



High-speed networking: decoding the diversity of rice

To meet world population demands for food it has been estimated that the production of rice, the world's most important staple food, must increase by 24% by 2050. As well as the challenges involved in growing more rice on less land and water, farmers need new rice varieties adapted to changing climatic conditions. The main objective of the International Rice Research Institute (IRRI) in the Philippines is to help farmers improve their yields and thus sustain their livelihoods – a mission that calls for joint efforts across the globe and for high-performance data communications networks, such as TEIN3, to facilitate data-intensive collaborative crop research.

Local livelihoods on the line

One of the consequences of climate change for many millions of rice farmers today is an increased risk of flooding. Although rice needs water to grow, most varieties can't survive being submerged for long.

Basant Kumar Rao is an Indian rice grower whose farm has been recently inundated. In earlier years this would have been a complete disaster, with his entire crop lost. This time, while little of his regular harvest could be salvaged, his crop of a new submergence-tolerant rice variety survived.

Teaming up to develop climate-proof rice varieties

IRRI scientists and collaborators have found a gene named Sub1 that allows rice to survive complete submergence for up to 17 days. The donor rice line with the Sub1 gene is a traditional variety which is low yielding, but if the same gene can be added to popular varieties preferred by farmers, the results can be dramatic as shown in the image overleaf.

A breeding technique, known as marker assisted selection, was used to transfer tolerance, including submergence tolerance, to various biotic and abiotic stresses in popular rice varieties. To conduct this work, materials and genomic datasets needed to be exchanged between scientists working in a number of different rice growing countries in Asia and Africa. Other data that needed to be shared by scientists working across the various geographical locations included high-resolution geographic information system (GIS) data on growth, survival and agronomic characteristics of rice varieties and yield forecast.



Basant Kumar Rao surveys his crop of submergence tolerant rice. "I trust Swarna-sub1. I'll keep growing it."

The Challenge

To meet the International Rice Research Institute's (IRRI) mission to help farmers improve their yields and sustain their livelihoods by developing resilient rice varieties, the success of which is heavily dependent on international collaborative research.

The Solution

Through its connection to PREGINET, the Philippine research network, IRRI scientists are able to access the high-capacity TEIN3 and GÉANT networks to exchange multi-gigabytes of genetic data with research centres in Europe and other parts of the world.

Key Benefits

TEIN3 enables IRRI's researchers to work with collaborators globally to analyse rice varieties rapidly and improve their yields and resilience, thereby tackling the challenge of ensuring food security.





End-result harvest of plots planted with the same rice variety with and without submergence tolerance gene (*Sub 1*) added: 3.8 v 1.4 tons/hectare.

DNA data transfer: Building a bigger picture with advanced communications links

Although the gene bank at IRRI holds over 109,000 known varieties of rice, relatively few of these have been used by the world's rice breeders. Advanced connectivity has an essential role to play in unlocking the potential of the gene bank.

Recently an international team of collaborators published details of a study on genetic diversity of 20 different varieties of rice, laying the foundation for the discovery of traits and their associated genes which are important for rice improvement. Understanding genetic diversity in rice at a molecular level is the key to improving important rice traits associated with higher yield, disease resistance, drought and flood tolerance, and human health benefits.

IRRI's scientists and collaborators at Cornell and Colorado State University in the US, as well as research organisations across the world are now applying next-generation DNA-sequencing technology to the genomes of over 60 rice varieties. Before long, 2,500 rice varieties will be genotyped with 600,000 markers.

IRRI scientist and first author on the recent study, **Dr. Ken McNally**, says:

"Tens of gigabytes of data generated in the initial study were shared with collaborators and published on external databases

to make them available to researchers around the world. The data volumes will rise dramatically in future."

"It would be impossible for IRRI to participate in this kind of scientific research, which requires collaborators to share and analyse massive amounts of raw data on a regular basis, without the benefit of advanced research network connectivity."

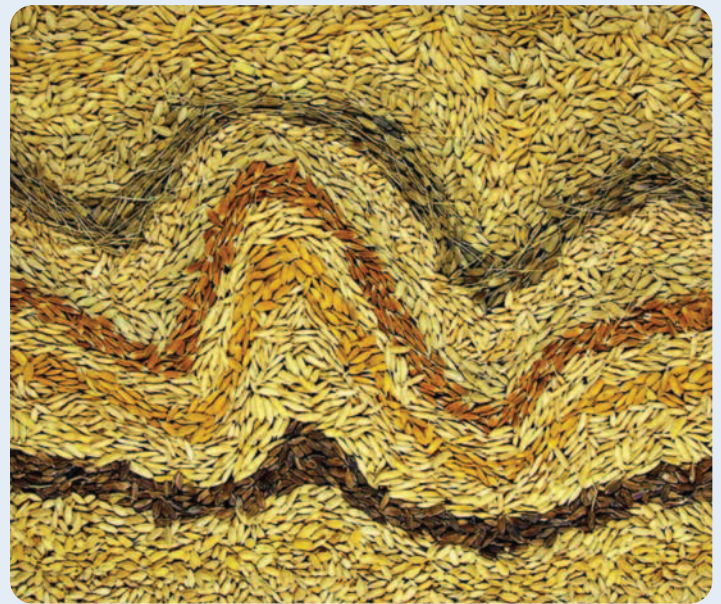
IRRI is connected to the national PREGINET network in the Philippines and is linked thereby, via TEIN3, to international collaborators on the pan-European GEANT network, as well as to colleagues in other parts of the world.

TEIN3: A powerful tool to ensure food security

IRRI collaborator **Dr. Detlef Weigel** of the Max Planck Institute of Developmental Biology in Tübingen, Germany, says:

"This is a milestone achievement that is key for the next phase of exploiting the genes that have been accumulated over millennia in the many rice strains available at IRRI and in gene banks at other rice breeding institutes worldwide."

IRRI scientists expect many new varieties of rice to be developed using marker assisted technology and that they will be important in adapting rice agriculture to climate change. TEIN3 will continue to contribute to tackling this challenge of ensuring food security.



TEIN3 – the research and education network for Asia-Pacific

- the third generation of the Trans-Eurasia Information Network
- dedicated high-capacity IP network for the research and education communities across Asia-Pacific
- provides direct connectivity to GÉANT and a gateway for global collaboration for over 45 million users in Asia-Pacific
- supported by €11.4m EU funding until 2012

For more information:

TEIN3: www.tein3.net

GÉANT: www.geant.net

PREGINET: www.pregi.net

IRRI: www.irri.org

EC: http://ec.europa.eu/europeaid/index_en.htm

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