Hon-Ming Lam – Professor, School of Life Sciences, CUHK Hong Kong

“My ultimate goal is to connect academic to application and take my research from laboratory to the field."

31.08.2018

Tags: Hong Kong, China, Biotech, Plant biotech, Soybeans

Professor Hon-Ming Lam, a renowned scientist specializing in soybean genomics, shares his passion for his research, the importance of soybeans to China’s future environmental and growth sustainability, his insights on Hong Kong’s ambition to become an innovation and technology hub, and his perspective on how government, industry and academics should collaborate in support of education initiatives.

Professor Lam, as a renowned scientist in plant biotechnology and expert in gene function, could you share a little about your research interests in soybean genomics?

I have been working on soybeans since I returned to Hong Kong in 1997 so it has been a 21-year journey now. Having received my PhD, which was actually in molecular biology, and finished postdoctoral training in the US, when I returned to Hong Kong, I wanted to apply my knowledge to something that was more applicable to the needs of China. At that time, many researchers were entering the medical field, in part because it was easier to attract funding.

With my background in plants, however, I looked at a different option. China was then still a very rural, developing country – and even today, despite the amazing economic growth of the past few decades, some parts of China remain rural. With limited land and water resources coupled with the huge agricultural needs of 1.3 billion people, intensive use of fertilizer in Chinese agriculture has started to result in long-term negative environment impact. Therefore, I decided to research ways to increase soil productivity and therefore farmers' incomes without affecting environmental sustainability.

Soybean occurred to me because of its nitrogen fixation capability, which can replenish depleted nitrogen stores in the soil naturally. Soybeans also originated from China so there was some sentiment involved too. In addition, Chinese agricultural scientists then were focusing more on staple crops like wheat and rice. With China's relentless economic growth, I expected that environmental sustainability will inevitably become a huge issue in the future. I also thought that China will increasingly be dependent on foreign countries like the US and Brazil for soybean imports.

Serendipitously, I then met a retiring Chinese scientist who has worked on soybeans all her life. We bonded over her research and I offered to continue her work. That is how it all started.

Across your over two decades of work, what have been some of the key milestones?

In 2008, I recognized the revolution occurring in genome biology. Genome sequencing costs had gone down due to new technology development. I heard that there were two other groups, one in the US and one in South Korea, also working on sequencing soybeans. Back then, it was still a risky endeavor because it was early, still expensive, and no one knew what the potential results might be. For this reason, I went to BGI, a Shenzhen-based institute that has one of the largest gene sequencing capabilities in the world. At that time, they were still focused on the human genome though they had sequenced a couple of plants, starting with the cucumber. One of the founders, Dr. Henry Yang, was one of the pioneers involved in the Human Genome Project. Having convinced them about the importance of soybeans to China, we asked for funding support from the Chinese University of Hong Kong (CUHK).

In January 2010, the American group published the first cultivated soybean genome in January in *Nature*. In December, we published our first milestone paper in *Nature Genetics*, which compared the genomics of different cultivated and wild soybean varieties from China and elsewhere. We thought that would make a huge splash – and indeed, it became the cover story in *Nature Genetics* that month! Two weeks later, the Koreans also published their paper in another reputable journal.

Together, the three groups set the agenda for soybean genomic research. Now that we have paved the way, many other research groups have since entered this niche. I quickly realized, however, that Hong Kong lacks the scale to compete effectively in terms of large scale sequencing. The mainland Chinese government can make huge investments that Hong Kong cannot match.

For this reason, I switched to focus on finding a gene that can be shown to be useful. Genomic analysis is all about correlation, whereas I wanted to identify and prove causation. I started with the trait of salt-tolerance because salinity is a problem in a large part of China. We first mapped many different regions for different characteristics like salt tolerance, growth period and so on, and I found that salt-tolerance is controlled by a specific genomic region. Then we did a more detailed analysis, and fortunately, we managed to find the target gene, which is an ion transporter, that was responsible for salt tolerance. This remarkable and pioneering discovery was published in *Nature Communications* in 2014.

For the first time, we showed that using a combination of genetics and genomic approaches, we can narrow a characteristic down to a single gene. This is a truly useful discovery and another breakthrough!

What are some of the practical applications of your research?

My ultimate goal is to connect academic to application and take my research from laboratory to the field. The gap between academic and practice is very noticeable in agricultural science. I wanted to see if my soybeans can help agricultural farmers in China, but I quickly realized that I cannot just offer my salt-tolerant soybean varieties to farmers. They need to have ownership over their crops, not me, and they know their problems and needs better than we do.

