The Research System of Plant Health in China

Prof. Xueping Zhou

Institute of Plant Protection
Chinese Academy of Agricultural Sciences
E-mail: xpzhou@ippcaas.cn

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Contents

• Introduction
• Research institutions and funding sources
• Consideration and suggestion for future development
Overview of crop diseases and insect pests in China
Major Pest Monitoring and Control

![Graph showing the area affected by occurrence and control of major pests from 1980 to 2015. The area is measured in hundred million hectares. The graph shows a general increase in both occurrence and control areas over the years. There are fluctuations, with peaks in 1995, 2005, and 2015.]
Major plant diseases and insect pests

- About 120 species
- Type I: 14 species, Type II: about 100 species
  Type I: More than 100 million mu per year
    actual loss over one million tons per year
    have a huge influence on politics and society
Wheat (5): wheat aphids, stripe rust, gibberellic disease, powdery mildew, sheath blight
Rice (4): rice planthopper, rice leaf roller, rice blast, rice sheath blight
Maize (2): corn borer, corn leaf spot disease
Polyphagous pests (3): locust, armyworm, meadow moth
Wheat stripe rust
Rice planthopper

- Brown rice planthopper: *Nilaparvata lugens*(Stal)
- White-backed planthopper: *Sogatella furcifera*
- Small brown rice planthopper: *Laodelphax striatellus*
Rice stem borers

◆ Long distance migration, known as “two-specific migration insects” on rice with the rice planthopper.
◆ A common pest in most countries that produce rice in Southeast Asia.
Rice blast
Rice sheath blight

- 水稻纹枯病
- disease spot
- sclerotium
- hyphae
- sheath blight
Rice virus diseases
Armyworm

- Major migratory pests
- Damage on winter wheat and corn
- Centralized hazards in Northeast, North China and Huanghuaihai region in China.
Of the 100 most threatening invasive species in the world, more than 50 were found in China.

In the past 10 years, more than 20 new species spread to our country with an average increment of 1~2 species per year, and the intrusion speed was dozens of times than before 1980s
Fall armyworm

Damage caused by Fall armyworm

Sources: FAO, CABI

Sources: China
发生趋势
Colorado potato beetle

- During World War II, the German army cast Colorado potato beetle to the British Isle of Wight.
- Distributed in Xinjiang, and the epidemic was found in Heilongjiang, China, in 2014.
Wheat killer-Ug99, once invade our country, could cause a devastating blow to 21.3 million hm² winter wheat highly possibly.

In 1999, it was first discovered in Uganda.

Wheat blast

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Basic Frame on Research System

1. Basic Research
2. Applied Research
3. Extension
Basic Research on Plant Health

- Organizations

- Research Institution
  - Institute of Plant Protection, Chinese Academy of Agricultural Sciences
  - Institute of Zoology, Chinese Academy of Sciences

- College/University
  - More than 30 Universities working on the basic research on plant health
    - Zhejiang University
    - China Agricultural University
    - Nanjing Agricultural University
Basic Research on Plant Health

Progress - Representative papers - (1)

Nature Biotechnology

Large-scale test of the natural refuge strategy for delaying insect resistance to transgenic Bt crops

Lin Jin, Haonan Zhang, Yanhui Lu, Yihua Yang, Kongming Wu, Bruce E Tabashnik & Yidong Wu

LETTER

Two insulin receptors determine alternative wing morphs in planthoppers

Hai-Jun Xu, Jian Xue, Bo Lu, Xue-Chao Zhang, Ji-Chong Zhuo, Shu-Fang He, Xiao-Fang Ma, Ya-Qin Jiang, Hai-Wei Fan, Ji-Yu Xu, Yu-Xuan Ye, Peng-Lu Pan, Qiao Li, Yan-Yuan Bao, H. Frederik Nijhout & Chuan-Xi Zhang

LETTER

Widespread adoption of Bt cotton and insecticide decrease promotes biocontrol services

Yanhu Li, Kongming Wu, Yuying Jiang, Yuyuan Guo & Nicolas Desneux
Basic Research on Plant Health

- Progress - Representative papers -(2)

