Bangladesh triples rice production with help of nuclear science

By Nicole Jawerth

New varieties of rice developed using nuclear techniques have helped Bangladesh increase its rice production threefold in the last few decades, despite increasingly harsh climatic conditions. This has enabled the country to establish a secure and steady supply of rice, while staying one step ahead of its rapid population growth.

"I have more rice for my family, and I now earn almost double with the rice and mustard seed I grow, compared to before," said Suruj Ali, a farmer from Gerapacha village near the border of Bangladesh and India, who grows a new type of rice plant called Binadhan-7. "I also save money because I don't have to spray as much for insects."

Binadhan-7 is one of several rice varieties developed by scientists at the Bangladesh Institute of Nuclear Agriculture (BINA), with the support of the IAEA and the Food and Agriculture Organization of the United Nations (FAO). It was developed through a process which uses radiation, called plant mutation breeding (see The Science box), and has become a popular rice variety in the northern part of the country, helping farmers and workers stabilize their income and find year-round employment.

Globally, more than 3000 plant varieties have been developed and released using plant mutation breeding techniques. These varieties will continue to play a key role in meeting global food demand, as the world's population rapidly grows and environmental conditions become more challenging.

"Plant mutation breeding saves time and money for researchers, and results in the kinds of plants farmers need to cost-effectively keep food on the table and money in their pockets," said Ljupcho Jankuloski, Acting Head of the Plant Breeding and Genetics Section of the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture. "For many farmers, these plant varieties are a game-changer."

Helping farmers in northern Bangladesh

What sets Binadhan-7 apart from local rice varieties is its shorter growing time and ability to produce more rice. Local varieties produce around 2 tonnes of husked rice per hectare and take about 150 days to mature for harvest. Binadhan-7 produces around 3.5 to 4.5 tonnes per hectare and takes around 115 days.

The extra weeks that local rice varieties take to grow are a problem, as the rice is exposed to increasingly harsh weather

The IAEA's technical cooperation programme has supported 40 fellows and scientific visitors from Bangladesh in the field of food and agriculture over the past 10 years. Three national projects related to agriculture are currently active.

The Binadahn-7 rice variety, developed by scientists at the Bangladesh Institute for Nuclear Agriculture, Mymensingh, Bangladesh.
(Photo: N. Jawerth/IAEA)

events and insects as temperatures shift with the changing seasons — a situation that is worsening as climate change causes more variable and extreme weather. It also leaves too little time to grow another crop before the seasons change, resulting in several months between seasons where fields lie unused.

"I used to only be able to grow two crops and would have several months each year without anything, but with Binadhan-7 I can now grow three crops and earn money all year long," Ali said. He, along with his family of five, lives off 3 acres of land where he grows rice and mustard seed. "I've used that extra money to build two new extensions for my house. I hope I can earn enough to send my kids abroad someday."

Since its release in 2007, Binadhan-7 has helped to improve the livelihoods of more than 20% of the people living in the northern region, according to BINA.

No meal is complete without rice

New rice varieties like Binadhan-7 help to address the demand for this staple food in Bangladesh.

"For most Bangladeshi people, a meal is not a meal if it does not include rice," said Mohammad Moinuddin Abdullah, Secretary at the country's Ministry of Agriculture. "With a projected population of 195 million by 2030, this puts immense pressure on rice production."

A cornucopia of new crops

Thirteen new rice varieties have been developed by BINA since the 1970s using plant mutation breeding, in part through assistance from the IAEA and its technical cooperation programme. More than 40 new crop plant varieties have been developed in the country using this technique, including chickpeas, jute, lentils, mustard seed, peanuts, sesame seed, soybean, tomato and wheat.

These new varieties help Bangladeshi farmers deal with enduring problems such as water shortages, drought, salty soil and soil degradation, which make it difficult for crops to survive and make land unusable for farming.

Like Bangladesh, many countries throughout the region work with plant mutation breeding to ensure people have food despite increasingly harsh climatic conditions. In October 2016, Bangladesh hosted an IAEA-organized training course on plant mutation breeding for new rice varieties for scientists from 12 countries in the region. Participants exchanged experiences and shared materials to refine and advance their research. Part of this training focused on helping young scientists to develop their skills and knowledge in advanced plant breeding techniques to ensure this work continues in their countries.

This course is one of several IAEA technical cooperation and coordinated research projects related to plant mutation breeding hosted worldwide each year.

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THE SCIENCE

Plant mutation breeding

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. Molecular-marker-assisted breeding, often referred to as marker-assisted selection, is used to accelerate the selection of plants with desired traits, carried by genes of interest.

Plant mutation breeding does not involve gene modification, but rather uses a plant's own genetic resources and mimics the natural process of spontaneous mutation, the motor of evolution. By using radiation, scientists can significantly shorten the time it takes to breed new and improved plant varieties.