Expanding the Types of Environments Where Rice Can Thrive

IRRI is using Illumina technologies to educate rice researchers about the benefits of genomics, supporting development of rice varieties that can withstand the impact of climate change.

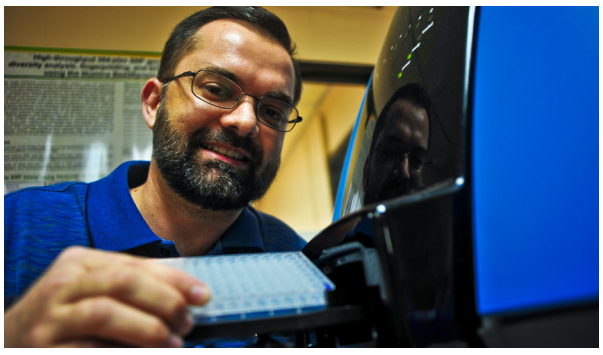
Recognizing that its technology could play a critical role in alleviating global hunger, malnutrition, and poverty, Illumina created the Agricultural Greater Good initiative. Each year, Illumina awards Greater Good grants to agricultural research organizations that are focused on identifying and breeding plants and animals that will increase the sustainability, productivity, and nutritional density of crop and livestock species. Under the grants, Illumina sequencing and genotyping reagents are provided free of charge.

IRRI
2011 Illumina Greater Good Initiative Award Winner

Introduction

The International Rice Research Institute (IRRI)[1] is one of three centers focused on rice studies within the Consultative Group on International Agricultural Research (CGIAR)[2] network.

Its mission is to support research around the world that will broaden the climates and environments where rice can be grown, putting seeds for these improved varieties in the hands of farmers. IRRI is helping researchers in countries where rice is grown in collaboration with the national rice research programs. Examples include Myanmar, Bangladesh, Indonesia, Vietnam, Laos, Cambodia, and East Africa.



Michael Thomson, Ph.D., is a Scientist, Molecular Genetics and Marker Applications Specialist at IRRI.

Enabling real-world applications of genomic research begins with capacity building, according to Michael Thomson, Ph.D., a Scientist, Molecular Genetics and Marker Applications Specialist at IRRI.

"We currently offer two courses, one on molecular breeding and a more technical course on single nucleotide polymorphism (SNP) data analysis," Dr. Thomson said. "There's usually about 20–25 people from around the world in each course. Our goal is to teach people how to use new genomics technology, and have them return to their home institute, apply it, and teach other people what they've learned."

SNP technology is helping researchers understand the genetics behind rice varieties through genetic diversity analysis and quantitative trait loci (QTL) mapping, enabling trait selection for marker-assisted backcrossing. "Usually these research groups have a collection of diverse rice varieties that they've phenotyped and are using, but they don't always know the genetic relationships between them," Dr. Thomson said. "Genetic diversity analysis enables rapid DNA fingerprinting tests so researchers can instantly see the relationships between their plant lines and choose which parents to use for mapping populations. After selecting two parents to create a population, they can use the 384 SNP array for a genome-wide scan. The QTLs identified can be used for marker-assisted backcrossing, enabling researchers to see all 12 rice chromosomes and select the best plants for their breeding programs. SNP technology is accelerating the breeding process, reducing the time it takes to develop a new variety from 10 years, to 5 or 6 years."

Rice is the staple food for more than half of the world's population. While 90% of it is cultivated on farms throughout Asia, increased rice consumption in Africa, Latin America, and the Caribbean is driving rice farming in those regions to reduce the need to import the grain.

Receiving the Greater Good initiative award enabled IRRI to introduce SNP technology to rice researchers at a subsidized rate because Illumina donates all the supplies. “Having the BeadXpress® system in our genotyping service lab has made the technology accessible to a wider range of people,” Dr. Thomson said. “It’s enabled them to see how the technology works and get a vision of what’s possible. We’ve also incorporated the system into the courses we teach. For the SNP data analysis course, we have enough reagents to run participants’ rice DNA samples in advance of their attendance. During the course they have the chance to analyze their own data, learn how to use it, and incorporate the results into their own research.”

The course has spread the word about the value of SNP technology, and there’s been increased interest in the IRRI genotyping service lab. “People mail their DNA samples to our service lab and we run them, everything from fingerprinting and diversity analysis to QTL mapping. The data enables them to make advances in their breeding programs. We’ll never compete with large service laboratories. That’s not our goal. We hope to be a resource for our partners, helping them to set up their own programs and answer questions as they get up and running.”

Breeding programs are varied with many focused on developing rice varieties that can handle the impact of climate change. Rice is sensitive to heat, with higher temperatures producing lower yields. Molecular breeding approaches can accelerate the ability to select for heat tolerance and other important traits. For example, rising ocean levels will increase salinity of coastal water tables. “We’re using the technology for salinity tolerance,” Dr. Thomson said. “There already exist numerous salt-affected areas that grow rice, as well as unused land that could be opened up for rice production once salt-tolerant varieties are developed.

For example, in Bangladesh, there are long stretches along the coast where nothing can grow due to high salt concentrations in the soil and water. Rice researchers are also looking for traits that impart flooding tolerance, disease resistance, biofortification (high zinc or high iron), and improved grain quality. With rice, it’s important to have the right texture and taste.”

Employing next-generation sequencing (NGS) is the next step for IRRI and its partners. “We’re using the 384 SNP array as a genome-wide scan, but I see us moving towards genotyping by sequencing,” Dr. Thomson said. “Within a year or two, it looks like sequencing will actually be more efficient for genotyping. The difference is the data analysis component, with researchers needing informatics support to analyze the data. It’s surprising how quickly researchers pick up new technologies, get excited about them, and bring them back to their institutes. We never want to underestimate how quickly people can adopt new technologies. In Indonesia, agriculture researchers bought HiScan® and HiSeq® systems and set up a new facility for rice genome analysis. Everything is moving quickly.”

Dr. Thomson hopes that the IRRI’s efforts will result in a win–win situation for everyone. “We’re focused on technologies that will increase global rice production, with a goal of striking a balance between lower prices for consumers and lower production costs for farmers that will enable them to make a profit.”

References

1. http://irri.org/
2. http://www.cgiar.org/

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