Traditional or conventional rice breeding accounts for a great portion of IRRI's rice breeding research. Traditional breeding takes advantage of existing natural genetic variation to introduce desirable traits into cultivated crop varieties. But conventional breeding methods are no longer sufficient to keep up with the demand for better rice varieties in a rapidly changing rice farming environment.

IRRI works closely with partners and players in the rice value chain to better understand their priorities, concerns, and needs and uses its extensive portfolio of rice breeding innovations to meet their needs.

Transformative rice breeding

IRRI utilizes cutting-edge breeding approaches to develop modern rice varieties by increasing the rate of genetic gain in the breeding program and shortening the time it takes to put a new rice variety on the market. As a result, smallholder farmers in vulnerable rice-growing areas will have quick access to improved rice varieties that ensure higher yields, better grain quality, and increase in income.

This new breeding strategy includes a renewed focus on Single Seed Descent breeding methods using Rapid Generation Advancement (RGA) techniques and Marker Assisted Selection (MAS) for traits where DNA markers were available, and population improvement (including genomic selection) for improving complex traits like yield.

Genetic modification

IRRI also uses biotechnology-based approaches that safely and responsibly deliver additional benefits to farmers and consumers that cannot be achieved through conventional breeding. One of these approaches is the genetic modification of rice to increase its nutrient content (iron, zinc, and beta-carotene) to help fight micronutrient malnutrition. IRRI uses genetic modification only for traits that are essential but not available in cultivated rice and wild varieties and when it offers a potentially very high humanitarian, productivity, or environmental benefit.

Throughout the conduct of its GM research, IRRI adheres strictly to national and international biosafety regulations and ensures that rigorous science is undertaken and independently assessed. IRRI has an Institutional Biosafety Committee that oversees the biosafety aspect of all its GM research.

Gene editing in rice breeding

The clustered regularly interspaced short palindromic repeats (CRISPR) is a revolutionary and low-cost gene editing tool that precisely manipulates, eliminates, or modifies unwanted traits, and generates new traits to improve the crop's yield, resistance to diseases and pests, and ability to thrive under harsh environmental conditions.

RICE BREEDING PORTFOLIO

1. **Rice for the changing needs of the people**
   Healthier Rice
   Because rice is the dominant cereal crop in most Asian countries and is the staple food for more than half of the world's population (including many of those living in poverty), even a small increase in the micronutrient content of rice grains could have a significant impact on human health.

   Healthier rice varieties have the potential to reach many people because rice is already widely grown and eaten. IRRI is developing healthier rice varieties with improved nutritional content to complement current efforts to reduce micronutrient malnutrition. These include rice varieties that are biofortified with iron, zinc, and beta-carotene.

   Safer Rice
   Rice plant absorbs metals from the soil for its own metabolic processes. Along with iron and zinc which are necessary for the rice plant to survive and grow, it also absorbs heavy metals such as arsenic, cadmium, mercury, and lead.

   IRRI is working on ways to reduce the uptake of harmful metals and enhance accumulation of good metals in the rice grain.

2. **Stress-tolerant and climate-resilient varieties**
   Environmental stresses constrain rice production, affecting farmers who live in rainfed lowland and upland environments. These stresses can be caused by extreme climatic changes such as drought, flooding, or saltwater intrusion from rising sea levels in coastal farm lands. Some other stresses are attributed to the inherent toxicities (iron and aluminum) or deficiency (zinc and phosphorous) in the soil. Our breeding programs aim to develop rice types that can survive in these harsh environments.

   IRRI breeders use molecular markers to help incorporate specific desirable gene variants into new varieties with more accuracy and speed.

3. **C4 Rice** - IRRI is making progress towards developing C4 rice - rice with a supercharged photosynthesis mechanism that is much better at using sunlight to convert carbon dioxide and water into grain. C4 rice could yield up to 50% more grain than currently possible from existing rice varieties.

4. **Hybrid rice** is a product of a cross between two genetically distinct rice parents. When the right parents are selected, the hybrid will have both greater vigor and better yield than either of the parents. The advantages of hybrid rice include higher yields, increased vigor (making them more competitive to weeds), and increased resistance to diseases and insects.

HOW WE DELIVER RESULTS

IRRI believes that addressing rice challenges relies heavily on strong partnerships. Working with the Philippine Department of Agriculture and the Department of Science and Technology, IRRI is able to promote adoption of farming innovations, sustainable rice systems, and best management practices.

For more information, contact us at

IRRI Headquarters (Philippines)
+63 2 580 5600
info@irri.org

www.irri.org

IRRI International Rice Research Institute

IRRI aims to improve livelihoods and nutrition, abolishing poverty, hunger, and malnutrition among those who depend on rice-based agri-food systems. In doing so, IRRI's work protects the health of rice farmers and consumers, and the environmental sustainability of rice farming in a world challenged by climate change. IRRI's work promotes the empowerment of women and supports opportunities for youth in an equitable agri-food system.

January 2019