IAEA Technical Cooperation Programme

Seeds of hope: Using mutation breeding to strengthen crops in Namibia

The challenge

Approximately 90% of subsistence farmers in Namibia depend solely on rainfall for crop cultivation and livestock production. Cowpea, Bambara groundnut, pearl millet and sorghum are the most widely grown staple food crops, but the varieties traditionally grown are low yielding and not drought tolerant. Cultivars with improved grain yield and tolerance to abiotic (e.g. drought) and biotic (e.g. disease and pests) stress factors are needed. Until recently, Namibia had no plant breeding programme and no qualified plant breeder able to develop new varieties for local conditions. Farmers used landraces, which are usually selected at harvesting, as the source of the next season's seeds. This approach has not been adequate to maintain the seed system, given the impact of climate change coupled with drought and unpredictable rainfall. Farmers have reported seed losses, which has had a negative impact on germplasm availability and food security.

The project

Since 2009, the IAEA's technical cooperation programme, in close collaboration with the Food and Agriculture Organization of the United Nations (FAO), has been helping Namibia to utilize gamma induced mutations for pre-breeding and breeding of high yielding, drought tolerant and insect pest resistant crop varieties. Mutation induction by gamma irradiation is recommended as an option for developing new crop varieties in a short period of time without negative impact on the environment. The seeds of traditional varieties of four crops important for food security (cowpea, pearl millet, sorghum and Bambara groundnut) were subjected to gamma irradiation at the FAO/IAEA Plant Breeding and Genetics Laboratory in Seibersdorf, Austria, with further selections of promising mutant lines.

Participants from a regional training course observing cowpea mutants growing at the Mannheim research station, Namibia. (Photo: Lydia Ndinelao Horn/Ministry of Agriculture)

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The impact

The first qualified Namibian plant breeder was trained at the African Centre of Crop Improvement, University of KwaZulu Natal, South Africa. Five technical staff members were also training through IAEA fellowships on breeding techniques, and soil and water management, at institutions in Nigeria and Kenya. The trained technicians are now managing experiments at government field research stations across the country. A farmers' field and information day was held at three research stations in April 2017. At these events the farmers selected their desired crop varieties based on field appearance and performance. In December 2017, newly developed varieties of cowpea (7 varieties) and sorghum (4 varieties) selected by farmers were officially released by the Ministry of Agriculture, Water and Forestry. Seed multiplication was carried out during the 2017–2018 cropping season to produce foundation seeds during the off-season period. These newly certified seeds will be available to the farmers for planting in the 2018–2019 season.

Breeders' seed multiplication of released sorghum and cowpea growing at Mannheim Research station, Namibia, 2018. (Photo: Lydia Ndinelao Horn/Ministry of Agriculture)

PROJECT INFORMATION

Project No: NAM5014

Project title: Evaluating Efficient Water and Nutrient Use, Molecular Characterization and Nutritional Composition of Mutant Germplasm Populations

Duration: 2016-2017 (2 years)

Budget: €136 700

Contributing to:

Partnerships and counterparts

- Ministry of Agriculture, Water and Forestry, Namibia;
- University of Namibia.

Facts and figures

- Seven varieties of cowpea and four varieties of sorghum, selected by farmers, were officially released by the Ministry of Agriculture, Water and Forestry in 2017;
- The first qualified Namibian plant breeder was trained to PhD level;
- Five technical staff members received targeted training through IAEA fellowships; and
- Five articles on the project have been published in respected journals.

The science

Mutation breeding is based on the induction of heritable genetic changes (mutations) in plant material using gamma- or X-rays or other mutagens. The mutations are expressed in the mutant plants, which are selected for new and useful traits, such as disease resistance, or tolerance to abiotic stresses. Mutation breeding uses the plant's own genetic make-up and enhances the natural process of spontaneous mutation.