



On the Way: Phytosanitary Education System in China

Prof. Dr. Zhihong Li

College of Plant Protection, China Agricultural University,
Beijing 100193, P.R. China
lizh@cau.edu.cn

**IPPC High-level Symposium on Cooperation of the Phytosanitary Measures
among the Chinese Initiative “One Belt” Countries
27-30 May 2019, Xi-An Shaanxi, China**

Outline

- The general situation of phytosanitary education system in China
- The practice of phytosanitary education in China: CAU as an example
- The challenges, opportunities and prospects of phytosanitary education in China



中國農業大學
China Agricultural University

I. The general situation of phytosanitary education system in China



Plant Quarantine

- **Official Control**
- **Public Participation**
- **Phytosanitary Education and Research**

Governments
Universities & Institutes
Other organizations

The origin of phytosanitary education system

- **The professional education of plant protection in China:** has a history dated back **1905**, courses of **Plant Pathology** and **Entomology** were opened in the College of Agriculture at Imperial University of Peking.



Group photo of teachers and students in the College of Agriculture (**The first graduates in 1913**)



Group photo of the graduates in the College of Agriculture (**1916**)



Establishment of the Department of Pest and Disease(**1923**)

(Photos cited from internet)



Dr. Bingwen ZOU

- **The earliest suggestion of plant quarantine in China:** in **1916** by Dr. Bingwen ZOU. He emphasized **the importance of plant quarantine.**



Dr. Fengmei ZHU

- **The first paper named as plant quarantine in China:** in **1927** by Dr. Fengmei ZHU. These papers emphasized the significance and basic methods of plant quarantine, including **the import quarantine and export quarantine.**

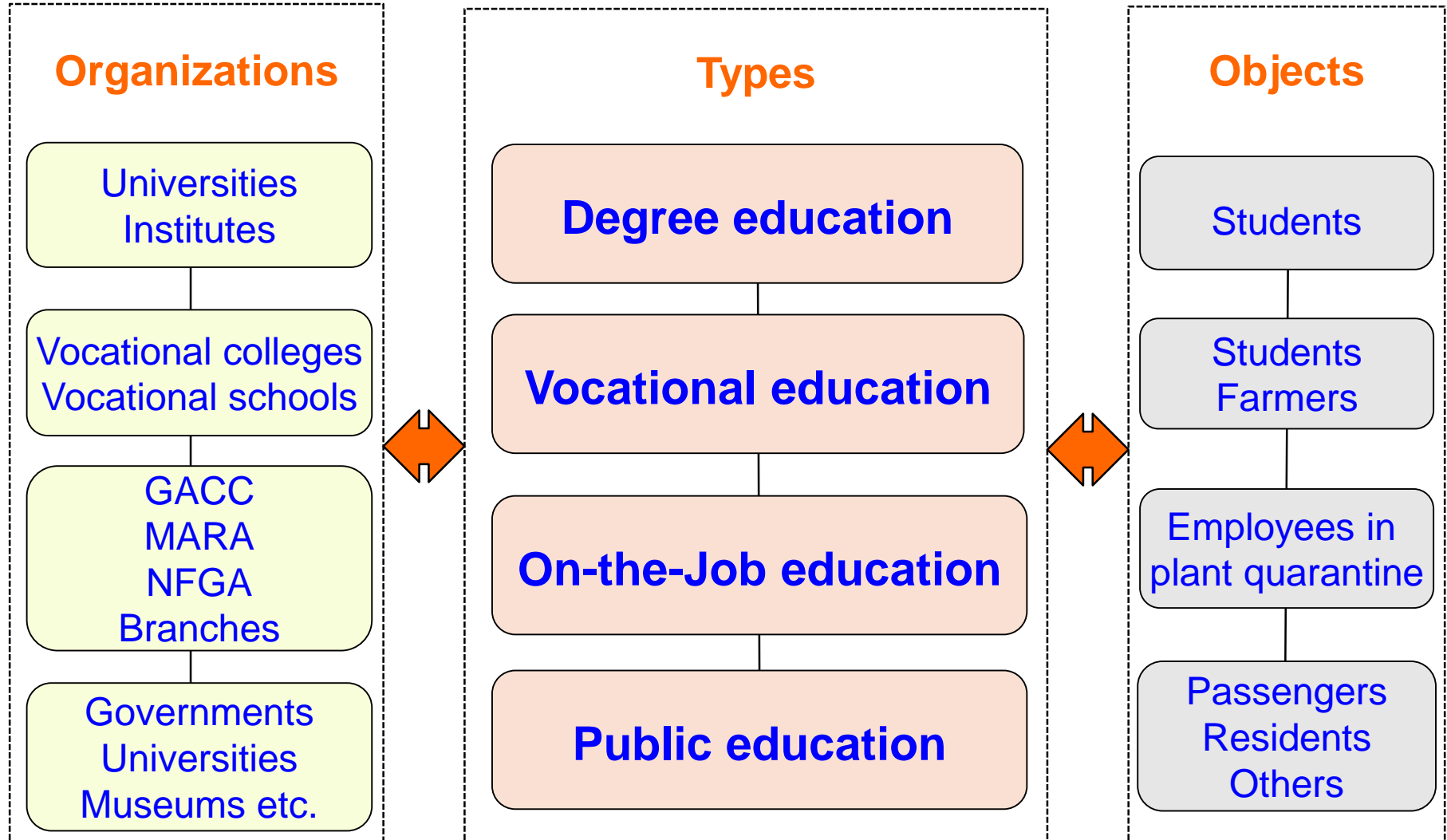
(Photos cited from internet)

