[Voice] Contribution to Science and Technology Diplomacy through Molecular Breeding Research of Cassava, a Useful Tropical Crop

From Japan On Dec. 10, 2013

Motoaki Seki, Ph.D.
Team Leader
Plant Genomic Network Research Team
RIKEN Center for Sustainable Resource Science

Professor
Plant Genomic Network Science Division
Kihara Institute for Biological Research
Yokohama City University

Research Theme: Advancement of Asian Cassava Molecular Breeding by Cutting-edge Technologies

Genome Research Advancement and Real Pleasure of Research:

I started my plant functional genomics research, which later led to international collaborative research, when I became a post-doc researcher at the Plant Molecular Biology Laboratory (PI: Dr. Kazuo Shinozaki) of RIKEN in 1995. Research on plant genome will eventually help us maximize potential of plants. I found this research rewarding because of its scientific and social significance. Fortunately, the functional genomics research at the RIKEN has made remarkable progress, including the large-scale analysis of full-length cDNAs in a model plant, Arabidopsis, from the beginning of my career at the RIKEN until the early 2000's. I was a senior scientist of the Plant Functional Genomics Research Group, RIKEN Genomic Sciences Center (GSC) during this period, and some of my research achievements were published in several international journals such as Science. The fact that my research has partly promoted plant research of the world encouraged me to continue my research.

Then, I was appointed as a Team Leader of the RIKEN Plant Science Center (PSC), where I continued to study plant functional genomics. I also tried to find a new research candidate other than Arabidopsis and found a tropical crop, cassava.

Cassava, a Useful Tropical Crop:

Cassava is often referred to as a "useful tropical crop." Its leaves are processed into livestock feed, and tapioca starch stored in its roots is used as various type of biomass materials

including food, fuel, plastic, amino acid, film and glue. Because cassava stems can be used for propagation by keeping it in the soil without fertilizer, it is an important crop that provides food security and income generation in many tropical countries.

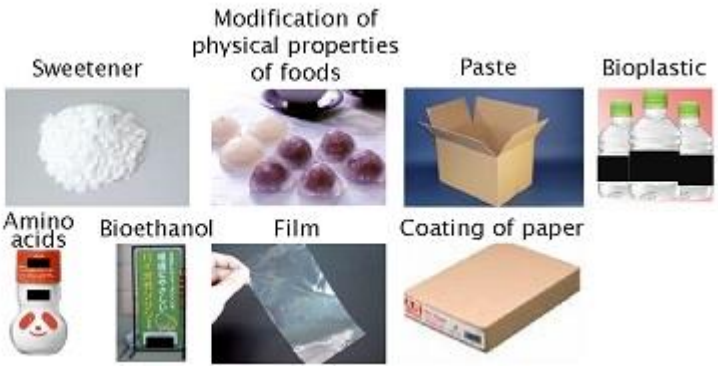

Figure 1.(left) Cassava Plants
Figure 2.(right) Industrial Use of Cassava

I have been interested in cassava since my old friend, Dr. Manabu Ishitani, a senior scientist at the International Center for Tropical Agriculture (CIAT), told us how useful cassava is. As sustainability of the global environment has been an important issue, I have wanted to contribute to solution of food and resource issues. So I started the cassava research on advancement of cassava molecular breeding in collaboration with CIAT in 2005. We thought that it is important to apply cutting-edge genome technologies and to identify the molecular function of the cassava genes for the advancement. My original goal of the research was large-scale isolation of cassava full-length cDNAs and identification of the useful genes, such as increased starch yield and stress tolerance. Little progress had been seen for cassava genome analysis in those days, and our group has reported the large-scale isolation of the cassava full-length cDNAs in 2007 for the first time.

After a few years of steady effort, I made remarkable progress with my cassava reseach when an international cassava collaborative research between RIKEN, Thailand, Vietnam and Colombia was launched in 2009.