**Advances in Understanding Begomovirus Satellites**

Xueping Zhou

**Novel Insights into Rice Innate Immunity Against Bacterial and Fungal Pathogens**

Wende Liu, Jinling Liu, Lindsay Triplett, Jan E. Leach, and Guo-Liang Wang

**Playing on a Pathogen’s Weakness: Using Evolution to Guide Sustainable Plant Disease Control Strategies**

Jiasui Zhan, Peter H. Thrall, Julien Papaïx, Lianhui Xie, and Jeremy J. Burdon

**Molecular Mechanisms of Nematode-Nematophagous Microbe Interactions: Basis for Biological Control of Plant-Parasitic Nematodes**

Juan Li, Chenggang Zou, Jianping Xu, Xinglai Ji, Xuemei Niu, Jinkui Yang, Xiaowei Huang, and Ke-Qin Zhang

**Role of Alternate Hosts in Epidemiology and Pathogen Variation of Cereal Rusts**

Jie Zhao, Meinan Wang, Xianming Chen, and Zhensheng Kang

**New Insights into Mycoviruses and Exploration for the Biological Control of Crop Fungal Diseases**

Jiatao Xie and Daohong Jiang

Papers published in Annual Review of Phytopathology
Basic Research on Plant Health

Progress - Representative papers -(3)

Advances in Silkworm Studies Accelerated by the Genome Sequencing of *Bombyx mori*
Qingyou Xia,1,‡ Sheng Li,2 and Qili Feng3

Invasion and Management of Agricultural Alien Insects in China
Fang-Hao Wan*,† and Nian-Wan Yang†

Red Turpentine Beetle: Innocuous Native Becomes Invasive Tree Killer in China
Jianghua Sun,1 Min Lu,1 Nancy E. Gillette,2,* and Michael J. Wingfield3

Molecular Mechanisms of Phase Change in Locusts
Xianhui Wang1 and Le Kang1,2,*

Biology, Ecology, and Management of the Diamondback Moth in China
Zhenyu Li,1 Xia Feng,1,* Shu-Sheng Liu,2 Minsheng You,3 and Michael J. Furlong3

Whitefly Parasitoids: Distribution, Life History, Bionomics, and Utilization
Tong-Xian Liu,1,* Philip A. Stansly,2 and Dan Gerling3

6 papers published in Annual Review of Entomology
CAAS and some universities, working on both basic and applied research, and more than 30 local plant protection institutions for each Province are also the main organizations working on applied research.
Progress - *Representative awards* - (1)

- **2012-First Prize of National Science and Technology Progress Award:** Construction and application of comprehensive management technology system of wheat stripe rust fungus source base. Prof. Wanquan Chen from IPP-CAAS.

- **2012-Second Prize of National Science and Technology Progress Award:** Insecticide resistance mechanism and key techniques of monitoring and management for the important crop pathogens, Prof. Mingguo Zhou from Nanjing Agricultural University.

- **2012-Second Prize of National Science and Technology Progress Award:** Construction and application of three stage breeding system for citrus varieties. Prof. Changyong Zhou from CRI-CAAS.
Progress—Representative awards -(2)

- **2013-Second Prize of National Science and Technology Progress Award**: Major agricultural invasive species early warning and monitoring technology, Prof. Fanghao Wan from IPP-CAAS.

- **2014-Second Prize of National Science and Technology Progress Award**: The development and application of a new type of agricultural fungicide natural anthraquinone compound, Prof. Dazhao Yu from Hubei Academy of Agricultural Science.

- **2014-Second Prize of National Science and Technology Progress Award**: Development and application of new pesticide for preventing and controlling crop virus disease and vector insects. Prof. Baoan Song from Guizhou University.
• **2014-Second Prize of National Science and Technology Progress Award:** Molecular detection techniques and species identification of important plant pathogens and their application in port quarantine. Prof. Jianping Chen from Zhejiang Academy of Agricultural Sciences.

• **2015-Second Prize of National Science and Technology Progress Award:** Key technologies and applications of high efficiency and reduction of pesticide based on biological target. Prof. Xiwu Gao from China Agricultural University.

• **2015-Second Prize of National Science and Technology Progress Award:** Mechanisms for epidemic of rice plant hopper and its sustainable control. Prof. Jichao Fang from Jiangsu Academy of Agricultural Sciences.
Progress - Representative awards - (4)

- **2016-Second Prize of National Science and Technology Progress Award:** Epidemics of rice stripe and rice black-streaked dwarf diseases and their green. Prof. Yijun Zhou from Jiangsu Academy of Agricultural Sciences.