- **From 2001**, as one member of WTO, China has faced more challenges from the **global market** and the international regulations.
- **In the trends of economic globalization and integration, pests are spread more quickly and widely in the world**, which are causing significant economic and biological losing of plants and plant products.
- **China pays high attention to the phytosanitary education** through **Four-in-One system**.



(Photos provided by quarantine officers in China)

The Four-in-One Education System



Public education: governments and universities mainly

- Passengers, regular program.
- Residents and other publics, periodical program.



The public phytosanitary education in China: phytosanitary regulations, phytosanitary procedures and quarantine pests

(Photos in 2017-2019, provided by plant quarantine workers in China)

On-the-job education: GACC, MARA, NFGA mainly

- Civil servants of plant quarantine, periodical program.
- Technicians of plant quarantine, periodical program.



**The on-the-job phytosanitary education in China:
national and regional technical training of plant quarantine**

(Photos cited from the related news of plant quarantine on internet)

Vocational education: colleges and schools mainly

- Junior college students, 3-year program.
- Farmers, periodical program.



The screenshot shows the CABTS (China Agricultural Broadcasting and Television School) website. The header features the CABTS logo and a blue wave graphic. The main navigation menu on the left includes: Education & Training, Academic Forum, Cooperation, Instructional Resource, and Publication. The central content area is titled 'Home' and displays a grid of images and text: 'Central Agricultural Broadcasting and Television School', 'agriculture' (with a building image), 'farmers' (with a van image), 'rural areas' (with a landscape image), and 'Nation Farmer's Science and Technology Training Center'. Below this grid is a 'NEWS' section with three items: 'National Working Conference for Presidents of CABTS Schools', 'Building Open Sharing Instructor Depository Management Platform for Promoting Further Implementation of New Type of Career Farmers', and 'Video Program of CABTS Awarded at the 19th China Sector Television Program Show'. On the left side of the page, there are several partner logos and links: '中国农业信息网' (China Agriculture Information Network), 'Rural Laborer Transfer Training' (www.nmpx.gov.cn), 'University of Saskatchewan Extension Division', and 'Agrifoodasia.com' (亚洲食品贸易开发中心).

Education and Training

Diploma Education



Using modern distance education and traditional training approaches, we provide secondary diploma education, post-secondary diploma education and cooperative higher education programs for rural people to study off-campus. The programs cover most areas of agriculture under the categories of crop cultivation, livestock, economics and management, agricultural engineering, forestry, agri-ecology, rural home economics etc

Enter

Training Programs



We also offer a number of types of training program including applicable agricultural technology training, Green Certificate training, youth farmers' training and etc We teach farmers both through distance media and face-to-face.

Enter

Rural Laborer Transfer Training



In 2004, six ministries as the Ministry of Agriculture, Ministry of Finance, Ministry of Labor and Social Security, Ministry of Education, Ministry of Science and Technology, Ministry of Construction cooperatively launched the 'Sunshine Program -

The farmer education in China: plant quarantine and IPM techniques

<http://www.crdenet.net.cn/>

Degree education: 50+ universities and institutes

- Undergraduates, 4-year program, Bachelor D.
- Postgraduates, 2-year / 3-year programs, Master D.
- Postgraduates, 3-year / 4-year / 5-year programs, PhD.



The degree education of plant protection in China: script, thesis, and dissertation.

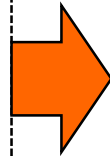
The two-level major structure of plant protection in China

Majors of undergraduates

Plant Protection

Pesticide Science

**Animal and Plant
Quarantine**



Majors of postgraduates

Plant Pathology

Agricultural entomology and Insect Pests
Management

Pesticide Science

**Plant Quarantine and
Agricultural Ecosystem Health**

Invasion Biology

Biosecurity

China Agricultural University

- US News & World Report (2018): Agricultural Sciences, the 4th university
- MOE China (2017): First-class university and 9 Top disciplines (including Plant Protection)

College of Agriculture at
Imperial University of Peking
(predecessor of Peking University)

1905

China Agricultural University

Merged by

- Beijing Agricultural Engineering University
- Beijing Agricultural University

1995

1949

Beijing Agricultural University

Merged by

- College of Agriculture of Peking University
- College of Agriculture of Tsinghua University
- College of Agriculture of North China University



中國農業大學



II. The practice of phytosanitary education in China: CAU as an example



- **Faculties:** 102 faculties, including 37 professors, 42 associate professors.
- **Students:** 990 students, including 401 undergraduates, 589 postgraduates (326 for Master Degree, 263 for PhD).
- **Directions:** 15 directions , for research and the education of postgraduates, including **Plant Quarantine and Invasion Biology (PQIB)**.



