Proceedings of the International Conference "Introduction of Crops: Achievements and Prospects"., 23-24 May 2013: 152-155

QUINOA A CLIMATE PROOF MULTI-PURPOSE CROPS TO INCREASE PRODUCTIVITY OF MARGINAL LANDS AND FARMERS' LIVELIHOODS IN THE DESERT AREAS OF UZBEKISTAN

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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 r better livelihood of rural communities.

ICBA have started a new project on "Towards a sustainable food production on marginal saline lands in Aral and Caspian seas basins" since 2013. The project main goal is to enhance food security by increasing food production on marginalized saline lands through the use of salt tolerant multi-purpose crops, trees and/or halophytic crops. 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 that will provide novel knowledge on the use and melioration of marginal lands in Uzbekistan, Azerbaijan and Kyrgyzstan.

In summer season of 2013 ICBA in collaboration with scientists from the Institute of Karakul Sheep Breeding and Samarkand State University evaluated vulnerability (exposure, sensitivity and adaptive capacity) of rural desert agropastoral communities to climate change and introduced multi - purpose salt and drought tolerant crops in strip-alley-system as adaptation measures.

It was also found that irrigation with low quality water (artesian and drainage) act as an alternate water resource and thus, plays an important role in saving freshwater resources as well as promoting agriculture in the marginal arid lands. Using of such integrated approach promotes both economic diversification and sustainable options towards improving food security, resilience and sustainable function of ecosystems.

An adaptation experiment for evaluating yield performance of three genotypes of quinoa (*Chenopodium quinoa* Willd.) a facultative halophyte from Chenopodiaceae in the model farms shown very encouraging results in reclamation of degraded salt affected marginal lands of the Kyzylkum desert (Navoi region, Uzbekistan). Seeds of quinoa from ICBA HQ germplasm were sown as main crops in the middle of March

2013 at air temperature ranging +14.5…+17.7ºC; soil temperature ranging +2+5ºC; 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 ~ EC_{iw} 10-15 dS/m) at the stage of seed bedding these crops successfully flowered and produced viable seeds.

Seed germination, plant establishment and growth in the filed trial were found to be good in all the three investigated genotypes of quinoa. First flowering was observed on May 2, 2013. The plants were harvested on July 10, 2013. The vegetation cycle of tested varieties was of 98 -120 days with a maximal height of plant of about 175-190cm. Grain yield per plant varied from in 22.66 to 45.66 g per plant; panicle weights varied from 42.98 to 92.88 g per plant; 1000 seed weights varied between 1,79-1.95 g; and stem weight per plant changed between 32.06 to 52.27 g. Data on biomass and seed yield obtained from these trials indeed supported the findings that quinoa holds promise as a grain and fodder crop for salt-affected arid areas.

Evaluated varieties were more water-use efficient, highly tolerant to salt by do not require preparatory fine leaching work before planting compared with traditional crops. Deficit irrigation showed considerable potential to increase water-use efficiency and yield, there were implications for salinity build up in the soil because of less water availability for leaching of salts added via irrigation.

The results suggest good adaptation and a high degree of flexibility of quinoa for tolerance or resistance to drought and salt stress under desert environments in Uzbekistan. The light saline sandy soils of the Kyzylkum desert are much more optimal for cultivation of this multi-purpose agro-industrial crop that could become a possible and economically interesting alternative flexible options for reclamation of un-utilized marginal salt affected drylands, reducing the summer fallow practices by increasing the land use ratio that will improve biodiversity and generate for improved livelihoods and nutrition of poor farmers and agropastoralists. Nowadays there is a significant increasing interest among farmers for the industrial cultivation of quinoa on the marginal non-productive fields in order to create a strong base of arid food and forage production.

So far, quinoa is not cultivated in the Central Asian region and there not much information is available on the environmental and its genetic diversity. As with any other new crop, one of the key factors for successful introduction and establishment of quinoa under the novel climates will be the identification of appropriate planting material. It is therefore important to study the adaptation and yield potential of several genotypes to select the most promising genotypes suitable for the local agro-climatic conditions. Information on these aspects as well as economic assessment of the profitability of cultivating quinoa is essential.

Quinoa productivity over the world due to its high nutritional value, high protein, and gluten free composition is now considered by nutritional experts to have the ability to play a critical role in overcoming issues of hunger, malnutrition and poverty. It can grow successfully in poor soils, including pure sand and in

environments with annual rainfall as little as 120-300 mm. Seeds contains high quality protein, rich in the essential amino acids lysine, methionine and threonine that are scarce in cereals and legumes. In the view of its exceptional nutritional quality and ability to grow under marginal environments quinoa is one of the most nutritious food crops to be largely introduced in the region. Besides its use for human consumption, quinoa seed has other uses as livestock and poultry feed, whole plant is used as green fodder and harvest residues are fed to animals.

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 and Caspian Sea Basins. Introduction and 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 and Caucasus.

Аннотация. В данной статьи рассматривается возможности введения в культуру кинои (*Chenopodium quinoa* Willd) –ценное кормовое, пищевое, техническое растение из семейство маревых, перспективной для улучшения мелиоративного состояния засоленных , маргинальных (низкого бонитета) землях.