The Research Team That Realizes Maximal Value from Each Location - Thailand, Vietnam and Japan:

I have been hoping that my research plays a part in science and technology diplomacy since I started studying cassava. My first candidate for an Asian research partner country was Thailand, which is a leader of cassava research in Asia. Being one of the major

producers of cassava, Thailand considers cassava as a strategic crop of the country and has sophisticated technology of DNA marker-assisted breeding. DNA marker-assisted breeding is a technology to breed plants by analyzing a DNA sequence of a gene and utilizing a DNA marker that discriminates plant varieties. When I was looking for an Asian research partner, Dr. Ishitani (CIAT) referred me to his previous college peer, Dr. Jarunya Narangajavana, who has been a leader of cassava research at the Faculty of Science, Mahidol University, Thailand. seki004 I contacted her to propose an international collaborative research project, and she willingly agreed to join the team. Cassava resources of Thailand and cutting-edge genome technologies of Japan were brought together to take the research one step further to establish a research platform for cassava functional genomic analysis.

One problem is that even if we find a useful gene, we cannot breed a useful variety of cassava in a short time, because genetic engineering of plants in fields is regulated both in Japan and Thailand. So, we decided to ask Vietnam, where genetic engineering of crops is allowed to be applied to breed crops in farm fields, to join the team in 2010. Dr. Lam-Son Phan Tran, my colleague from RIKEN and a Vietnamese Principal Investigator (PI) at RIKEN PSC, and Dr. Le Tien Dzung, a RIKEN FPR fellow at Dr. Lam-Son Phan Tran's lab helped us to find a right person to contact, and they introduced me to Dr. Le Huy Ham, Director General of the Agricultural Genetics Institute (AGI). This is when we organized a collaborative research team between Japan, Thailand, Vietnam and Colombia.

Figure 3. With Dr. Ishitani (CIAT) and Dr. Le Huy Ham (AGI)

Figure 4. With Researchers from Thailand, Vietnam and CIAT (at AGI, Jan. 2014, e-ASIA Kickoff Meeting)

Harmony-Oriented Collaboration Style:

We efficiently carried forward our international collaborative research by discussing through e-mails and online conferences, how much progress we had made in our research to share common awareness of the issues. We also visited each other several times a year so that we can have a face-to-face discussion. One advantage of working with researchers from Asian countries is the geographic closeness; we are only about five to six hours away from each other by plane and are virtually in the same time zone.

Since all the researchers were very nice and had the capacity to work cooperatively, the research proceeded very well. It is very important to respect each other and work as a team when a research needs to be completed within a limited period of time. People live on rice both in Thailand and Vietnam, just like we do in Japan, and that may have generated a sense of affinity among us.

Most of the researchers from Thailand and Vietnam were younger than me. This is probably because their governments encourage competent young researchers to study abroad. Three Vietnamese and one Thai students have joined my lab since this collaboration was launched. I also hope to make a contribution to human resources development to help these students lead plant science research in their home countries in the future. When I was trying to find research partners, I realized how important it is to have a wide range of relationships. I believe that the development of human resources would result in building broader social networks.

