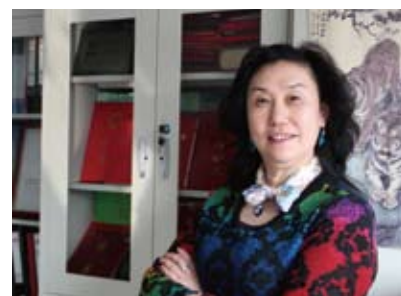


Fruit Scientist TIAN Shiping: Using Biotechnology for Control of Fruit Diseases

By XIN Ling (Staff Reporter)

Fruit is an important source of minerals and vitamins in the human diet. However, how to maintain the quality of postharvest fruits has been a long-standing problem for botanists all over the world. At the foot of Fragrant Hills in the western suburbs of Beijing, a group of scientists from the Institute of Botany, Chinese Academy of Sciences have been exploring biological and genetic means to answer that old question. Under the leadership of Prof. TIAN Shiping, the team scored remarkable progresses in recent years and has become a leader in the field.



Prof. TIAN Shiping.

Biological Control of Postharvest Diseases: Using New Technologies to Answer Old Questions

In her office decorated with green plants and colorful

flowers like a mini garden, Prof. TIAN skillfully cut open a navel orange for the *BCAS* reporter. “Have some. Want to keep young? Eat more fruits,” she laughed.

According to Prof. TIAN, fruit is not only essential for our daily nutrition but economically significant to China,



Prof. TIAN Shiping and her student doing experiments in the lab in 2013.



the world's largest fruit producer and exporter. However, while increasing fruit production by 5% is extremely hard, it is common to see piles and piles of them rotting after harvest. "In China, nearly one third of harvested fruits are decayed every year. The loss is beyond 16 billion dollars," she pointed out.

The traditional practice of using chemical fungicides to control postharvest diseases has led to severe food safety problems and environment pollution. Therefore, scientists came up with a new method called "biological control" which has emerged as an effective strategy to combat major postharvest diseases of fruits and vegetables. The main idea of biocontrol is to find certain microorganisms along the food chain, "antagonists" as they were called, which can naturally prohibit the growth of pathogens.

"Biocontrol became my research focus after returning China from Italy in 1997," Prof. TIAN said. But before working out any practical biotechniques, she needed to understand two fundamental scientific issues. One is the physiological characteristics and transformation of a fruit's postharvest life; the other is pathogens' acting mechanism and the fruit's "defense responses" to pathogen infection.

To begin with, Prof. TIAN and her colleagues needed to get some antagonistic microbes from the host. "We started isolating microbial agents from fruit surface with fruit washing, and then we identified their function against fungal pathogens and investigated their mode of action."

By far, the team has isolated more than six antagonist yeasts and confirmed their functions against major fungal pathogens causing decay in various fruits. The modes of action of the antagonist agents have been also ascertained to be mainly related with antibiosis, competition for nutrients and space, parasitism, as well as induced resistance. "Our study represents a more effective and reasonable 'source-control' means for food safety management," the professor emphasized.

After more than 15 years of endeavor, Prof. TIAN has become a leading figure in her field. With her efforts, her lab, her Institute, the Chinese Academy of Sciences and even China has become important names in postharvest fruit study around the world.

"Writing Our Research Results on the Chinese Landscape"

Besides the use of modern technologies, Prof. TIAN's research is unique in its application-oriented nature. A decade ago, when many botanists were obsessed with pure theoretical research on model plants like *Arabidopsis thaliana*, Prof. TIAN was clear what she was after. In her words, "even if we gain a thorough understanding of

Arabidopsis thaliana, it won't be readily applicable to the study of apples, oranges or cherries. As agricultural scientists, we must listen to the voices of farmers."

"I agree with President BAI when he says 'our research results should be written not only in scientific journals but on the vast Chinese landscape'," she quoted CAS President BAI Chunli as saying.

And Prof. TIAN lived up to her scientific ideals. Her lab has been strongly involved in the collaboration with local governments and enterprises, offering their findings to farmers – often for free or at very low prices.

She still remembered when in 1999 a group of officials from Dalian came to her institute to look for a postharvest expert for their local sweet cherry base. Without ready-made technologies at hand, Prof. TIAN decided to take up the challenge. She threw herself into the field and worked day and night with coworkers. Several months later, she developed a whole set of storage technologies for sweet cherries, including the application of salicylic acid at the right time before harvest to enhance fruit resistance, the use of antagonists in harvested fruit to combat pathogens, as well as a storage scheme combining refrigeration with controlled atmosphere storage.

Prof. TIAN invited the officials to taste the cherries she preserved over a period of time. "The director showed his thumb to me, 'Unbelievable! Almost as fresh as those just picked off from the tree'," she was proud. Since then that cherry base has expanded tenfold in area.

In Shaanxi Province, Prof. TIAN's team settled the cracking and pest infestation problems for over 60 thousand hectares of jujubes, a time-honored special produce of the region. They also designed postharvest storage and drying technologies for local enterprises. Thanks to the jujubes' superior taste and nutrition, they have become a popular gift choice across China and the unit price can reach 0.25 dollars per jujube.

