Grapes; Biochemistry; Seed Biology; and Plant Germplasm Resources Database Management.

Currently, the main goals of the institute are to 1) enrich the existing germplasm holdings by executing collection expeditions of endangered, cultivated, and wild plant species; 2) maintain the longevity of the existing collection by seed viability testing and periodic seed increases; 3) develop and implement strategies for mid- and long-term storage of plant germplasm; 4) undergo reciprocal exchange of plant germplasm with research institutes, germplasm repositories, and government agencies worldwide; 5) successfully quarantine seeds and clonal materials undergoing testing for infestation with potentially threatening agents; 6) efficiently and effectively evaluate germplasm to identify and further test accessions showing agricultural promise; 7) develop and maintain a database of all accessions that includes key descriptors, such as collection site and performance parameters along with preliminary recommendations to

Table 1. Chronology of the names of Uzbek Research Institute of Plant Industry (UzRIPI).

| Name of institute | Years |
|-------------------|-------|
| Central Asian Branch of the Saint Petersburg (Leningrad) Institute of Applied Botany | 1924–1927 |
| Central Asian Experiment Station of the All-Union Research Institute of Plant Industry | 1927–1979 |
| Central Asian Branch of the All-Union Vavilov Institute of Plant Industry (referred to as VIR) | 1979–1991 |
| Uzbek Research Institute of Plant Industry | 1992–present |

Fig. 1. Map of the Republic of Uzbekistan (reproduced with permission from the Dept. of Public Information, Cartographic Section, United Nations, Map no. 3777 Rev. 5, August 2003).
breeders and geneticists; and 8) produce seed of strains showing high promise for breeders, geneticists, and farmers.

Germlasm resources. UzRIPI maintains over 50,000 accessions of 210 plant species from 98 countries, including economically valuable agricultural crops and wild relatives. The collection consists of the following numbers of accessions: 16,000 cereals; 1,600 legumes; 9,200 oil and fiber crops; 1,500 forages; 5,000 vegetables and melons; over 4,000 tree fruits, berries and grapes; and 140 medicinal and other nontraditional crops. The institute maintains 6,300 live plant specimens in the greenhouse and field as well as numerous herbarium specimens. The entire germplasm collection is diligently maintained through the regeneration of viable seeds and clonal materials. Reciprocal germplasm exchange programs have been developed between UzRIPI and a number of institutions worldwide, including active collaborations with the All Union N. I. Vavilov Institute of Plant Industry in St. Petersburg and centers of origin of cultivated plants (Vavilov, 1922). In 1924, Vavilov used these early collections in the formulation of his theory on the centers of origin of cultivated plants (Vavilov, 1926). Consequently, recent exploration efforts have focused on the collection of endangered endemic germplasm. These exploration efforts involved a consortium of Central Asian institutes in addition to UzRIPI, including the Richard R. Schroeder Uzbek Scientific Research Institute of Fruit Growing, Viticulture and Wine Production, the Uzbek Scientific Research Institute of Vegetable, Melon, and Potato, the Cotton Breeding and Seed Production Institute, the Uzbek Scientific Research Institute of Botany, and others. Key scientists involved in these collection efforts were Natalya I. Zatkreger, Roalad O. Udatkin, Klabidya A. Kobilskaya, Eduard N. Lomakin, Nikolai G. Ruban, Tatyana N. Ulyanovla, Vladislav I. Shichkov, Fots T. Tsangas, Irshat Sh. Shahnmedov, Aleksei F. Privman, and Karim I. Baimetov. (Tsangas, 1994). Collections were made over a broad range of environments and elevations in all countries of Central Asia.

Breeding. Breeding activities at the institute were started in the mid-1920s. Since then, over 750 cultivars have been released with 65 still in wide cultivation in Central Asia, including 20 that are under production in other regions. At present, UzRIPI is releasing new cultivars at the rate of 1 to 2 per year.

Grapes. Pavel A. Baranov, Iliria A. Rakoja, Yakov F. Katz, and Alexander M. Negrul were responsible for the collection, evaluation, and culture of grapes (Vitis vinifera) at the institute (Pugachew and Djabbbarov, 1974). Simultaneous grape collection and evaluation was conducted in Tashkent province at the Richard R. Schroeder Uzbek Scientific Research Institute of Fruit Growing, Viticulture, and Wine Production with their collection containing 1,300 advanced accessions (Esenbaev et al., 1981). At the institute over 100 grape selections have been collected that feature very large fruit with unique pigmentation and excellent quality. Parthenocarpic (seedless) types have also been found and added to the collection. In central Kopetdag and the Kizilha and Oktan gorges of Turkmenistan, andromonoecious grape selections were collected. Strong evidence supports the Kopetdag region of Turkmenistan as the center of origin of V. vinifera L. ssp. sylvestris Gmel. (Tsangas, 1994).

