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Honeybee Disease Surveillance and Control in P.R.China

Shufa Xu

Institute of Apicultural Research,
Chinese Academy of Agricultural Sciences
August 24, 2021



**OIE Virtual Regional Workshop on Honey Bee Diseases
in Asia and the Pacific**

24 August 2021

OUTLINES

- Beekeeping management system
- Related laws and regulations
- Disease surveillance system
- Disease situation
- Achievement and challenge



The screenshot shows the website of the Institute of Apicultural Research, Chinese Academy of Agricultural Sciences (CAAS). The header includes the institute's name in Chinese and English, along with a logo and navigation links. The main content area features a profile for Prof. Shufa Xu, including a photo, his name, and a brief biography in Chinese. The biography mentions his role as a research fellow and supervisor, his expertise in beekeeping pathology and ecology, and his involvement in various research projects and publications. The contact information provided is his address in Beijing.

Prof, Shufa Xu, Dr.

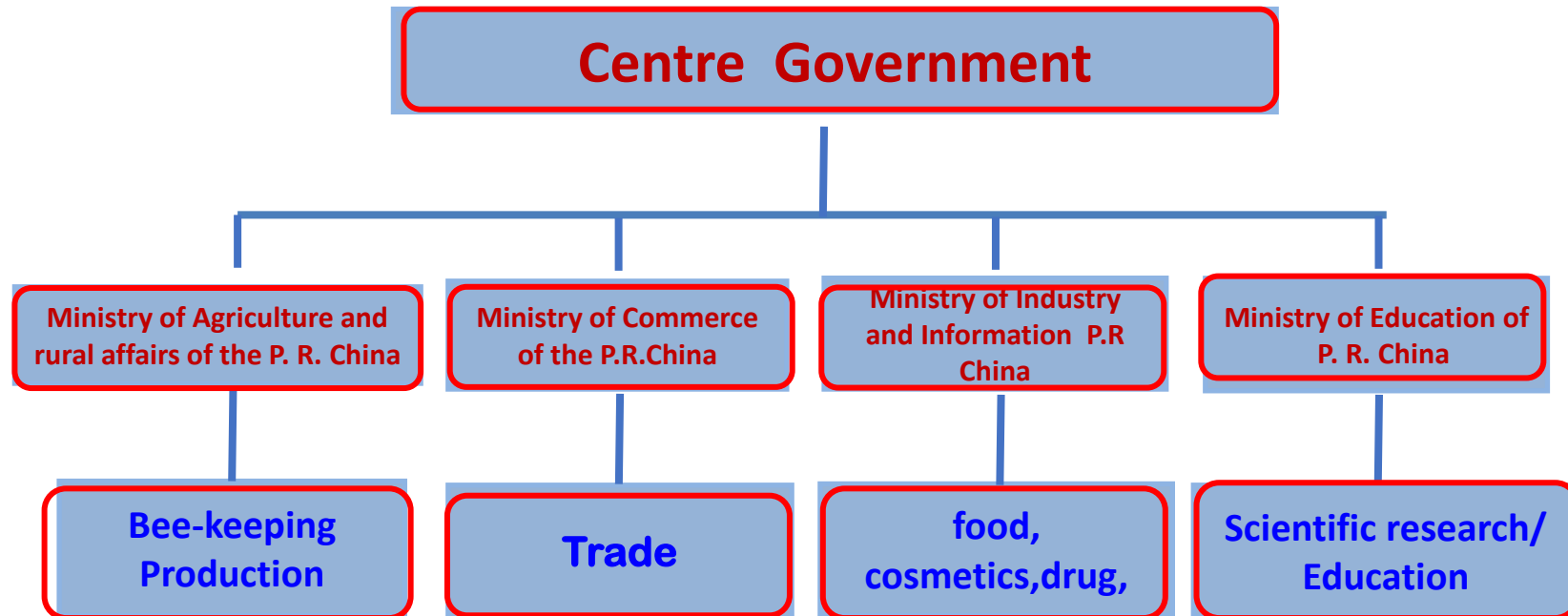
Institute of Apicultural Research,
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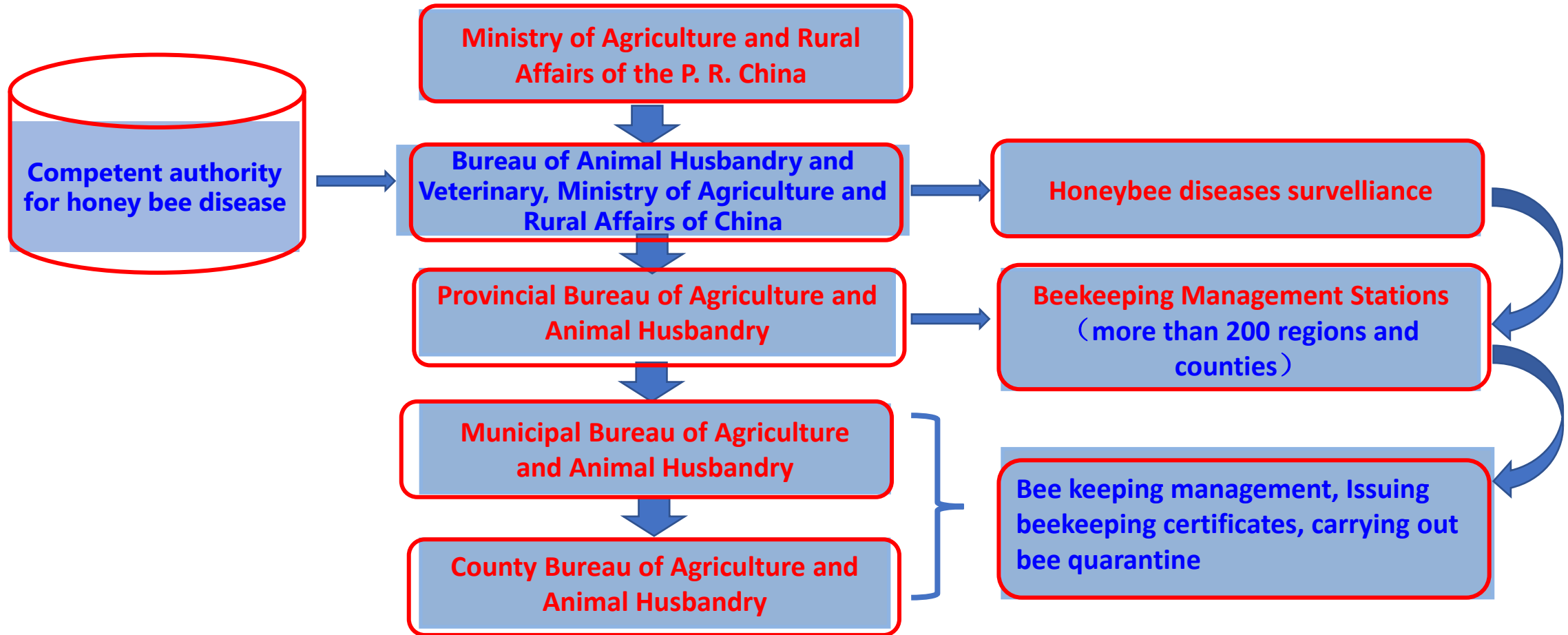
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Beekeeping management system