(<http://cpp.cau.edu.cn/>)

The Development of PQIB



- **From 1990 to 1995:** Specialization of plant quarantine, leading by Prof. Ruihua Jin and Dr. Hong Chen.
- **From 2001 to now:** Laboratory of plant quarantine and invasion biology (CAUPQL), leading by Dr. Zhihong Li.
- **From 2004 to now:** Direction of plant quarantine and invasion biology (PQIB), leading by Dr. Zhihong Li, especially the education of postgraduates.

The Missions of PQIB

- **Education:** training the undergraduates and postgraduates with advanced theory, method and technology of plant quarantine and invasion biology.
- **Research:** studying the techniques, measures and mechanism of prevention and control of quarantine pests and invasive alien species.
- **Service:** providing the technical guidance, decision supports and outstanding professionals of plant quarantine and invasive alien species management to government and other organizations.



The Team of PQIB (May 2019)

■ 22 supervisors:

- 10 faculties: 5 Prof. + 5 Associate Prof.
- 12 part-time supervisors: from phytosanitary institutes and centers, collaboration program from 2004

■ 66 students:

- 15 PhD students (4-year / 5-year program, 1 student from Bangladesh of English education)
- 36 Master degree students (2-year / 3-year program, 1 student from Bangladesh of English education)
- 15 undergraduates (1-year program)

The Education and Research of PQIB



The phytosanitary education and research in CAU:
more practices on course, thesis&dissertation, and society service.

The main courses

- **Plant Quarantine:** 32 hours, for undergraduates, required course of plant protection major, from 1980s.
- **Outline of Animal and Plant Quarantine:** 32 hours, for undergraduates, elective course, from 2001.
- **Treatment Technology of Plant Quarantine:** 32 hours, for undergraduates, elective course, from 2006.
- **Invasion Biology:** 32 hours, for undergraduates, elective course, from 2019.
- **Principles and Techniques of Plant Quarantine:** 48 hours, for postgraduates, elective course, from 2003.
- **IPPC and Plant Quarantine:** 32 hours, in English for postgraduates, elective course, from 2008.
- **Invasion Biology:** 32 hours, in English, for postgraduates, elective course, from 2011.
- **Professional English and Scientific Writing of Plant Quarantine and Agricultural Ecosystem Health:** 16 hours, for postgraduates, required course, from 2013.



More case studies of plant quarantine during courses:
The students from China, Pakistan, Bangladesh, Thailand, Malaysia, Egypt, South Africa, Malawi, Trinidad and Tobago, and Jamaica etc., 2017-2019.

The sub-directions of thesis and dissertation

- **Pest Risk Analysis:** quantitative assessment especially, techniques such as SOM, @Risk, CLIMEX/MaxEnt, ArcGIS etc.
- **Pests Identification:** molecular identification especially, techniques such as DNA Barcoding, PCR, Real-time PCR, Chip etc.
- **Pests Treatment:** environmentally friendly treatment especially, techniques such as fumigation, irradiation, heat and cold treatment etc.
- **Pests Invasion Mechanism:** invasive fruit flies and viruses especially, techniques such as genome, transcriptome, RNAi, informatics etc.



More training and more opportunities: advanced phytosanitary techniques + international and national communications.

The practices and services

- **Technical support in China:** PRA of import fruits and seeds, species identification of fruit flies, other stored insect pests and virus etc..
- **Decision support in China:** plant quarantine measures and standards for GACC, MARA, etc..
- **International services:** TAAO newsletters and other services, DNA Barcodes database of EIFF (e.g., for Papua New Guinea), ISPMs evaluation, etc.



More international and national services of plant quarantine:
Pests investigation, PRA, species identification and training etc.

