



Enhanced food and income security in Southwest and Central Asia (SWCA) through potato varieties with improved tolerance to abiotic stress

Potato is an important food and cash crop in India, Bangladesh, Tajikistan, and Uzbekistan, grown primarily by smallholder farmers. Heat, soil salinity, and drought are major constraints to potato production, and climate change is increasing their impact.



This project was designed to develop improved potato varieties for these countries and the broader SWCA region, with greater tolerance to abiotic stress. Results are expected to reach at least 200,000 farm families to boost production, reduce crop losses, and enhance food security and incomes. Seed systems and capacity development will be strengthened, too. Positive spillover effects can be applied across the region and in other parts of the world, where potato is subject to similar abiotic stress conditions.

A demand-driven approach

The project uses a demand-driven approach to ensure that varieties are developed to suit farmers' needs. Four baseline surveys were conducted with farmers in especially vulnerable areas of India and Bangladesh to guide varietal development. Results indicated that the most important characteristics for farmers include earliness, heat and drought tolerance.

With partners from Germany, Bangladesh, India, Tajikistan, and Uzbekistan, CIP used genetic stocks, molecular tools, and research methods to support the development of varieties to meet farmer preferences. Germplasm was tested, multiplied, and validated under laboratory and field conditions.

Major results

Tajikistan. Viability of in-vitro potato plantlets at 1.5% NaCl concentration was estimated to be 100% for many CIP-bred clones after 42 days, compared to 0% viability for the Dutch control variety, Picasso.

CIP-bred clones 392797.22 and 720148 were the best performing clones in field trials carried out in Muminabad (22.2 and 30.2 t/ha) and Faizabad districts (20.4 and 30.4 t/ha). CIP-bred clone 397077.16 also showed promising results with yield always above 20 tons/ha.

Uzbekistan. CIP clones showed good resistance to heat stress during the early stages of plant growth in July-August. They also showed a high level of tolerance to soil salinity that reached 4 dS m⁻¹ at harvest in SyrDarya region, higher than those found in literature. For certain clones, a yield higher than 20.5 t/ha (397077.16) was obtained under terminal drought conditions with irrigation suspended after 40 days from planting. In the heat tolerance field trial carried out in Tashkent using clones from CIP's LTVR (Lowland Tropic Virus Resistant) population, the average marketable yield was 29.6 t/ha, with values ranging between 19.6 (397029.21) and 40.8 t/ha (397035.26).

India. Four clones were identified and introduced to test their suitability for release in cereal-based



Gujarat State, India. Harvesting of heat tolerant CIP clones/varieties.



One of the best CIP clones (397077.16) identified in Central Asia has traits of resistance to biotic (virus) and abiotic stress (heat, drought, and salinity).

systems of the sub-tropical lowlands. They are early maturing and heat tolerant, with yields ranging from 45 to 50 t/ha, higher than local heat-tolerant varieties,

Bangladesh. Heat and salinity stress are particularly relevant, because of the conformation of soils and shallow depth of the groundwater. Many CIP clones outyielded the locally-used Dutch variety, Diamant, as well as local varieties LalPakri and LalShil, under temperatures ranging from 30 to 33°C during the day, with soil salinity levels equivalent to 2.5 dS m⁻¹.

Other activities and results

- Plant growth models, screening methods, and marker systems for key traits of abiotic stress tolerance have been adapted and applied for stress tolerance breeding.
- National Agricultural Research Systems (NARS) have received genetic stocks and tools to speed up the breeding process.
- Stress tolerance traits and genes have been identified and combined in new biodiverse parental material.
- Geo-referenced risk maps and growth models validated by the project are available to researchers and policy makers for vulnerability analysis and decision support.
- 25 scientists working for the NARS of the target countries have been trained to develop new resistant varieties and to make baseline data surveys for greater farmer adoption and better impact assessment.
- A Business Plan for the establishment of a private seed potato enterprise in Uzbekistan has been prepared for donor funding or bank loan.
- Quality seed of biotic stress tolerant and early bulking

varieties for diversified cropping systems have been produced and disseminated to farmers.

Expected long-term impacts

- At least 200,000 farm families will benefit from abiotic stress tolerant varieties.
- New varieties will boost production and reduce risks of crop loss in project areas with spillover effects in Pakistan, Afghanistan, and lowlands of Central Asia.
- With heat and salt-tolerant potato varieties, non-traditional growing areas will come under potato cultivation, improving food security and livelihoods of resource-poor farmers.

Partners

International Potato Center (CIP); Research Institute of Crop Stress Tolerance of the Federal Research Center for Cultivated Plants- Julius Kühn- Institute (Germany); Central Potato Research Institute (CPRI), Shimla, All India Coordinated Potato Research Project (ICAR), (India); Tuber Crops Research Center (TCRC), (Bangladesh); Institute of Plant Physiology & Genetics, Institute of Horticulture, Dushanbe, (Tajikistan); Institute of Bioorganic Chemistry of the National University of Uzbekistan, Institute of Vegetables, Melon and Potato and the Agro-Chemistry Institute, Tashkent, (Uzbekistan); BRAC (Bangladesh); Mercy Corps, Global Partners, Garm, and Tukhmiparvar, Dushanbe, (Tajikistan); and Farmers and Farmers' Associations; S.D. Agricultural University, Potato Research Station, Deesa, Gujarat



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