General Frame



Bee-keeping and diseases surveillance system



Domestic and international trade



Provincial bee management/ extention stations

- Heilongjiang provincial bee and silk worm management centre
- Liaoning provincial Honeybee breeding farm
- Shanxi Jinzhong Honeybee Breeding Farm
- Guangxi Beekeeping technical guidance Station
- Xinjiang Beekeeping technical guidance Station
- Beijing silk worm and Beekeeping technical guidance Station
- Sichuan provincial Bee management station
- Livestock Improvement station, Yunnan Provincial Bureau of Agriculture
- Gansu provincial Bee Technology Extention Station

Apicultural Research Institute

- **Apiculture Research Institute, Chinese Academy of Agricultural Sciences**
- Jilin Province Institute of Apicultural Science
- Bee Research Institute, Mudanjiang Branch, Heilongjiang Academy of Agricultural Sciences
- Silk worm and Honeybee Research Institute, Yunnan Academy of Agricultural Sciences
- Jiangxi Province Institute of Apicultural Science
- Insect Institute of Research, Guangdong Academy of Agricultural Sciences
- Plant protection Institute, Hainan Academy of Tropical Agricultural Sciences
- Plant protection Institute, Tibet Academy of Agricultural Sciences
- Honeybee Research Institute, Chongqing Academy of Animal Sciences
- Institute of Animal Sciences, Chinese Academy of Agricultural Sciences



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Universities with Bee Sciences Education / Research

- College of Animal Sciences, Fujian agriculture and Forestry University (College of bee Science)
- College of animal science and technology, Yunnan Agricultural University
- Institute of bee and silkworm Research, School of animal science and technology, Zhejiang University
- Institute of bee Research, College of animal science and technology, Jiangxi Agricultural University
- College of animal science and technology, Shanxi Agricultural University
- School of animal science and technology, Yangzhou University
- School of science and technology, Shandong Agricultural University
- College of resources and environment, Henan University of science and technology
- College of life sciences, Chongqing Normal University
- College of plant protection, Anhui Agricultural University



Yunnan Agricultural University

动物科学技术学院 高原渔业学院
Faculty of Animal Science and Technology Plateau Aquacultural College