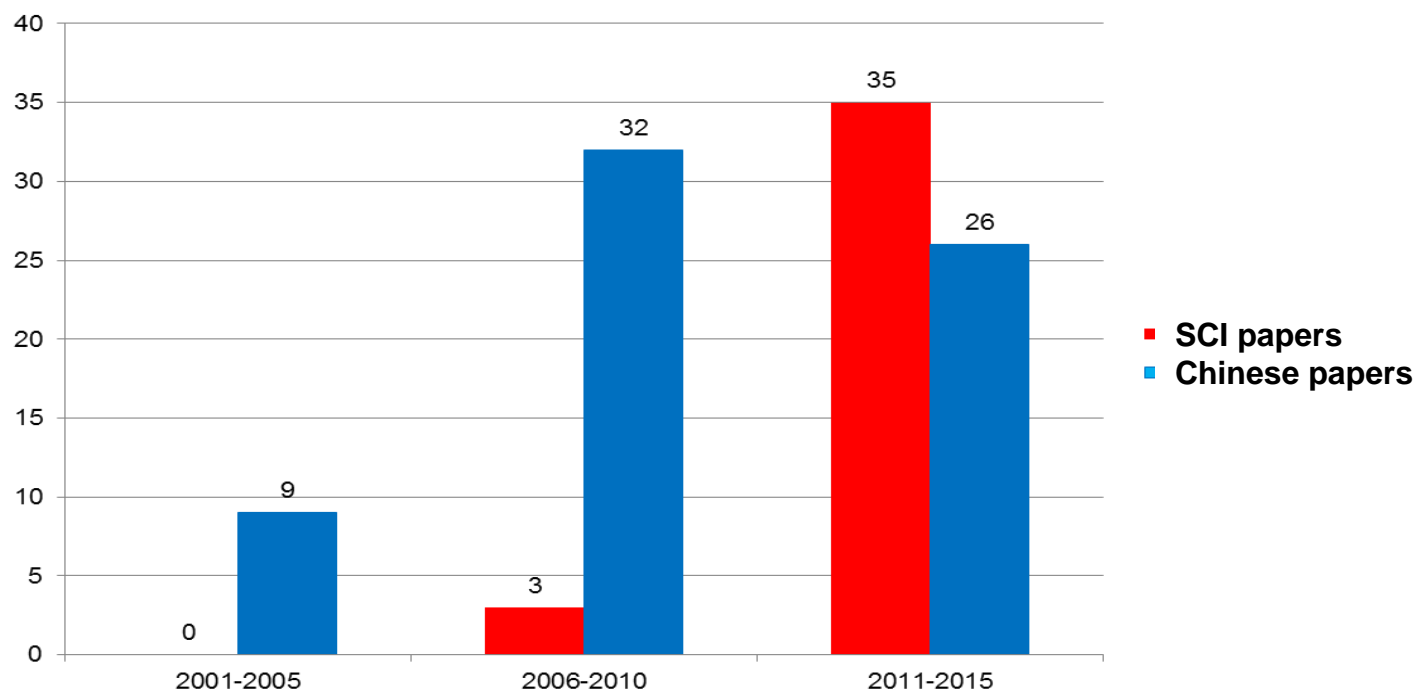
The Achievements of CAUPQL

- From 2001-2018: 78 Bachelors
- From 2005-2018: 67 Masters (including 5 international graduates)
- From 2007-2018: 23 PhDs (including 1 international graduate)



Most of the 168 graduates
are working in the fields of plant protection, especially for plant
quarantine and Invasion Biology.

- From 2001 to now, ~120 papers + 10 patents + 20 software copyrights on plant quarantine and invasion biology.



The number of papers during 2001-2015 in CAUPQL

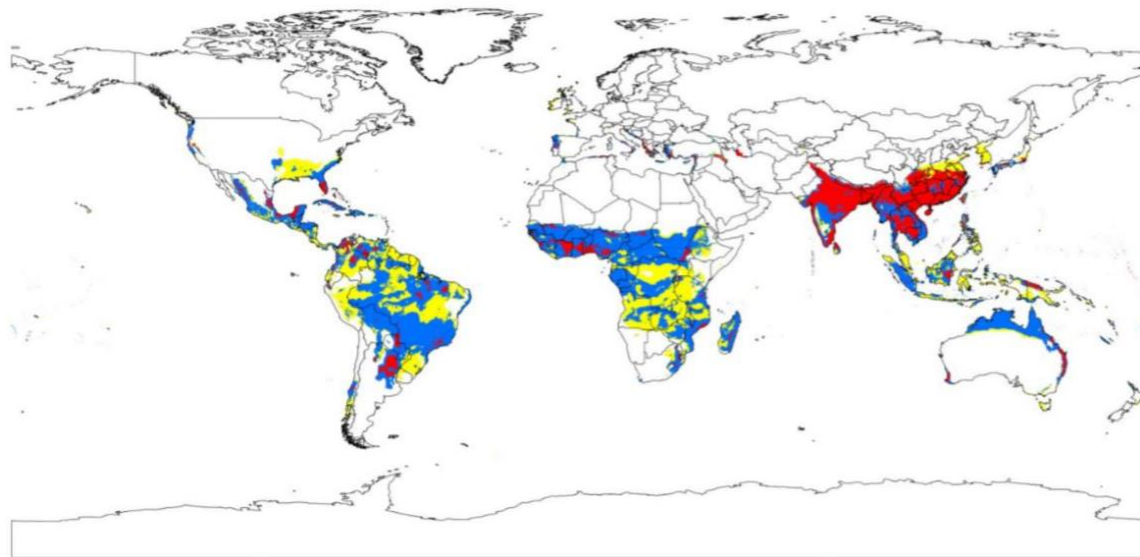
Climate change impacts on the global potential geographical distribution of the agricultural invasive pest, *Bactrocera dorsalis* (Hendel) (Diptera: Tephritidae)

Qin Yujia¹ Wang Cong² Zhao Zihua¹ Pan xubin² Li Zhihong^{1*}

¹Department of Entomology, College of Plant Protection, China Agricultural University, Beijing 100193, P.R. China

