Potato growers in Uzbekistan learn to save water; Tajikistan smallholder potato farmers improve income

Helping Farmers in Central Asia Produce Potatoes in Intense Heat and Drought Conditions

Potato is an important staple in the Central Asian nations of Tajikistan and Uzbekistan, yet farmers in many parts of these countries face challenges from extreme summer heat, soil salinity, and competition for water. This situation is expected to be worsen in the future as climate change intensifies the hot, dry conditions of the Aral Sea Basin, where diminishing rainfall and growing irrigation demand are expected to leave lowland regions with 30% less water for crops. CIP has consequently worked with local partners to develop early maturing, drought- and heat-tolerant potatoes that are adapted to local conditions, and the recent release of various new varieties bodes well for the future of potato production in this region.

As part of the Agile Potato for Asia Program, CIP has collaborated with national partners in Tajikistan and Uzbekistan on the development of potato varieties that produce well under extreme heat and water stress, while transferring and testing technologies to enhance on-farm water management, with support from Germany's Federal Ministry of Economic Cooperation and Development (BMZ). In collaboration with the International Water Management Institute, Hohenheim University, the Scientific

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Research Institute of Vegetable, Melon and Potato Crops and the Institute of Bioorganic Chemistry (Academy of Sciences) in Uzbekistan, and the Institute of Horticulture and Vegetable Growing (Academy of Agricultural Sciences) in Tajikistan, CIP has coordinated the development of new agile potato varieties, and the validation and dissemination of tools to help farmers use irrigation water more efficiently.

At the same time, this research has improved knowledge of how potato plants respond to drought stress, the effects of different irrigation regimes on tuber production, and the presence of drought and heat tolerance within CIP's potato breeding populations. This helped scientists identify the best CIP clones for breeding programs, develop decision-support tools for farmers facing water scarcity, and test new technologies for monitoring field trials and predicting which crosses are likely to have high levels of heat- and drought-tolerance.

The project resulted in the registration of seven CIP-bred potato varieties for release and distribution to farmers by national partners in Tajikistan and Uzbekistan. After identifying candidates within its breeding pool, CIP coordinated field trials for 31 virus-resistant, drought- and heat-tolerant clones, most of which produced well under the region's challenging environmental conditions. However, according to Rusudan Mdivani, CIP's Regional Liaison for Central Asia and the Caucuses, subsequent cooking and taste tests revealed that some of these clones had a bitter taste, which may be caused by the accumulation of glycoalkaloids in tubers caused, in turn, by the intense heat of the region's long summer days. CIP researchers are trying to develop an inexpensive test to detect which clones accumulate glycoalkaloids under heat stress in order to remove those parents from breeding populations.

Seven of the CIP-bred varieties that performed well under local summer conditions and produced potatoes with good flavor and cooking qualities were registered for release in Tajikistan and Uzbekistan. These varieties not only tolerate extreme heat, water stress, and soil salinity, but they also produce tubers within 90 days and are resistant to viruses that can significantly reduce potato yields in the region. CIP researcher Timur Abdurakhmanov explained that the region's farmers typically plant seed potatoes imported from other countries, which are susceptible to the accumulation of viruses that reduce the yields of subsequent planting cycles, forcing farmers to buy new seed every year. However, with the CIP-bred, virus-resistant varieties, farmers can save part of their harvest to use as seed the following year, which represents significant cost savings and reduces the risk of crop loss.

While breeding potatoes that are adapted to the Aral Sea Basin, CIP shared potato seed production technology with project partners, in order to help them get new varieties out to farmers and develop an alternative to imported seed. Uzbekistan's Institute of Bioorganic Chemistry has the capacity to produce up to 2 million in vitro plants per year, and produced 115 tons of seed potatoes of the varieties Sarnav (CIP 397077.16) and Pskom (CIP 390478.9) in 2015. This seed will be multiplied in 2016

and distributed to farmers in three regions of Uzbekistan who will use it to grow and sell seed potatoes. Abdurakhmanov observed that Sarnav is an especially good alternative to the imported varieties that are widely grown in the country.

Another variety that has great potential for the region is Tajikiston (CIP 392797.22), one of four CIP-bred potato varieties released in Tajikistan in recent years. Approximately 500 smallholders in that country's Jirgatol and Khatlon regions planted Tajikston in the summer of 2015, whereas farmers in Tajikistan's Ganci and Istravshan districts planted Fayzobod (CIP 397077.16).

Mdivani explained that farmers in Tajikistan's lowlands successfully grew Tajikiston during the second summer growing season of 2015 – from August to November – when temperatures rise too high for the imported potato varieties. She noted that the heat-resistant, early-maturing varieties developed by CIP allow farmers to produce potatoes during a window between other crops, when land would otherwise lay fallow, which means more income for smallholders and better diets for people in rural communities.

CIP and partners have also evaluated the effects of different irrigation regimes – furrow irrigation, partial root-zone drying, and drip irrigation – on potato yield and production cost. Farmers at demonstration sites in Uzbekistan's Ferghana and Andijan regions who applied recommended irrigation regimes doubled water productivity and reduced irrigation applications by 45%. Irrigation regimes and decision-support systems for improving water use efficiency were shared with hundreds of farmers, students, extension officers and researchers via field training, seminars, brochures, and a teleconference.

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“We want to give farmers the opportunity for reliable yields and income generation without high dependence on diminishing natural resources such as water, or agrochemicals,” said Merideth Bonierbale, who leads CIP’s genetics, genomics, and crop improvement research.

She noted that while producing potato varieties and irrigation recommendations that will help Central Asian farmers increase their production in the short and long terms, the project also improved scientists’ understanding of the potato’s response to heat and water stress, and the presence of heat- and drought-tolerance within CIP’s potato breeding populations. This knowledge will inform efforts in potato breeding and crop management to help potato farmers in other regions facing similar challenges.

“All our learning is global. In fact, there are other regions of Asia that have conditions similar to the Aral Sea Basin’s, and heat and drought are affecting potato production in

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Africa and South America as well," said Bonierbale. "As far as heat-tolerance goes, we think it will be the future of breeding, in light of climate change and the intensification of cropping systems needed to keep pace with food needs, especially in Asia. This project has thus been a good baptism of fire for CIP's breeding program overall."

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