

Quinoa for Marginal Environments



Quinoa seeds come in a rainbow of colors, each with traits for specific uses. The seeds are highly nutritious, making them a preferred food source for a healthy, balanced diet.



Trials in the UAE resulted in the identification of four quinoa genotypes that are suitable for sandy soils such as those in the Arabian Peninsula.

Thematic Area: ACrop Productivity and Diversification

Purpose: Identify high yielding and nutritionally balanced quinoa varieties with good local adaptation and high levels of salinity tolerance

Geographic Scope: Arabian Peninsula and United Arab Emirates (UAE)

Timeline: 2 Phases (2007-2013); (2013 - 2016)

Partners:

- The Ministry of Environment and Water (MOEW)
- Abu Dhabi Farmer's Service Center (ADFSC)
- National Agrarian University (UNALM), Peru
- Institute of Research and Scientific Cooperation and Technological Arabic - Latin American and the Caribbean (ICCTALA)

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The future of food security is a crucial global challenge. One of the most promising crops towards future food and nutritional security is quinoa (*Chenopodium quinoa*). Originating in South America, quinoa was highly revered by the ancient Andean civilization, but it was not until the 1970s when quinoa began to be introduced to the rest of the world that we began to understand how special this plant is. In addition to having a very high nutritional value, quinoa is highly resilient and it thrives where other crops no longer yield. It grows in altitudes as high as 4500 m above sea level, withstands wide ranges of daily temperatures, produces with as little as 300 mm of rainwater per year and yields in short timeframes. Most importantly, quinoa not only endures salinity but also some quinoa ecotypes prosper in saline soils. There are more than 3000 quinoa ecotypes whose potential and nutritional value has not been explored outside the Andes.

ICBA is pursuing a long-term initiative to identify high yielding and very nutritional quinoa varieties with elevated levels of salinity tolerance and good adaptation to the local environment of the marginal regions it targets, including the Arabian Peninsula. This project, Quinoa for Marginal Environments in the United Arab Emirates (UAE), is one of ICBA's projects under the quinoa initiative and it aims to evaluate and develop quinoa as an alternative crop for the United Arab Emirates.

Activities and Outcomes

During Phase 1, ICBA acquired 121 germplasm accessions from the United States Department of Agriculture (USDA) and evaluated them for growth performance and yield at ICBA's Research Station during the cropping season November – March 2007-2008. Of these 121 germplasm accessions, 73 survived and ICBA scientists harvested their seeds. Of the 73 germplasm accessions tried out, the top 20 performers were selected for subsequent trials during cropping seasons 2008-2009 and 2009-2010.

The data from the two cropping season trials were analyzed, and the best performing five accessions based on average seed yield were selected for further trials. These trials took place during



Quinoa cultivars vary in size, growth habit and color of leaves and seeds. Seeds are harvested at maturity when the lower leaves of the plant have dropped and the inflorescence color pales.

cropping seasons 2010-2011 and 2011-2012. In each season mass selection was practiced to eliminate inferior plant types and improve yield potential of the selected accessions.

Initial results from the trials were very encouraging and confirmed quinoa's suitability to withstand high salinity in water and soils, suitability to grow under the extremely dry desert conditions of the UAE, and huge potential as an alternative food and feed crop when growing traditional crops becomes uneconomical due to increased groundwater salinity. Before quinoa production can be scaled up at the country level, further testing of its adaptation and yield potential at the farm level under different soil and irrigation water qualities is needed.

Studies were conducted in two model farms (Madinat Zayed and Ghayathi) in the Western region of Abu Dhabi during the growing season of 2012-2013 in collaboration with the Abu Dhabi Farmer's Service Center (ADFSC). The results were positive. In Ghayathi, where water salinity is very high for traditional crops, the mean seed yield obtained from three of the quinoa genotypes was on par with the highest yields of 7.5 tons/ha reported from South America and Europe. The green biomass yield was also high, indicating the potential of quinoa as an alternative forage crop for salt-affected areas.

Results from the following cropping season (2013-2014) involving four genotypes produced record yields of 10.5 tons/ha, even when the irrigation water salinity increased further. These results demonstrate that quinoa can be used even to rehabilitate farms which are abandoned for cultivation of the traditionally grown crops due to high salinity.

The ongoing Phase 2, implemented in close partnership with the UAE Ministry of Environment and Water, and the National Agrarian University (UNALM) in Peru, aims to identify the best production and management practices to maximize yields under normal UAE farm conditions. It will also include animal feeding trials to assess the forage potential of quinoa.

During the growing season of 2013-2014, the four genotypes were planted in three locations within the northern emirates of the UAE under different growing conditions. Results were positive with high seed ranging from 1.90 tons/ha to 5.4 tons/ha and biomass yields from 8.5 tons/ha to 30.7 tons/ha, further confirming quinoa's potential as a food and feed crop for marginal environments.

Six new varieties were received from Peru in 2014 and during cropping season 2014-2015, the seeds were multiplied to test which other genotypes are promising in desert conditions prevalent in the UAE.

Future Directions

The UAE project will continue during the next few years in its pursuit to identify the suitable varieties, and the best production and management practices to maximize yields. Later on the nutritional analysis of the genotypes with the highest potential will be carried out. Seed multiplication of the most promising genotypes will be pursued to ensure enough seeds are available in the market for scaling up production.

On a global scale, ICBA will pursue its objective to implement cutting edge research to collect, screen and identify the quinoa genotypes that have the best potential for wide scale adoption in marginal environments. Data will be collected from different agro ecological zones. Crops will be evaluated based on yield, resistance to diseases and pests, easy and reliable production of inexpensive seed, ability to adapt to local management systems, and ultimately good quality and taste.



Quinoa leaves are useful as feed, which increases this crop's potential.