²Chinese Academy of Inspection and Quarantine, Beijing 100176, China

Correspondence: Zhi-hong Li, lizh@cau.edu.cn





Life table invasion models: spatial progression and species-specific partitioning

ZIHUA ZHAO,^{1,10} CANG HUI,^{2,3} RICHARD E. PLANT,⁴ MIN SU,⁵ TIM CARPENTER,⁶ NIKOS PAPADOPOULOS,⁷ ZHIHONG LI,¹
AND JAMES R. CAREY^{8,9}

¹Department of Entomology, College of Plant Protection, China Agricultural University, Beijing 100193 China

²Centre for Invasion Biology, Department of Mathematical Sciences, Stellenbosch University, Matieland 7602 South Africa

³Mathematical and Physical Biosciences, African Institute for Mathematical Sciences, Muizenberg 7945 South Africa

⁴Departments of Plant Sciences and Biological and Agricultural Engineering, University of California, Davis, Davis, California 95616 USA

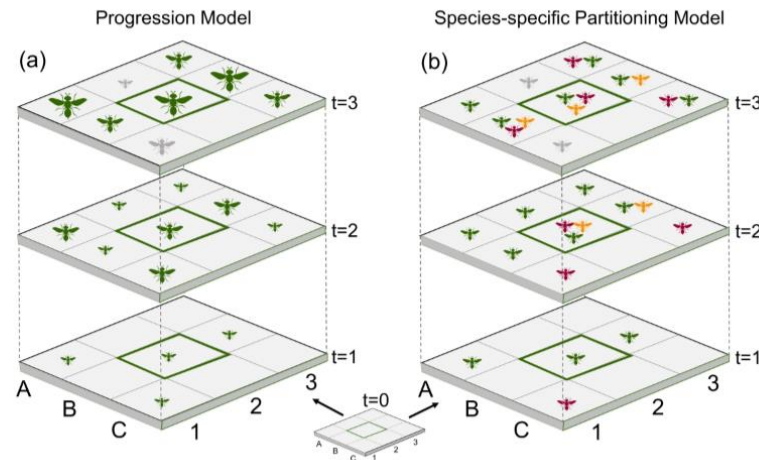
⁵School of Mathematics, Hefei University of Technology, Hefei 230009 China

⁶School of Veterinary Medicine, University of California, Davis, Davis, California 95616 USA

⁷Laboratory of Entomology and Agricultural Zoology, School of Agricultural Sciences, University of Thessaly, Thessaly 38446 Greece

⁸Department of Entomology, University of California, Davis, California 95616 USA

⁹Center for the Economic and Demography of Aging, University of California, Berkeley, California 94720 USA



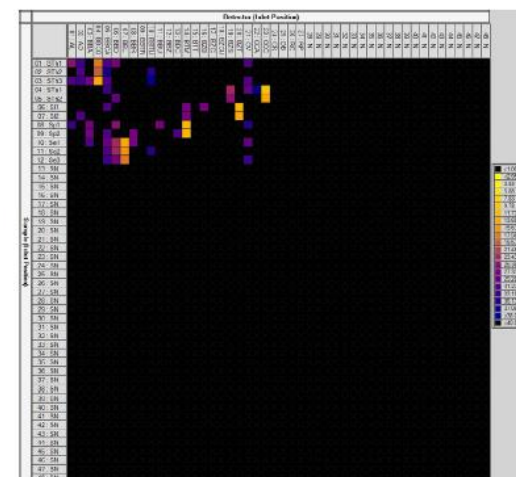
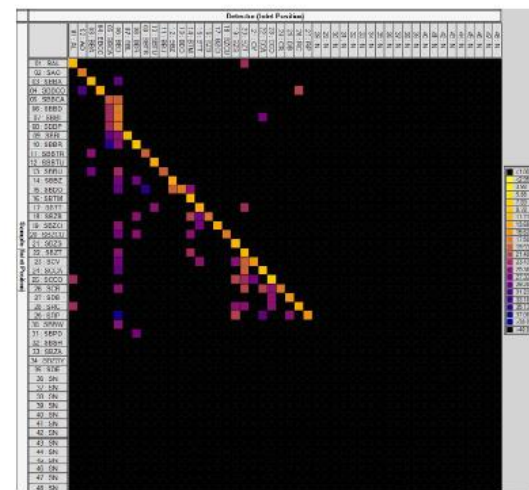
A high-throughput detection method for invasive fruit fly (Diptera: Tephritidae) species based on microfluidic dynamic array

FAN JIANG,*† WEI FU,† ANTHONY R. CLARKE,‡ MARK KURT SCHUTZE,‡ AGUS SUSANTO,§ SHUIFANG ZHU† and ZHIHONG LI*





*College of Plant Protection, China Agricultural University, Beijing 100193, China, †Institute of Plant Quarantine, Chinese Academy of Inspection and Quarantine, Beijing 100176, China, ‡School of Earth, Environmental and Biological Sciences, Queensland University of Technology (QUT), G.P.O. Box 2434, Brisbane 4000, Qld, Australia, §Faculty of Agriculture, Padjadjaran University, Jatinangor, 40600 West Java, Indonesia