- **2016-Second Prize of National Science and Technology Progress Award:** Technology establishment for high efficiency and low risk of pesticides and application. Prof. Yongquan Zheng from IPP-CAAS.

- **2017-Second Prize of National Science and Technology Progress Award:** Essential technologies for control of disease and insect by crop diversity and their application. Prof. Youyong Zhu from Yunnan Agricultural University.
Progress - Representative awards - (5)

- **2018-Second Prize of National Science and Technology Progress Award:** Technologies for control of vegetable diseases caused by oomycetes. Prof. Xiuguo Zhang from Shandong Agricultural University.

- **2018-Second Prize of National Science and Technology Progress Award:** Mechanism for pathogenesis and techniques for control of fruit tree rot disease. Prof. Lili Huang from Northwest A&F University.

- **2018-Second Prize of National Science and Technology Progress Award:** New target and application of fungicide. Prof. Mingguo Zhou from Nanjing Agricultural University.
extension

Framework of extension system

- National
- Provincial
- Prefectural
- County
- Township

The National Agro-Tech Extension and Service Center (NATESC)

Provincial-Township Plant Protection Station or Extension Service Station
Main Methods of Extension System

Government-oriented extension

Farmer’s demand-oriented extension
Gap between Research-Extension

- Basic Research
- University
- Applied Research
- Technology
- Product
- Extension

How to bridge the gap between the research technology or products and farmers???

Reasonable Extension System!!!

Contributed to farmer or crop production
Projects for Research on Plant Health

- National Natural Science Foundation
- National Key Research and Development Program from MOST (2015- )
- Modern Agro-Industry Technology Research System from MARA
- Projects from Provincial Government
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Statistics table of crop pests and rodents occurrence and damage

Area of occurrence (million hectares)

1991年
1992年
1993年
1994年
1995年
1996年
1997年
1998年
1999年
2000年
2001年
2002年
2003年
2004年
2005年
2006年
2007年
2008年
2009年
2010年
2011年
2012年
2013年
2014年

百万亩次
百万亩次
挽回粮食损失（万吨）
实际粮食损失（万吨）

million hectares (million tons)
National Strategic Planning

- Green prevention and control: cover rate would be more than 30%, which is increased by 10% 2014;
- Unified prevention and control: cover rate would be more than 40%, which is increased by 10% than 2014;
- Scientific Application: Utilizing rate of chemical pesticides would be more than 40%, which is increased by 5% than 2013.

By 2020, zero growth of pesticides
Ideas and Goals

- Reduce 15000 T per year
- Decreased to the level of the beginning of the century, by the year 2020
Technical Measures

• **Control**: control crop diseases and insect pests
  - Control the disease and pest initial population number
  - Control the using frequency: no harmful impact even though disease and pest occurred

• **Replace**: replace High-toxic pesticides and inefficient spray tools
  - Develop low toxicity and risk pesticide
  - Increase the atomization and subsidence, preventing the issues like serious escape and leakage.

• **Precise**: implementation of precision pesticide application
  - Precision pesticide application to targets
  - Pesticide application symptomatic timely and appropriate

• **Unified**: promotion of unified prevention and control
  - Provide specialized service to resolve the serious confusion and difficulties of pesticide application
Promoting green prevention and control

- Established 218 national green prevention and control demonstration areas;
- Vigorously promoting ecological compatible and environment-friendly control strategies, including ecological control, behavioral manipulation, biological control, physical control and scientific application of pesticide, and the effect is pronounced.
Cultivation techniques

Crop rotation

Deep ploughing

Pest net

Clean the pastoral
Ecological engineering - increase biodiversity

Increase biodiversity
Use push plant

Celery: Repellent whitefly
Use bio-pesticides - virus, fungi, bacteria
Use natural enemies-release
Natural enemy insect products: more than 20 species

Application area more than 5 million mu
Use natural enemies - protect
Use insect pheromones
Use light trap and sticky trap
Use other non-chemical control measures

- Trapping crop
- Trapping plants
- Light traps
- Raising ducks
- Resistant varieties plus organic fertilizers
Thank you!