



Using mutation breeding to enhance food security in ARASIA States Parties*

The challenge

Wheat and barley are among the most important food crops contributing to food security and income generation for many farmers in the States Parties of the Co-operative Agreement for Arab States in Asia for Research, Development and Training related to Nuclear Science and Technology (ARASIA). However, Arab countries are the largest net importers of cereals in the world – 35% of daily calories consumed come from wheat alone.

Despite advances made in increasing the yield of cereal crops in the region, several biotic (disease and pest) and abiotic (drought, salinity and heat) factors continue to limit productivity. Water shortages are a critical challenge – much of the land in the region is too dry for cultivation and grazing, and most cultivated areas depend on rainfall and are adversely affected by climate change. Introducing new drought-tolerant crops, combined with water-use efficiency in the area, offers a useful approach to enhancing food security.

The project

In order to address the constraints that affect sustainable agricultural productivity in the region,

ARASIA States Parties launched a regional mutation breeding programme with IAEA support. The aim was to develop crop mutant varieties with high yields and short maturing times that would be resistant to biotic and abiotic stresses and more tolerant of variable climatic conditions, according to the specific needs of the participating countries.

The IAEA provided training and technical advice to the national teams of the participating Member States through training courses, fellowships and scientific visits, and helped procure the necessary equipment. The aim was to improve local know-how and basic laboratory research facilities for plant breeding. This encompassed mutation induction, mutation detection, techniques for screening mutant lines for biotic and abiotic stress resistance and tolerance, as well as other enabling biotechnologies such as tissue culture, doubled haploid and marker assisted selection.

The participating countries formally agreed to exchange mutant lines and advanced seed material, which contributed to a very fruitful exchange of expertise and seed materials.



Field day at a project workshop in Jordan.

*ARASIA is the cooperative Agreement for Arab States in Asia for Research, Development and Training related to nuclear science and technology.

The impact

Over the course of three consecutive technical cooperation projects, an important number of mutant variants of wheat and barley were identified and developed, including variants that matured early, were resistant to disease and produced high yields. To ensure the best possible adaptation of the mutant variants developed, they were grown and evaluated under diverse ecological conditions, in close cooperation with participating farmers. Some of the countries participating in the projects have already disseminated newly developed lines to farmers for adoption in their fields. Two advanced mutant lines were developed that produce higher yields and earlier maturing in all locations when compared to the varieties formerly dominant in the region.

Core groups of staff are now available in all participating countries, capable of managing national programmes for efficient mutation induction and selection, and related techniques.



M3 lines of bread wheat at the Agriculture Research Station in AlMuzahmiy, Riyadh, Saudi Arabia.

PROJECT INFORMATION

Project No: Three regional projects

Duration: 2007–2017

Budget: €1 140 441

Regional Agreement: ARASIA

Contributing to:



Partnerships and counterparts

During the projects, close collaboration and partnerships were established between national atomic energy authorities with the technology and national agricultural directorates that are responsible for the agronomic work.

In addition, the impact of the projects sensitized partnerships with academia in several countries, leading to the establishment of advanced degree courses, such as a Masters curriculum in Lebanon and a PhD course in Saudi Arabia.

Facts and figures

- Sixteen training courses were held, seven of them at the FAO/IAEA Plant Breeding and Genetics Laboratory in Seibersdorf, Austria, where 261 scientists were trained;
- 18 fellowships and 26 scientific visits were supported;
- 13 workshops were carried out;
- A regional database on wheat and barley mutants has been set up;
- Advanced mutant lines of wheat and barley that produce high yields with a short maturity period have already been adopted by farmers in different locations.

The science

Plant mutation breeding is the process of exposing plant seeds, cuttings or a shredded plant leaf to radiation, such as gamma rays, and then planting the seed or cultivating the irradiated material in a sterile rooting medium, which generates a plantlet. The individual plants are then multiplied and examined for their traits. By using radiation, scientists can significantly shorten the time it takes to see beneficial variations to as short as a year. Mutation breeding uses a plant's own genetic resources to mimic the process of spontaneous mutation that occurs in nature all the time.

www.iaea.org/technicalcooperation