Abstract

Invasive species can be detrimental to a nation's ecology, economy and human health. Rapid and accurate diagnostics are critical to limit the establishment and spread of exotic organisms. The increasing rate of biological invasions relative to the taxonomic expertise available generates a demand for high-throughput, DNA-based diagnostics methods for identification. We designed species-specific qPCR primer and probe combinations for 27 economically important tephritidae species in six genera (*Anastrepha*, *Bactrocera*, *Carpomya*, *Ceratitis*, *Dacus* and *Rhagoletis*) based on 935 COI DNA barcode haplotypes from 181 fruit fly species publically available in BOLD, and then tested the specificity for each primer pair and probe through qPCR of 35 of those species. We then developed a standardization reaction system for detecting the 27 target species based on a microfluidic dynamic array and also applied the method to identify unknown immature samples from port interceptions and field monitoring. This method led to a specific and simultaneous detection for all 27 species in 7.5 h, using only 0.2 µL of reaction system in each reaction chamber. The approach successfully discriminated among species within complexes that had genetic similarities of up to 98.48%, while it also identified all immature samples consistent with the subsequent results of morphological examination of adults which were reared from larvae of cohorts from the same samples. We present an accurate, rapid and high-throughput innovative approach for detecting fruit flies of quarantine concern. This is a new method which has broad potential to be one of international standards for plant quarantine and invasive species detection.



Population structure of a global agricultural invasive pest, *Bactrocera dorsalis* (Diptera: Tephritidae)

Yu-jia Qin^{1*}  | Matthew N. Krosch^{2*} | Mark K. Schutze² | Yue Zhang¹ |
Xiao-xue Wang¹ | Chandra S. Prabhakar^{2,3}  | Agus Susanto⁴ | Alvin K. W. Hee⁵  |
Sunday Ekesi⁶ | Kemo Badji⁷ | Mahfuza Khan⁸ | Jia-jiao Wu⁹ | Qiao-ling Wang¹ |
Ge Yan¹ | Li-huan Zhu¹ | Zi-hua Zhao¹ | Li-jun Liu¹ | Anthony R. Clarke²  |
Zhi-hong Li¹

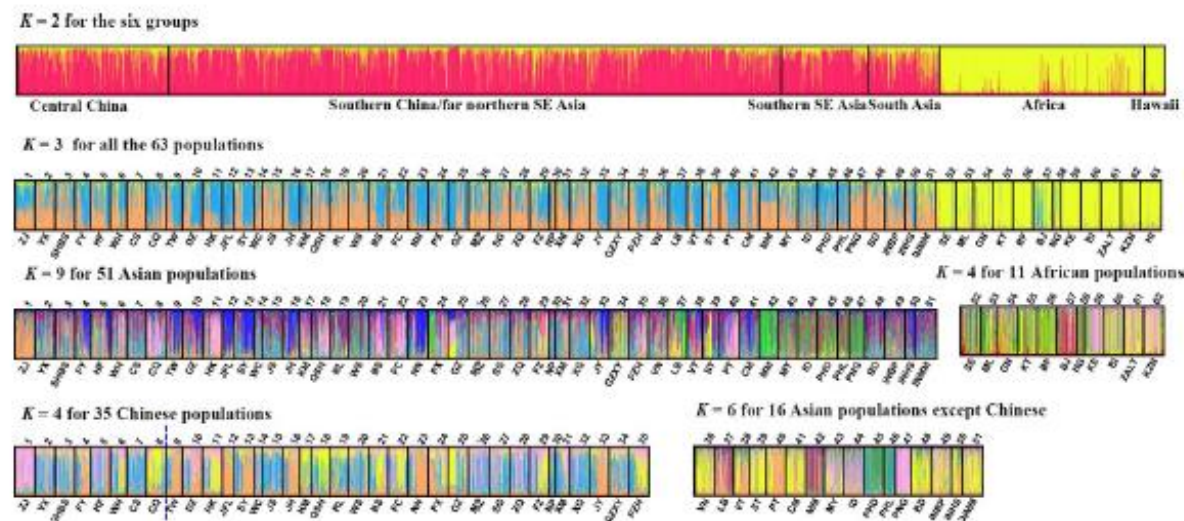


FIGURE 3 Bayesian results based on STRUCTURE of *Bactrocera dorsalis*. Individuals were grouped by six groups or 63 collection site according to Figure 1 and Supporting Information Table S1, each individual was represented by a vertical bar displaying membership coefficients, and the blue dotted line divides central and southern China

A transcriptional and functional analysis of heat hardening in two invasive fruit fly species, *Bactrocera dorsalis* and *Bactrocera correcta*