Following the independence of Uzbekistan in 1991, the institute sponsored over 40 plant collection expeditions to Central Asia yielding 3,025 new accessions of economic plant species for their germplasm holdings. Expeditions in the Pamir Mountains brought back rye (Secale cereale L.) lines that have large seeds and spikes and legumes and wild grasses from different elevations. Also from this region, the first known collections of Aegilops sp. (goat grass) were made and a new latex-bearing plant was introduced to the collection, Scorzoner a tan-saghz Lipsch. et Bosse., that promises to be a source of natural rubber. Further, new ecotypes of prostrate summer cypress (Kochia prostrata (L.) Schrad.) and saxaul (Haloxylon persicum Bunge.) were collected.

During the many collection expeditions, much information has been accumulated on the range of habitats and ecosystems where the target species occur. The institute’s scientists studied the range in genetic diversity of 1,380 cultivars of 10 vegetable crop species growing in Uzbekistan, including carrot, radish (both globe and forcing), turnip, beet, lettuce (Lactuca sativa L.), dill, celery, parsley (Petroselinum crispum Mill.), and parsnip (Pastinaca sativa L.) (Mavlayanova et al., 1998). During the course of plant collecting since the 1920s, scientists have noted that landraces and related wild species of economic crops have been steadily disappearing in Central Asia (Brejnev, 1974; Vavilov, 1926).
Table 2. Characteristics of selected grape cultivars developed at the Institute.

| Cultivar                  | Avg fruit wt (g) | Avg cluster wt (g) | Time of ripening         | Soluble solids (%) | Fruit color            | Yield (t/ha⁻¹) | Major end use | Seedless |
|---------------------------|------------------|--------------------|--------------------------|--------------------|------------------------|----------------|---------------|----------|
| Tarnau                    | 1.8              | 520                | Mid-August               | 22                 | Yellow-green           | 48–60          | Wine          | Yes      |
| Oktaybrskii               | 5.9              | 400–500            | October                  | 24                 | Pink with thick wax    | 36–40          | Fresh         | No       |
| Guzal kara                | 6.4–6.8          | 480–584            | Mid- to end of August    | 22                 | Black with thick wax   | 20–25          | Fresh         | No       |
| Kishmish VIRa             | 2.1              | 360                | October                  | 26                 | Green-yellow           | 20–25          | Fresh, dried  | Yes      |
| Muskat Uzbekistana        | 5.0              | 500                | Late- October            | 25                 | Green-yellow           | 40–50          | Fresh, wine   | No       |
| Perlet                    | 1.95             | 416                | Mid-July                 | 26.6               | White-yellow           | 28–32          | Fresh, dried  | Yes      |

*a US check cultivar.

These studies have incorporated germplasm from France (‘Madlen Anjevin’ used as female parent), Turkmenistan (‘Kishmish Turkmensky’ and ‘Kara djijdji’ used as male parent), and Hungary (‘Jemchug Saba’ used as male parent) (Juravel and Ruban, 1968). N.G. Ruban published a comprehensive description of grape cultivars grown in Central Asia in 1972.

Using the vast grape collection, many important grape cultivars were developed with many still very popular in Central Asia. These include a) table (fresh)–‘Guzal kara’, ‘Volgo-Don’, ‘Pobeda’, ‘Muscat Uzbekistanskii’, ‘Oktaybrskii’, ‘Hurmani Kizil’, ‘Italiya’, ‘Karaburnu’; b) wine–‘Tarnau’, ‘Muscat VIR’, ‘Superka’; and c) dried–‘Ak-tash’, ‘Nilufar’, ‘Bessemaynnii’, ‘Kishmish rozovii’, ‘Kishmish VIR’ (Table 2). A.M. Negrul and M.S. Juravel were presented with the most prestigious State Award in the former Soviet Union for achievements in grape breeding.

Cotton. The UzRIPI cotton collection currently consists of over 5,000 accessions from around the world representing Gossypium hirsutum L., G. barbadense L., G. arboreum L., and G. herbaceum L., including 70 tetraploid forms and 29 wild diploid forms. Collections of pima cotton (G. barbadense) were made from growers fields and experiment stations within Central Asia that are early maturing, high fiber content, large bolls, early maturing, dwarf growth habit, low gossypol, and pigmented fiber (Visotskii, 1963). The Uzbek Cotton Breeding and Seed Production Institute independently manages a collection of about 12,000 Gossypium accessions (Saidaliev and Abdullahiev, 1995).

