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Areas of Research

Pear germplasm resources and genetic breeding, Pear genomics and gene function research, Mechanisms of self-incompatibility in pear, Fruit quality and regulation mechanisms.

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Research Interests

Evaluation and Innovation of Pear Resource, Genomics and Bioinformatics of Pear, Reproduction Physiology and Cell Biology, Fruit Quality and Regulation Mechanisms

I work as the director of the Centre of Pear Engineering Technology Research of Nanjing Agricultural University from 2006, which is affiliated to the State Key Laboratory of Crop Genetics and Germplasm Enhancement. I also served as the chief scientist of the China Agriculture Research System (Pear) from 2008. In 2015, the center was approved as National Pear Improvement Center Nanjing Subcenter. In 2019, the center was approved as Jiangsu Pear Engineering Technology Research Center.

The main research directions of this center include: Evaluation and Innovation of Pear Resource, Genomics and Bioinformatics of Pear, Reproduction Physiology and Cell Biology, Fruit Quality and Regulation Mechanisms.

1. Evaluation and Innovation of Pear Resource

More than 1,000 pear resources from home and abroad have been collected and preserved in our center. Over 50 important agronomic traits have been evaluated systematically, and the fingerprint of these resources have been also constructed. Meanwhile, we are interested in developing new resources and breeding new cultivars with elite traits, such as early maturity, disease resistance, high fruit quality, self-

pollination, red-color and other special characteristics. To date, we have nurtured more than 80,000 progenies from 100 hybrid populations, and innovated more than 50 new resources as cultivar candidates. Altogether, 6 new pear cultivars bred by our center have been approved and released publicly. In addition, high density linkage map has been constructed, and QTL loci related to skin color, content of stone cells, sugar and acid have been localized. Consequently, molecular markers tightly linked to these traits have been developed for the marker assisted selection in the cross breeding, and a total of 12 national patents have been authorized.

2. Genomics and Bioinformatics of Pear

Leading by our center, 60 researchers from China, USA and Japan have sequenced and released the first pear genome in the world. In this project, a length of 512.0 Mb sequence of 'Dangshansuli' was assembled, and more than 4,2000 functional genes were annotated. Specifically, the unique pear gene families and genes related to the stone cells and other traits of fruit have been analyzed. It firstly revealed that the 17 pear chromosomes are formed through whole genome duplication, chromosome recombination and lost event, and the high heterozygosity of pear genome has also been illustrated. Based on the whole genome sequence of pear, several new research fields have been developed in our center, such as the functional genomics, comparative genomics, and bioinformatics. World widely, we have constructed the pear genetic linkage map with highest density using the SNP and SSR markers developed from the whole genome sequence. Meanwhile, we have constructed the first public professional pear genome website (<http://peargenome.njau.edu.cn>), which has been widely used by researchers from 26 countries, and has been widely concerned and well appraised by domestic and foreign colleagues. In recently, more than 20 SCI papers in this filed were published.

3. Reproduction Physiology and Cell Biology

We are the earliest to study the interaction between pollen and pistil in pear around the world. Based on the result obtained over the past twenty years, we proposed a theory that inhibition of self-incompatibility pear pollen tube growth is due to the products of self-incompatibility gene (S gene). Furthermore, we have clarity that the phenomenon of programmed cell death occurred in the self-incompatibility pollen. In other hand, we have detected the roles of ion channels in controlling pollen tube transport and release gamete. We have identified and characterized a hyperpolarization-activated Ca²⁺ channel in the plasma membrane of pollen tube, and the effects of chemical messengers, such as spermidine and long-chain base phosphates, on pollen tube elongation has been uncovered. The overall publication in this project is more than 40 papers, and about 20 papers among them have been indexed by SCI, including the journals such as "Plant Cell", "New Phytologist", "Plant Journal" and "Journal of Cell Science". Moreover, these results have been positively cited by the papers published in high impact journals such as "Science". The research results in this project is highly original and creative; it provides important leaps forward in our understanding of the interaction between pollen and pistil in pear.

4. Fruit Quality and Regulation Mechanisms

Basing on industry requirements, research on fruit quality and developmental biology, including sugar, acid, stone cells, aroma, shape and color, has been being conducted in our research team. Besides, some techniques on quality regulation were developed and put into cultural practice, which have benefited the social and economic efficiency.

Education Background

Bachelor: Fujian Agriculture and Forestry University

Master: Shanxi Agricultural University

Doctor: Mie University

Work experience

1983.08-1985.08 Fu'an Agricultural Vocational School, Fujian Province, Lecturer

1988.08-1991.04 Horticultural Institute, Henan Academy of Agricultural Sciences
Assistant researcher

1991.05-1992.04 Fruit Tree Research Office, Mie Prefecture Agricultural Technology Center, Japan, Chinese researcher

1992.05-1994.12 Horticultural Institute, Henan Academy of Agricultural Sciences,
Associate researcher

1999.08- College of Horticulture, Nanjing Agricultural University, Professor

2004.10-2007.10 The Japan Society for the Promotion of Science (JSPS), Special Researcher

Honors and Awards

Awards

1) Award of Second Place for National Science and Technology Progress, "Breeding of new high-quality early and mid-ripening pear varieties and innovation of high-efficiency breeding technology", Ranked 1st, 2018.

2) Award of Second Place for National Science and Technology Progress, "Innovation and application of pear self-flowering germplasm", Ranked 1st, 2011.

3) The first prize of scientific research achievements of Shennong China Agricultural Science and Technology Award (2016-2017), "Innovation and application of excellent pear germplasm, quality improvement and efficiency technology", Ranked 1st, 2017.

4) Award of First Place for Ministry of Education Technology Invention, Development and application of pear high-efficiency tree shape and flower and fruit management technology, Ranked 1st, 2013.