学院行政机构

- 管理机构
 - 综合办公室
 - 教学管理办公室
 - 科研和社会服务办公室
 - 研究生工作办公室
- 教学单位
 - 动物科学系
 - 动物营养与饲料科学系
 - 草业科学系
 - 水产养殖系
 - 蜂学系**
- 实践教学基地
 - 实习鸡场
 - 实习猪场
 - 实习饲料加工厂
 - 草地认知中心
 - 实习养蜂场
- 学术机构
 - 院学术委员会
 - 院教学指导委员会



Disease surveillance system

1.Proactive risk assessment

Section of bee disease prevention and control, China Agricultural Research System (Honeybee)

- Surveillance
- Diagnose disease agent
- Risk assessment of the diseases
- Provide controlling measures



2. Cases reports & Disease Control Technique Supports

- **Bee owner** reports the cases of disease in apiary to the **local Technique Extention Center** which managed bee keeping or industry in local government. The owner might be beekeepers or companies.
- Then the Technique Extention Center will diagnose the diseases or disasters firstly by clinical inspection and might give suggestion to the apiary if they can diagnose correctly.
- If can not identify the cause of the damages, normally they will invite some labs , such as **IAR, CAAS or some universities** which have the ability to detect the pathogens accurately by sending the samples to them or inspecting in sites directly.
- If a new emerging disease listed in **OIE Code** was confirmed, the result will be reported to the local competent authority for bee disease/animal diseases. **The strict programme will be started accordingly**. Normally, the competent authority for animals, the husbandry unit will work together to assess the risk of the disease.