Onion. Central Asia is reported to be the center of origin for onions, Allium sp., (Vavilov, 1951). In addition to A. cepa L., many wild relatives are native to this region (A. oshinii O. Fedtsch., A. vavilovii M. Pоп. et Vved., A. praemixtum B. Fedtsch., and A. pskemense B. Fedtsch.). Over 110 wild Allium species exist within the Republic of Uzbekistan alone, with over 500 accessions held in the collection at the Uzbek Institute of Botany in Tashkent (Abdakarimov et. al, 1996). Breeders at UzRIPI developed the successful onion cultivar ‘Dungamski 12’.

Melons. Central Asia is reported to be the center of origin/diversity for melons (Vavilov, 1951). Konstantin I. Pangalo was primarily responsible for the collection and breeding of melons (Cucumis melo) and squashes (Cucurbita pepo L., C. moschata Duch, and C. maxima Duch.) at the institute. As a result of many extensive collection expeditions, UzRIPI currently has a germplasm holding of approximately 1,600 melon accessions. Unique melons...
Table 3. Characteristics of selected melon cultivars developed at the institute.

| Name                      | Total sugar (%) | Flesh color               | Shape       | Wt (kg) | Rind type        |
|---------------------------|-----------------|---------------------------|-------------|---------|-----------------|
| Early-Maturing (50–80 d)  |                 |                           |             |         |                 |
| Kok-Kaly-Posh             | 6.2–8.6         | White                     | Round       | 2.5–35.0| Segmented       |
| Mid-Maturing (80–100 d)   |                 |                           |             |         |                 |
| Bosvald                   | 7.0–8.6         | Light-green               | Elliptical  | 3.0–4.0 | Striped         |
| Assate                    | Up to 10.0      | white                     | Ovate       | 4.0–7.0 | Netted          |
| Obinavot                  | 7.4–9.3         | White                     | Round       | 3.0–4.0 | Spotted         |
| Bukharka 944 (Chogore)    | Up to 12.5      | White                     | Round       | 4.0–6.0 | Lightly spotted |
| Baii Kurgan               | 7.3–9.4         | White                     | Ovate       | 4.0–6.0 | Netted          |
| Arabakeshka 1219 Shakar palak | 10.0             | White                     | Ovate       | 8.0–17.1| Netted          |
| Krasomsy 2580             | 9.0–11.0        | Orange                    | Elliptical  | 3.0–4.0 | Netted          |
| Koi-bash 476             | 8.0–11.0        | White                     | Ovate       | 3.0–9.0 | Netted          |
| Late-Maturing (100–130 d) |                 |                           |             |         |                 |
| Gulybi Oranjevay          | 9.5             | White                     | Ovate       | 4.0–7.0 | Lightly netted  |
| Umirvaki 3748             | Up to 10.5      | White-green               | Ovate       | 3.0–6.0 | Lightly netted  |
| Kok Gulybi                | 9.6–14.0        | White                     | Ovate       | 7.0–25.0| Wrinkle-netted  |

Table 4. Characteristics of selected apricot cultivars developed at the institute.

| Cultivar                | Avg fruit wt (g) | Fruit color                  | Years to fruit production | Yield (t·ha⁻¹) | Ripening time | Major use          |
|-------------------------|------------------|------------------------------|---------------------------|----------------|---------------|--------------------|
| Komsoomlets             | 75–80            | Yellow-orange with carmine reddiness | 4–5                       | 12–13          | Mid-June      | fresh              |
| Vimpel                  | 60–70            | Yellow-orange with carmine reddiness | 3–4                       | 12–13          | Early-June    | Dried and canned   |
| Zaraya Vostoka          | Up to 105        | Light-yellow with bright pink reddiness | 5                       | 12–12.3        | Late-June     | Table, dried       |
| Spitak kremovii         | 60–65            | Light green to cream with pink-carmine reddiness | 5                       | 13–14          | Late-June to early July | Table, canned       |
| Hurmai ranni            | 30–35            | Light green with orange, no reddiness | 4–5                       | 13–13.5        | Early-June    | Table, dried       |
| Oranjevija pozdni 263   | 30–35            | Yellow-orange with dark red reddiness | 5–6                       | 14–15          | Late-June to early July | Canned             |
| Gevandi                 | 40–50            | Yellow-orange with red reddiness | 5–6                       | 12–13          | Early-June    | Table, canned       |