5) Award of First Place for Jiangsu Province Agricultural Technology Promotion, Integration and promotion of key technologies for high-quality, safe and efficient

production of pears, Ranked 1st, 2014.

6) Shennong China Agricultural Science and Technology Award Outstanding Innovation Team (2018-2019), Ranked 1st, 2019.

7) Award of First Place for Ministry of Education Natural Science, Discovery of Excellent Genes for Pear Fruit Quality and Research on Molecular Breeding Technology, Ranked 2nd, 2015.

8) Award of Second Place for Ministry of Education Natural Science, Identification and application of self-incompatibility genotypes of pear and stone fruit trees, Ranked 1st, 2010.

Honors

1) 2012, Award of National Excellent Doctoral Dissertation

2) 2012, Instructor of Excellent Doctoral Dissertation of Jiangsu Province

3) 2020, A role model for moral education and teaching in Nanjing Agricultural University

4) 2019, Zhongshan Distinguished Professor in Nanjing Agricultural University

5) 2018, The First Top Ten Graduate Tutors of Jiangsu Province (Nomination Award)

6) 2017, The 12th Nanjing Top Ten Science and Technology Stars

7) 2017, The 1st Jiangsu Province Innovation Competition Certificate

8) 2013, 2016, Approved candidates for the first level (Young and Middle-aged Chief Scientist) of the fourth phase and the fifth phase of Jiangsu Province "333" high-level talent training project

9) 2014, National outstanding scientific and technological workers

10) 2012, Excellent Scientific and Technological Worker of Jiangsu Province

Selected Publication

1) Dongqing Shi#, Jun Wu#, Haibao Tang#, Hao Yin# , Hongtao Wang , Ran Wang , Runze Wang, Ming Qian, Juyou Wu, Kaijie Qi, Zhihua Xie, Zhiwen Wang, Xiang Zhao, Shaoling Zhang * (张绍铃), Single-pollen-cell sequencing for gamete-based phased diploid genome assembly in plants, *Genome Research*, 2019, 29(11): 1889-1899. **(IF 14.397)**

2) Xin Qiao, Qionghou Li, Hao Yin, Kaijie Qi, Leiting Li, Runze Wang, Shaoling Zhang* (张绍铃), and Andrew H. Paterson. Gene duplication and evolution in recurring polyploidization–diploidization cycles in plants. *Genome Biology*, 2019, 20:38 **(IF 16.497)**

3) Jun Wu#, Yingtao Wang#, Jiabao Xu#, Schuyler S#. Korban#, Zhangjun Fei#, Shutian Tao#,....., Shaoling Zhang* (张绍铃). Diversification and independent domestication of Asian and European pears. *Genome Biology*, 2018, 19(1):77 **(IF 16.497)**

- 4) Wu J (Wu, Jun);.....; Zhang SL (Zhang, Shaoling)* (张绍铃). The genome of the pear (*Pyrus bretschneideri* Rehd.). Genome Research, 2013, Vol 23, Num 2: 396-408 (IF 14.397)
- 5) Chen, J., Wang, P., de Graaf, B.H.J., Zhang, H., Jiao, H., Tang, C., Zhang, S*(张绍铃)., and Wu, J*. (2018). Phosphatidic Acid Counteracts S-RNase Signaling in Pollen by Stabilizing the Actin Cytoskeleton. Plant Cell 30, 1023-1039. (IF 9.996)
- 6) Ju-You Wu, Hai-Yong Qu, Zhong-Lin Shang, Shu-Tian Tao, Guo-Hua Xu, Jun Wu, Hua-Qing Wu and Shao-Ling Zhang* (张绍铃). Reciprocal regulation of Ca²⁺-activated outward K⁺ channels of *Pyrus pyrifolia* pollen by heme and carbon monoxide. New Phytologist, 2011, 189(4): 1060–1068 (IF 7.833)
- 7) Haiyong Qu, Shaoling Zhang* (张绍铃). Identification of hyperpolarization-activated calcium channels in apical pollen tubes of *Pyrus pyrifolia*, New Phytologist, 2007, 174(3): 524-536 (IF 7.833)
- 8) Wu JY, Qin XY, Tao ST, Jiang XT, Liang YK, Zhang SL. 2014. Long-chain base phosphates modulate pollen tube growth via channel-mediated influx of calcium. Plant Journal. 2014, doi: 10.1111/tbj.12576; pmid: 24905418 (IF 6.948)
- 9) Juyou Wu , Zhonglin Shang , Jun Wu , Xueting Jiang , Panagiotis N. Moschou , Wending Sun, Kalliopi A. Roubelakis-Angelakis , Shaoling Zhang*(张绍铃). Spermidine Oxidase-derived H₂O₂ Regulates Pollen Plasma Membrane Hyperpolarization-activated Ca²⁺-permeable Channels and Pollen Tube Growth. Plant J, 2010, 63: 1042-1053 (IF 6.948)
- 10) Wang CL, Xu GH, Jiang XT, Chen G, Wu J, Wu HQ, Zhang SL* (张绍铃). S-RNase triggers mitochondrial alteration and DNA degradation in the incompatible pollen tube of *Pyrus pyrifolia* *in vitro*. The Plant Journal, 2009, 57, 220-229 (IF 6.948)
- 11) C.-L. Wang, J. Wu, G.-H. Xu, Y.-B. Gao, G. Chen, J.-Y. Wu, H.-Q. Wu, S.-L. Zhang* (张绍铃). S-RNase disrupts tip-localized reactive oxygen species and induces nuclear DNA degradation in incompatible pollen tubes of *Pyrus pyrifolia*. J Cell Sci, 2010, 123: 4301-4309 (IF 6.29)

Reference

<http://yyxy.njau.edu.cn/info/1062/10270.htm>