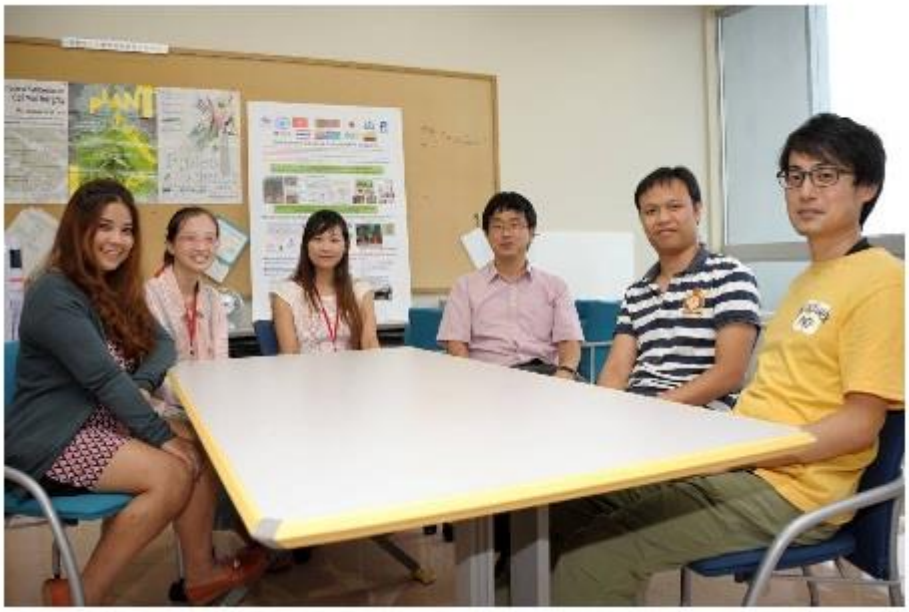

Figure 5. With Vietnamese and Thai Students and a Cassava Core Team Member (Dr. Yoshinori Utsumi)

Encouragement from Vietnamese Deputy Prime Minister:

Between 2009 and 2011, researchers from the four countries collaborated to establish a global-standard research platform for cassava functional genomics research. We will further study cassava using this platform. Another cassava collaborative research program with AGI and CIAT were launched at the joint laboratory (International Laboratory for Cassava Molecular Breeding, ILCMB; Please see the logo at Figure 3) in the AGI, Hanoi in 2012.

Dr. Nguyen Thien Nhan, Deputy Prime Minister of the Socialist Republic of Vietnam visited RIKEN's Yokohama Campus in May 2013 and attended a signing ceremony for a memorandum of agreement on further collaboration between the RIKEN Center for Sustainable Resource Science (CSRS) and the AGI for molecular breeding research of cassava. All of us, including research members, students and myself, were pleased by his visit and inspired to continue with the ongoing research using cassava and Arabidopsis.

Cassava may also have a stimulating effect on the social and economic development of Asia and Africa. In order to relate our research to so-called green innovation, we also need to work in collaboration with industry. Because some companies in Japan, Thailand and Vietnam have been showing increasing interest in cassava, we may be able to collaborate with these companies in the future. I would like to continue with research to maintain a good relationship, where Japan and Southeast Asian countries collaborate and take advantage of each other's

strengths toward our mutual development.

Figure 6. Presentation to Vietnamese Deputy Prime Minister during His Visit to RIKEN's Yokohama Campus

Profile

Motoaki Seki

Bachelor, Faculty of Agriculture, Kyoto University (1988) Ph.D., Faculty of Science, Hiroshima University (1994)

Postdoctoral Researcher, Laboratory of Plant Molecular Biology, RIKEN Tsukuba Life Science Center (1995) "Arabidopsis functional genomics and molecular responses to abiotic stresses in plants".

Research Scientist, Laboratory of Plant Molecular Biology, RIKEN Tsukuba Life Science Center, Japan (1998) "Arabidopsis functional genomics and molecular responses to abiotic stresses in plants".

Senior Scientist, Plant Mutation Exploration Team / Plant Functional Genomics Research Group, RIKEN Genomic Sciences Center (GSC) (1999)

"Arabidopsis functional genomics using full-length cDNAs and whole-genome transcriptome analysis in abiotic stress responses."

Team Leader, Plant Genomic Network Research Team, RIKEN Plant Science Center (PSC) (2006)

Guest Professor, Plant Genomic Network Science Division, Kihara Institute for Biological Research, Yokohama City University (2008)

Team Leader, Plant Genomic Network Research Team, RIKEN Center for Sustainable Resource Science (CSRS) (2013)

Research Interests:

1. Analysis of RNA regulation mechanisms in environmental stress adaptation and acclimation.
2. Analysis of epigenetic regulation mechanisms in environmental stress adaptation and acclimation.
3. Development of useful plant resources such as stress-tolerant plants by use of chemical compounds.
4. Analysis of cassava regulatory networks of starch biosynthesis by integrated omics analysis and development of useful cassava plants such as improved plant productivity.