Table 5. Characteristics of selected peach cultivars developed at the Institute.

| Cultivar                | Avg fruit wt (g) | Fruit color                  | Years to fruit production | Yield (t·ha⁻¹) | Ripening time | Major use          |
|-------------------------|------------------|------------------------------|---------------------------|----------------|---------------|--------------------|
| Gulnoz                  | 130–150          | Cream-white with reddiness   | 2 years                   | 18–20          | Mid-June      | Fresh              |
| Bellii Rannii VIRA      | 100–150          | Cream-white with carmine reddiness | NA                       | NA             | Late June     | Fresh              |
| Chimgan                 | 90–100           | Yellow no reddiness          | 2 years                   | 18–19          | Late July, early August | Dried, fresh and canned |
| Uchkan (nectarine)      | 110–120          | Cream-yellow with reddiness  | 2 years                   | 16–17          | Late July, early August | Fresh              |
| Lyuchak                 | 65–70            | Yellow with light carmine    | 2 years                   | 17–18          | Late June, early July | Dried, fresh and canned |
| Elberta (U.S.-check)    | 150–170          | Orange-yellow with carmine   | 2 years                   | 17–18          | Mid-August    | Dried, fresh and canned |
| Jerseyland (U.S.-check) | 150–180          | Dark orange with carmine     | 2 years                   | 18–20          | Early July    | Dried, fresh and canned |
compact growth habit, and inflated short glumes. These include varieties alborubriflatus Vav., latifolium Flaksh., and eritroperumum inflatum Palm., where cold hardiness and salt tolerance is particularly notable. Forms of bread wheat were also discovered that lack ligules.

Roald A. Udachin discovered nine new wild relatives of bread wheat within the Central Asian collection (Udachin and Shahmedov, 1984). Cytogenetic studies of newly discovered wild relatives (Triticum sphaerococcum Perc., T. turgidum Jakubz., T. persicum Vav., and T. jugubzherii Udacz, et Shakhm.) are being conducted to determine phylogenetic relationships and to investigate their potential for interspecific hybridization with cultivated wheat (Kurbanov et al., 1988). The bread wheat cultivars ‘Unumi Bugdai’, ‘Karlik 85’, and ‘Pseudomerdionali 122’ and durum wheat cultivars ‘Dobraya’ and ‘Aleksandrovka’ have been developed and released based on germplasm collected and maintained at the institute. R.A. Udachin and I.Sh. Shahmedov published the monograph “Central Asian Wheats” in 1984. In addition to wheat, barley and triticale were bred at the institute developing an extremely early maturing barley ‘Zafar’ and the triticale cultivars ‘Uzor’, ‘Prag serebristii’, and ‘Mnogozernii 2’. G.K. Kurbanov published a monograph on dryland barley in Uzbekistan in 1972.

Maize. New drought and heat tolerant cultivars of maize (Zea mays) have been released by the institute. Scientists at the institute developed effective field evaluation methods using a drought tolerance scoring system that includes five categories (1 = drought tolerant, 5 = drought intolerant) to screen maize populations (Gorbunov, 1977, 1991). Accessions from Asia, Africa, North America, and South America are being grown under varying levels of field moisture and are scored for drought tolerance. Cytoplasmic male sterility (CMS, Moldavian type) has also been used to assist in the production of hybrid seed (Massino et al., 2000).

Fiber crops. Breeding programs have been conducted in fiber crops, including jute (Corchorus olitorius L). Nikolai V. Kultiasov and Grigori A. Pereverzev were awarded the highest State Prize in the former Soviet Union for the development of the jute ‘Pervenets Uz’. Scientists at the institute. UzRIPI looks forward to collaboration, cooperation, and reciprocal exchange of plant germplasm with interested scientists and organizations around the world.

Conclusions
The Uzbek Research Institute of Plant Industry acts as a comprehensive scientific research institute in addition to maintaining and continually enhancing a vast germplasm repository representing numerous valuable plant species. Since its establishment in 1924, the institute has been actively engaged in plant exploration, collection, research, evaluation, and genetic improvement. Current germplasm holdings, research, and breeding efforts are described in this paper to familiarize scientists in the western world with the greatly underutilized assets of the institute. UzRIPI looks forward to collaboration, cooperation, and reciprocal exchange of plant germplasm with interested scientists and organizations around the world.

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