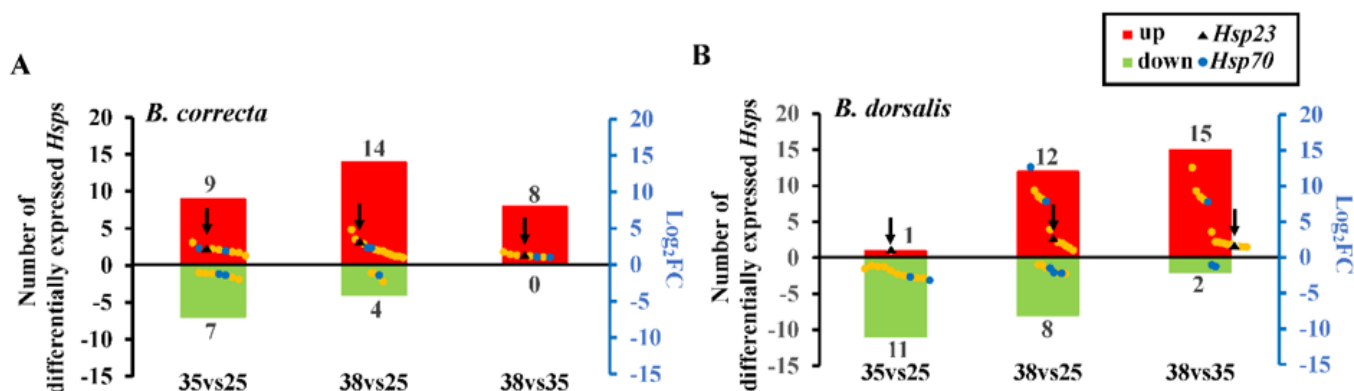
Xinyue Gu¹  | Yan Zhao¹ | Yun Su¹ | Jiajiao Wu² | Ziya Wang¹ | Juntao Hu^{3,4} | Lijun Liu¹ | Zihua Zhao¹ | Ary A. Hoffmann⁵ | Bing Chen⁶  | Zhihong Li¹

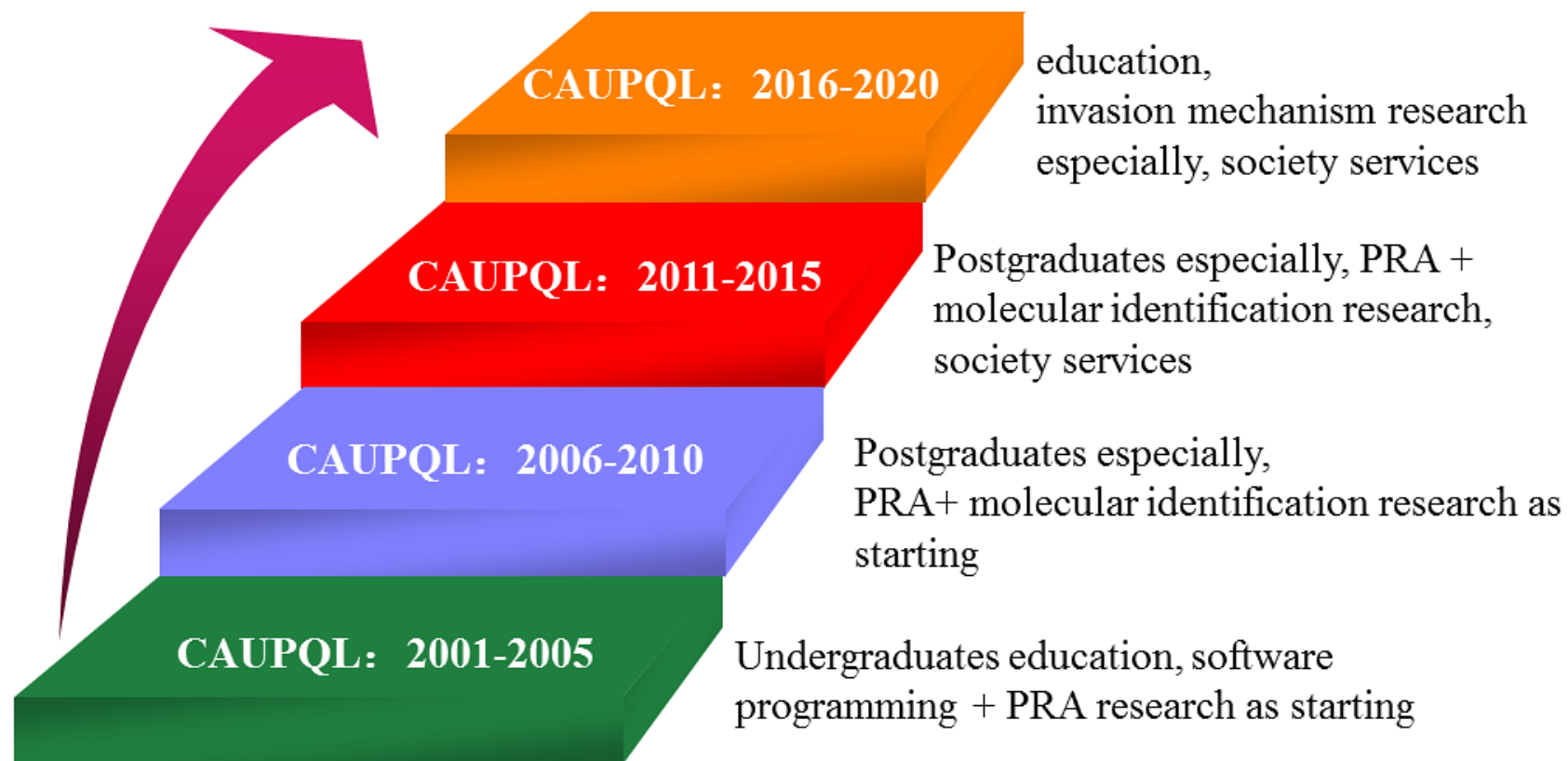
¹Department of Entomology, College of Plant Protection, China Agricultural University, Beijing, China

