

Cross-regional partnerships for improving food and nutritional security in marginal environments of Central Asia



Field training seminar on quinoa crops production Tashkent Agrarian University

Thematic Area: Improving food and nutritional security in marginal environments of Central Asia **Purpose:** Enhance food security by increasing food production on marginalized saline lands through the use of salt tolerant multi-purpose crops, such as quinoa (*Chenopodium quinoa* Willd.) Chenopodiaceae.

Geographic Scope: Uzbekistan, Kyrgyzstan, Tajikistan

Timeline: 2015-2017

Partners:

Uzbek Scientific Production Center on Agriculture at the Ministry of Agriculture and Water Economy of the Republic of Uzbekistan
 Academy of Sciences of the Republic of Uzbekistan
 Tashkent State Agrarian University
 Samarkand State University
 Karakalpakstan Branch of Tashkent Agrarian University, Nukus, Karakalpakstan
 Institute of the Gene Pool of Plants and Animals (Academy of Sciences of the Republic of Uzbekistan)
 Institute of Bioorganic Chemistry (Academy of Sciences of the Republic of Uzbekistan)
 Uzbek Institute of Karakul Sheep Breeding and Desert Ecology Research
 Innovation Centre of Phytotechnologies at the National Academy of Sciences of the Republic of Kyrgyzstan
 National Agrarian University of the Republic of Kyrgyzstan
 Tajik Agricultural Academy of Sciences (Genetic Resources Center)
 Institute of Soil Science and Agrochemistry, Tajik Agricultural Academy of Sciences

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Drought and salinity has a far greater effect on food security in Central Asia. Evaluation, domestication and sustainable utilization of native and introduced halophytic and salt-tolerant plant resources it would have a significant goal for salinity control, remediation of arid/saline lands for increasing income and better livelihood of rural communities.

ICBA have started a new project on “Cross-regional Partnerships for improving Food and Nutritional Security in Marginal Environments of Central Asia” since April 2015. The project main goal is to enhance food and nutrition security by increasing food production on marginalized saline lands through the use of salt tolerant multi-purpose crops, such as quinoa (*Chenopodium quinoa* Willd.)-facultative halophytes from Chenopodiaceae. Quinoa is a facultative halophyte (salt loving), one of the oldest crops cultivated in the Andes (Latin America) about 5,000 years. It has ability to adapt to climate change and is characterized by high water-use efficiency; growth well on abandoned waste and degraded lands. This makes quinoa an excellent non conventional crop for the production of seeds for food and feed in Central Asia. Quinoa shown a good adaptation under rainfed conditions, i.e. grows well with little irrigation or irrigated with low-quality water (artesian; drainage etc.). Quinoa seeds are very nutritious, rich in protein and micronutrients.

Its seeds may be consumed as human food in flour, baked products, soups, drinks, salads and breakfast cereals. Also, leaves and stems are used as animal feedstock for its higher nutritive value.

The core of the new project is the integrated, interdisciplinary research conducted by a team of specialists in plant eco-physiology, soil science, plant chemistry, animal nutrition, extension crop and other disciplines from different research institution, farmers in Uzbekistan, Tajikistan and Kyrgyzstan. The main objectives of the project are:

- Identify potential research sites representative of the production regions with salinity, temperature and water/drought stress (1-2 major stress identified per country);
- Conduct field trials to identify stress tolerant quinoa cultivars through evaluation under marginal growing conditions;
- Evaluate the nutritional and anti – nutritional factors / phytotoxic effects in quinoa produced under extreme growing conditions;
- Study the potential of quinoa as animal feed and determine the best mixed ratio for quinoa with conventional fodder/feed;
- Multiply and disseminate seeds of quinoa germplasm for trials in the partner countries.

Activities and Outcomes

Uzbek scientists are working on development of innovative technologies in agriculture. In particular, they are introducing new valuable food and feed crops resistant to drought, heat and soil salinity able to grow and produce good quality seeds. One of these crops is quinoa, which has been evaluated at experimental field station of Agrarian University of Uzbekistan.





Experimental plot in Tajikistan (summer seed sowing term)

Quinoa germplasm was evaluated using 12 agro-biological parameters in order to identify the most salt/drought tolerant and high productive varieties for grain production.

Seeds of quinoa from ICBA HQ germplasm were sown as main crops in the middle of April 2015 at air temperature ranging +14.5 +17.7°C; soil temperature ranging +2+5°C; air humidity ranging 41–56%; and monthly rainfall of 7.1 mm. Under saline environments (soil salinity of about 5,0-7,8 dS/m , ground water salinity of ~ ECiw 10-15 dS/m) at the stage of seed bedding these crops successfully flowered and produced viable seeds.

Quinoa varieties/improved lines from ICBA germplasm such as Q3, Q5 and Q2 had significant higher field seed germination, growth rates, plant height, yield of fresh and dry biomass and seed production during the vegetative stage than that of locally planted annual chenopods.

The comparative data on plant performance identified two main quinoa groups:

1. Fast growing and early maturing Quinoa 5 (NSL 106398) and Quinoa 3 (Ames 13761) as early maturing (56-62 days)
2. Late maturing accessions. (Q1 and Q4)

The remaining varieties/improved lines showed intermediate growth rates.

Highest yield of Q5 and Q2 was obtained at 25 cm spacing for 14 April sowing date (18.19 t/ha) in Tajikistan, and 7.90 t/ha under saline soils in Karakalpakstan.

The top performing 2 varieties/Q5 (Uzbekistan and Kyrgyzstan) and Q2 (Tajikistan) lines of Quinoa germplasm were selected for further dissemination in Central Asia. Quinoa accessions/varieties, and exhibited about 30% dry fodder yield and 25% seeds more than local annual chenopods. These lines are promising for further dissemination for grain production at all experimental trials in Uzbekistan (6), Tajikistan (2) and Kyrgyzstan (3).

ICBA will continue research with the focus on evaluating the productivity on a range of soils using different qualities of irrigation water and identifying high yielding salt and heat tolerant quinoa lines/varieties suitable for marginal areas in Aral Basin. Scaling up of quinoa for diversification of agricultural production systems in non-traditional environments requires further investigation of entire technology package, value chain and marketing products of this valuable, but little , known crops in Central Asia.

Future Directions

- Develop integrated (crop, soil and water) management practices for quinoa grown under marginal conditions; disseminate knowledge-based decision support systems to identify best practices for quinoa production in extreme environments;
- Define and implement mechanisms for seed production through formal and informal systems;
- Refine and disseminate postharvest processing technologies;
- Develop guidelines/manuals on seed production including cultural practices, purity maintenance and postharvest handling;
- Identify utilization options – traditional uses and non-traditional uses (saponins for pharmaceutical industries) and undertake product and value-chain development for quinoa. In view of the importance of livestock for the mixed farming systems in the region, the digestibility and nutritional value of plant waste after seed harvesting is particularly important for their utilization that involve crop-livestock interactions.



Field Farmer trials of Quinoa in Kyrgyzstan (Azamat farm, Issyk-kul, 2015)