For a mango base in Panzihua, Sichuan Province which has been suffering long from anthracnose, Prof. TIAN and colleagues used oxalic acid to induce mangos' immunology before harvest and effectively reduced latent infection in the field. They also set up a set of integrative storage technologies including precise concentrations of O₂ and CO₂ in controlled atmosphere and temperature to maintain quality and extend postharvest life of mango fruit. By far, the base has enlarged by more than twentyfold in area.

On Prof. TIAN's desk there is a cone-shaped glass container filled with colorful fruits and vegetables — golden kumquats, red cherry tomatoes and green cucumber slices — immersed in a kind of specially prepared vinegar. "They



Elaborate fruit vinegar products, developed by Prof. TIAN and a farmer from Shandong, have become a ready seller on the western market.

are edible. But western people like to place it on the dining table as a piece of artwork,” she introduced with a smile.

“It was a successful marriage of my lab’s technology and the idea and design of a farmer from Shandong Province about ten years ago. They are popular on the western market. They’ve brought good profits to my partner; he’s running an investment company nowadays,” she continued, pointing at more of those elaborately designed fruit vinegar products shown on her computer screen.

As the professor looked back, her research has not only answered the inquisitive heart of a scientist, but given concrete help to farmers in the field. “Maybe that’s why I can keep working on the subject for so many years.”

A Double Driven Scientist: From Interest to Responsibility

However, she did not expect to go into agriculture at the very beginning.

Born in a military family in Sichuan in 1957, TIAN lived and worked in the countryside as a young girl, being keenly aware of the hardship of rural life. In 1978, she passed the national college entrance exam, but was assigned to study agriculture in a small and remote university.

“I was depressed, but my parents encouraged me to go ahead. They influenced me a lot, especially with their integrity and devotion to work,” she recalled. “Fortunately, as I settled down to study, I naturally became interested in horticulture and fruit sciences and have stuck to them since then.”

After graduation, TIAN worked as a young scientist at the Sichuan Academy of Agricultural Sciences. In 1991, she

got a chance to study at the University of Bologna — the oldest university in human history.

“I went there as a visiting scholar. But as soon as I arrived in Italy, I was fascinated by the working conditions and beautiful sceneries there. I decided to apply for postgraduate study. To achieve that goal, I worked very, very hard, often being the first to reach and last to leave the lab. My teachers saw my performance and determination, and helped me win a four-year scholarship from the local government. I passed the entrance exam with good marks.” In 1995, TIAN Shiping became her university’s first PhD graduate from China.

In 1997, she decided to return China and go on with her studies in fruit sciences. Nearly a year after she joined the Institute of Botany, she received a five-thousand-dollar grant from the institute’s director general — her first research funding since coming back — and was glad to start her own lab.

“Under the Academy’s Knowledge Innovation Program, my lab grew up quickly and it pushed me to move forward.” Today, Prof. TIAN’s lab is a big family that pools more than twenty scholars from research professors to graduate students, with sustaining support from major funding agencies like the National Natural Science Foundation of China, the Ministry of Science and Technology and the Chinese Academy of Sciences.

“My classmates in the United States even envied me for having set up a research empire in Beijing,” she laughed.

Prof. TIAN said she had been driven by two things: academic interest and a strong sense of responsibility — a simple faith that a scientist should never quit his or her research easily.



In Prof. TIAN's eye, the success of a scientist mainly depends on, rather than intellectual advantages, how hard he/she works and how long he/she keeps working before getting to important achievements in a specific field. Loving science means more than an inspiration. It calls for whole-hearted devotion and perseverance.

"My generation has undergone dramatic social changes in the last fifty years, so maybe we are endowed with a stronger sense of responsibility," she noted.

As for women scientists, they often show more tenacity in work compared with male colleagues. However, due to their traditional roles in the family, their career faces more difficulties, she remarked.

Prof. TIAN would never forget the days when she had to look after her newborn girl and study English at night for studying abroad. During the six years in Italy, she missed her daughter and family very much — "As there are gains there must also be losses, I said to myself. I didn't allow myself to give up. So here I am."

Working for a Better Future of Postharvest Pathology in China

Standing at the frontier of postharvest pathology, Prof. TIAN saw more to be done in front of her.

A big concern is that compared with developed countries, the industrialization of biotechnology-based postharvest disease control in China is seriously lagging

behind. The gap mainly comes from the obstacles in technology extension rising from the nation's existing agricultural structure.

"In China, most growers are also sellers of their produces. Under such small-peasant economy, it would be extremely difficult for our technology to reach the farmers from house to house," the professor explained. "We have to strengthen our ties with enterprises because one day they'll lead the agricultural development in China."

Prof. TIAN praised some efforts made by the Chinese government in this regard, including a nationwide program launched recently to bridge farmers and supermarkets for the distribution of agricultural products. She believed the government should continue to promote such programs with greater efforts.

"Structural change needs time and scientists need patience," she said in a self-mocking tone.

Prof. TIAN's goals in the coming years also include training more talents to boost the development of postharvest pathology. As the supervisor of a total of two dozen postgraduates in the past fifteen years, she sincerely hoped her students hold on to their scientific pursuits. She was glad to see more and more outstanding young researchers working in her field or related fields. "I'm inspired to know that many of my students have chosen to continue their research in China, at CAS institutes or local universities. I wish the best for them, and for the future of postharvest pathology in China," she smiled.



Prof. TIAN and her colleagues in the spring of 2009.