²Guangdong Inspection and Quarantine Technology Center, Guangzhou, China

Abstract

Many insects have the capacity to increase their resistance to high temperatures by undergoing heat hardening at nonlethal temperatures. Although this response is well





Main Development Steps of CAUPQL

**Our experience: the international collaboration is the basis for
phytosanitary education and research.**



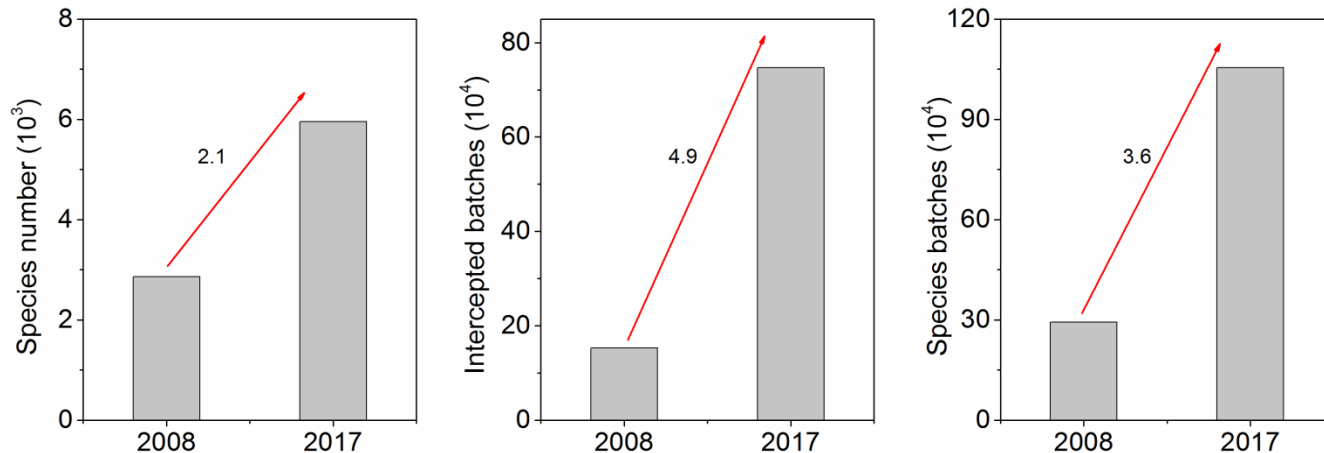
中國農業大學
China Agricultural University

III. The challenges, opportunities and prospects of phytosanitary education in China



The Challenges of Phytosanitary Education

- **Movement increasing:** especially the development of trade, tour and e-commerce. **For pests: So free trip!**
- **Global changing:** especially the development of climate change and nitrogen deposition. **For pests: So suitable environment!**
- **Pests evolving:** especially the development of invasive mechanism of pests. **For pests: So happy life!**



The increasing of pest intercepted data from import plants and products to China

The Opportunities of Phytosanitary Education

- **More attentions:** Public Education Day of National Security from 2015, including plant quarantine and IAS management.
- **More supports:** National First-Class University and Top Discipline Programs from 2017, National Key R&D Programs from 2016, and CSC program in recent 5 years.
- **More platforms:** One Belt and One Road Initiative, e.g., Collaborative laboratory and center. FAO-China SSC program and IPPC 2020-2030, e.g., 4 packages, ISPMs, Third party entities etc..



The FAO-China Workshop Roma, Nov. 2016



The IPPC program in Sri Lanka, Feb. 2019

The Prospects of Phytosanitary Education

- **To strengthen the Four-in-One education system:** especially the **public education** and the **postgraduates education** as the basis of prevention and control of pests.
- **To establish the international platform of E&R:** especially the **international/regional collaborative centers** of phytosanitary education and research.
- **To share the international education resources:** especially the **international remote education system/database** of plant quarantine.



The international phytosanitary education system: more efforts from the world

Outline

- The general situation of phytosanitary education system in China
- The practice of phytosanitary education in China: CAU as an example
- The challenges, opportunities and prospects of phytosanitary education in China

BEST WISHES FROM CAU!
LOOKING FORWARD TO MORE COLLABORATIONS
AND PROGRESS ON PHYTOSANITARY EDUCATION
AND RESEARCH!

