

Fighting climate change: Rice variety developed with nuclear techniques expands in Indonesia

By Miklos Gaspar



Workers at Indonesia's National Nuclear Energy Agency (BATAN) planting rice varieties developed using irradiation.

(Photo: Yustantiana/BATAN).

Stucky, strong and quick to ripen – that is how Indonesian farmers like their rice, and that is exactly what nuclear science has delivered to them. And higher income, to top it all.

Late 2017 was the second season that some 200 farmers in East Java used the variety Inpari Sidenuk (“nuclear dedication” in Indonesian), meeting the challenge posed by climate change while doubling their yields to 9 tons per hectare. Inpari Sidenuk is one of 22 rice varieties developed by scientists at the country’s National Nuclear Energy Agency (BATAN) using irradiation, a process often used to generate new and useful traits in crops (see The Science box).

The IAEA, in cooperation with the Food and Agriculture Organization of the United Nations (FAO), and partly financed through the Peaceful Uses Initiative (PUI), supports researchers in 70 countries, including Indonesia, in the use of radiation for agricultural research. The development of new, improved varieties helps increase the supply of food, and thereby food security.

“It is particularly important for us to have varieties that meet the new, more erratic weather conditions brought about by climate change,” said Abdul Rasyid Afandi, a farmer

in Mangaran, who has planted the new variety on over half of his 2-hectare plot.

Farmers here are able to plant rice three times a year, once in the dry and twice in the rainy season. The length of the seasons has varied more than usual in recent years, resulting in drier overall weather and the spread of new pests and diseases, he explained. As a result, farmers have seen yields with previously used varieties dip below 5 tons per hectare.

The introduction of Inpari Sidenuk has not only led to the recovery of previous yield levels, but at 9 tons per hectare has significantly surpassed earlier harvest rates. The plant is much shorter, making it less vulnerable to strong winds, which used to destroy around a tenth of the crop.

The only problem is the lack of seeds available to farmers, said A. Sidik Tanoyo, a Ministry of Agriculture official in East Java. “It’s important that more seeds are produced to increase the area under cultivation, which will contribute to increased productivity and farmers’ incomes,” he said. It is now the task of the country’s agriculture authorities to produce more seeds of the new variety. Such mass production no longer requires irradiation, only the conventional multiplication of seeds.

Seamless cooperation between BATAN and agriculture authorities is crucial in ensuring the distribution of any new variety to farmers, said Ita Dwimahyani, a plant breeder at BATAN’s Centre for Isotope and Radiation Application. Inpari Sidenuk was developed from a local variety in 2007, and released by BATAN in 2011. However, difficulties with distribution have meant that it has taken a few years for it to get to farmers.

“We are very enthusiastic about this new variety,” Afandi said. He added that the extra income he hopes to earn in coming years will contribute to the university education of his children and allow him to save more money for his old age.

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Indonesia selects nuclear-bred soybean variety for mass production

Indonesia’s Ministry of Agriculture has selected an improved soybean variety developed using nuclear techniques as the basis for its national self-sufficiency plan, which aims to increase food security in the country.

Tempeh, made of fermented soybeans, is a national staple, usually consumed with rice and broth. Due to an increase in population and living standards in the last couple of decades, however, consumption has grown considerably and Indonesia has gradually lost its self-sufficiency in tempeh production. It is now importing close to 60% of the 2.2 million tons of soybeans consumed each year. The Government would like to significantly increase domestic production. That, however, requires a variety suitable for the country’s tropical climate, with high yields and resistance to local pests.

The Ministry of Agriculture has now selected a variety developed by the country’s National Nuclear Energy Agency (BATAN) for mass seed production and distribution among farmers thanks to its favourable traits, said Lukman Hakim, the ministry official in charge of the project. The variety called Mutiara 1 was developed using irradiation. The syllable “ra” in its name stands for radiation.

Mutiara 1 has numerous advantages compared to the traditional soybean variety, said Gatot Gatot, one of 12 farmers in the heart of the country’s soybean-growing area in East Java to already use the new variety. “The plants are shorter and stronger, tolerant to wind and resistant to disease,” he said. Even more importantly, the yield — at above 3 tons per



hectare — is 25% higher than that of local varieties. The seeds are larger and higher quality, fetching between 6500 and 7000 rupiah (40–44 euro cents) per kg, compared to under 6000 rupiah for the local variety.

Of the 200 farmers in this village, most would like to plant Mutiara 1, but for now there aren’t enough seeds to go around, said A. Sidik Tanoyo, a Ministry of Agriculture official in the district. “This will now change as a result of the recent government decision.”

In the meantime, BATAN scientists will continue to develop new varieties, further improving their traits. Mutiara 1 is less optimal in the wet season, when its bigger seeds acquire a brownish colour and are less viable, said Azri Kusuma Dewi, a plant breeder at BATAN’s Centre for Isotope and Radiation Application in Jakarta. “We need to work on further optimizing Mutiara 1 by inducing mutations and breeding another variety for the rainy season,” she said.

The soybean variety grown by Indonesian farmer Gatot Gatot has been developed using irradiation. The Ministry of Agriculture has selected it for multiplication as part of its food security plan.

(Photo: M. Gaspar/IAEA)

THE SCIENCE

Breeding new varieties using nuclear techniques

Twenty-two rice varieties have been developed by BATAN scientists through a process known as mutation breeding. Applied since the 1930s to accelerate the process of developing and selecting new, valuable agronomic traits, mutation breeding uses a plant’s own genetic make-up, mimicking the natural process of spontaneous mutation. The mutation process generates random genetic variations, resulting in plants with new and useful traits.

BATAN scientists use gamma irradiation to induce mutations in seeds and considerably speed up the natural mutation process. After seed irradiation, they test the new mutant plants for various characteristics and select those displaying useful traits for further breeding and subsequent distribution to farmers.