Therefore, I changed my strategy by working with local leaders to offer the screening services to help them screen their local soybean varieties for salt and also drought tolerance, which is important for northwest China in particular. Working with a colleague at the Gansu Academy of Agricultural Sciences, we successfully generated three double-tolerant varieties, and we received approval from the Gansu Provincial government to release the three cultivars to farmers.

One out of the three cultivars has very good adaptability so we will see if it can be used outside Gansu Province. Another one was tested in remote villages at high altitudes (higher than 2,100 meters), where you normally do not grow soybeans because the growing period is short and you will have difficulty with irrigation. But soybeans are beneficial to re-fertilize the soil there, which tends to be sparse anyway. Through a charity, we donated some seeds and we discovered that they grew very well! The last one is very good for the food industry so I reached out to a Hong Kong-based food company that agreed to award an initial contract of 50 tonnes to the farmers. In the future, hopefully they can formalize a supply chain and build a network.

We did not want to make a personal profit so we did not apply for any IP protection, mainly because I do not think the farmers can afford the IP fees. My purpose is not monetary gain.

More broadly, how would you assess the research and academic environment in Hong Kong?

We need to work on multiple aspects. Fundamentally, the right government policy is very important. At the moment, I think the government's blueprint is still too simplistic. It is not enough to simply say you want Hong Kong to be a technology hub – this is akin to asking someone to draw a picture with other two parameters. We need clearer policies for science and technology.

I think we also need to take a more international view instead of focusing too much on Hong Kong itself. For instance, agricultural sciences is not an area that draws a lot of attention in Hong Kong because we do not have much arable land. But technology crosses boundaries and is not just about production or goods, it is about the knowhow and expertise you have that can be exported. I think we should also look beyond China even, or the US and Europe. There are many developing countries where we can offer our knowledge and strengths to help their development. Many of these countries will probably follow in China's footsteps and undertake significant reforms in the next few decades. Government policy should be more concrete, forward-looking and international.

Education is also very important. I applaud the Hong Kong government for offering STEM financing: HKD 200,000 as a one-off to all high schools in Hong Kong, and HKD 100,000 to all primary schools! However, the Hong Kong education system is still very exam-oriented, which compresses innovation because students are overly focused on getting good grades. I am also very passionate about education and I am involved in many public outreach programs. I find it most energizing to speak to younger primary school students because they get so excited about new concepts without being concerned about being right. Older students focus too much on exams and tend to lose interest in things that are not included in the exams.

How are you involved in various education and STEM initiatives?

Personally, I advocate for adding value to STEM – and I mean human value. I therefore add an 'A' for liberal arts, humanities: 'STEAM'. This year, I organized a year-long STEAM program involving students from 13 high schools. In the first phase, I asked them to grow soybeans from seed to seed to observe growth and development, and the life cycle. I also gave them mini lectures on different aspects of agriculture needs and soybean research. In the second phase, I took them to Gansu Province to see the fields with their own eyes. I ask them to interview researchers there about the water conservation system in place, for instance. I will also ask them to take records on soybean fields under direct sunshine for half an hour to experience how difficult it is for the farmers.

In the third phase, I will give them real investigative possibilities based on their interests. If it is biology, they can develop DNA markers to differentiate different beans. For engineering, they can design new irrigation systems that can be controlled by their cell phones. The mission is to teach them how science operates, involves investigation and can help societies.

Fundamentally, working in education, we need to stimulate and enable students to enter science and technology areas. Then we will be able to build a robust talent pipeline.

In addition, a few years ago, I was approached by Amgen, one of the largest biotech companies in the world, to establish a branch of their innovative science education program in Hong Kong called the Hong Kong Amgen Biotech Experience (ABE). I introduced them to a science educator, Professor Victor Lau, at the CUHK Education Faculty.
We now have a great team and I am happy to say that the program has proven very popular. Our first program did so well that we gained a reputation, and many more schools wanted to join us after, but we can only handle around 25 to 30 schools for each intake. In fact, I spoke to the Amgen program director yesterday and she said Hong Kong's ABE program has one of the highest numbers of participants globally! For this reason, we have been invited to share our experiences and good practices globally. Sometimes we video some of our activities to send to Amgen as well. One factor for our success is that we have involved a combination of scientists and science educators. Another goes back to the concept of ownership. When we train the teachers in the schools, we encourage them to own the systems and syllabus. We provide set lesson plans and equipment but we emphasize them to personalize them and to adapt activities to their students. We also choose teachers with very strong motivations.

If industry can talk to academics more, not just in search of profitable product collaboration, but also on such educational initiatives to encourage more young people to join the industry, that would be great. For them, the investment is not that high but the potential long-term impact on students could be huge.

Ultimately, whether you are government, industry or academia, being forward-looking is critical.

See more interviews