Related laws and regulations

Related laws and regulations

《中华人民共和国畜牧法》（摘要）

第四十七条 国家鼓励发展养蜂业，维护养蜂生产者的合法权益。

有关部门应当积极宣传和推广蜜蜂授粉农艺措施。

第四十八条 养蜂生产者在生产过程中，不得使用危害蜂产品质量安全的药品和容器，确保蜂产品质量。养蜂器具应当符合国家技术规范强制性要求。

第四十九条 养蜂生产者在转地放蜂时，当地公安、交通运输、畜牧兽医等有关部门应当为其提供必要的便利。

养蜂生产者在国内转地放蜂，凭国务院畜牧兽医行政主管部门统一格式印制的检疫合格证明运输蜂群，在检疫合格证明有效期内不得重复检疫。



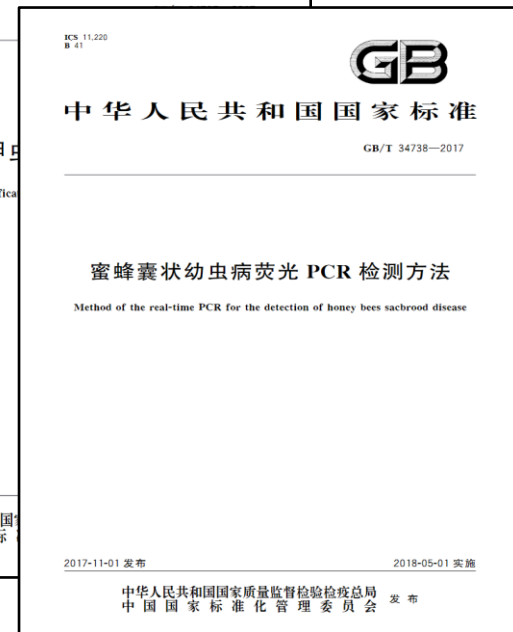
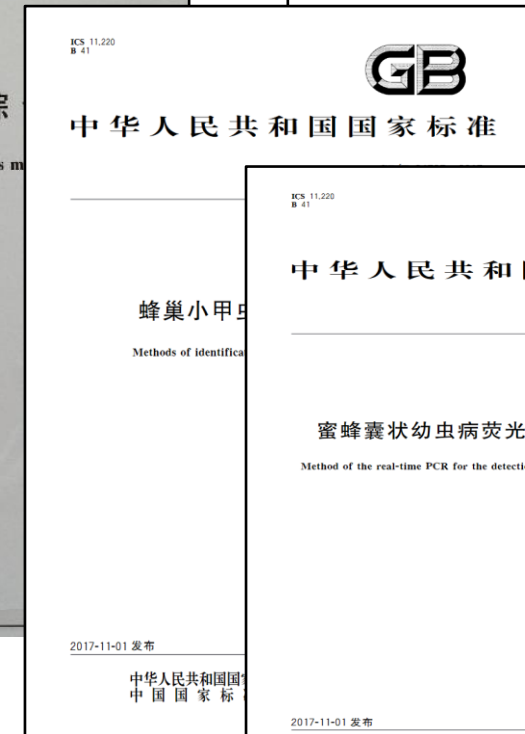
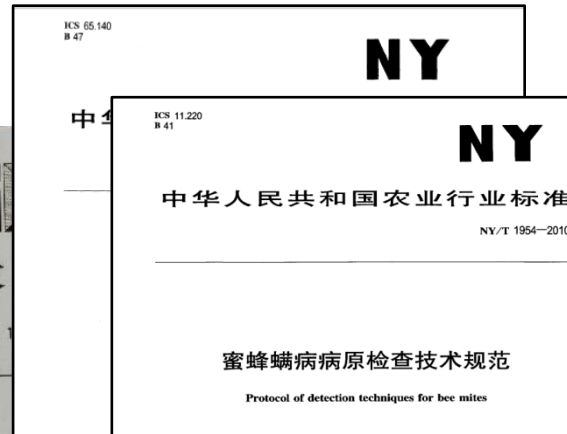
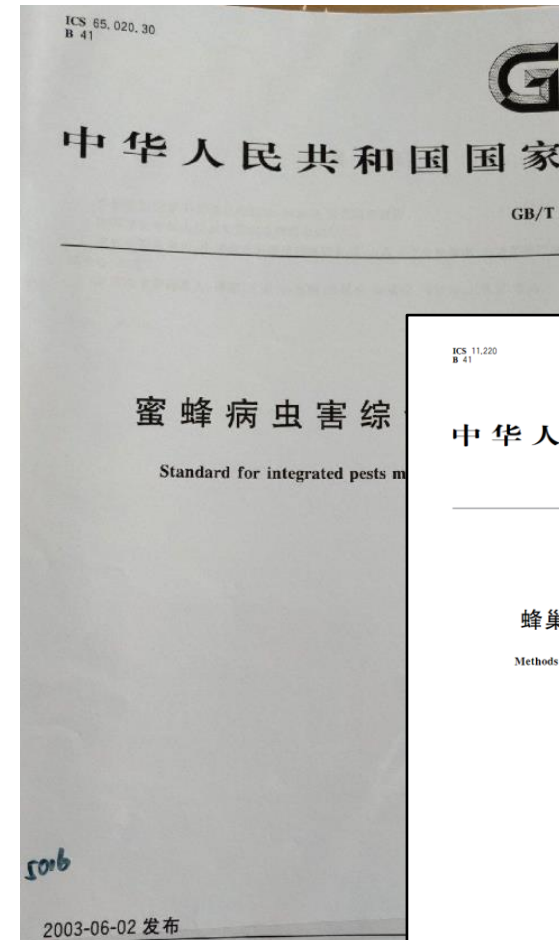
- **Animal Husbandry Law of the People's Republic of China (2005)**
- **Animal Epidemic Prevention Law of the People's Republic of China (2021)**
- **Law of the People's Republic of China on the Entry and Exit Animal and Plant Quarantine**
- **Lists A, B and C Diseases**(Notice of the Ministry of Agriculture of People's Republic of China No. 96)
- **List of Inspection and Quarantine**(General Administration of Customs of the P.R.China)

The official bee disease diagnostic/testing agencies

- Both **general Custom** and **local Custom** can diagnose the diseases which were listed in OIE Manual and OIE Code when exporting and importing.
- **The Lab in local veterinary surveillance centre** has the ability in testing and reporting the infection and infestation of new emerging bee diseases listed in OIE Code.
- **Research units on bees and universities** which established department of bees can diagnose the disease and provide the measure suggestion to prevent and control the damages from bee diseases.
- **Companies, et al.**



No.	Code	Standards	Issue Date
1	2019年第28版	Terrestrial Animal Health Code	
2	GB/T 35908-2018	Diagnostic techniques for chalkbrood of honey bees	2018/9/1
3	GB/T 34738-2017	Method of the real-time PCR for the detection of honey bees sacbrood disease	2018/5/1
4	GB/T 31270.10-2014	Honeybee acute toxicity test	2015/3/11
5	GB/T 20014.27-2013	Good agricultural practice—Part 27: Bee control points and compliance criteria	2014/6/22
6	GB/T 21812-2008	Chemicals - Honeybees, acute oral toxicity test	2008/9/1
7	GB/T 21813-2008	Chemicals - Honeybees acute contact toxicity test	2008/9/1
8	GB/T 21528-2008	Bee products production management regulation	2008/8/1
9	GB/T 19168-2003	Standard for integrated pests management of honey bee	2003/11/1
10	NYT_2837-2015	Identification of Varroa from honey bees	2015/12/1
11	NYT-1954-2010	Protocol of detection techniques for bee mites	2010/12/1
12	NYT-1951-2010	Protocol of diagnosis for foulbrood disease	2010/12/1
13	GB/T 34737-2017	Methods of identification for small hive beetle infestation	2018/5/1
14	DB62/T 2803-2017	Protocol of prevent and control for Chinese sacbrood virus	2017/9/30
15	SN/T 3990-2014	Protocol of detection of honey bees sacbrood disease	2015-05-01



Bee disease situation in China

Notifiable bee diseases in China

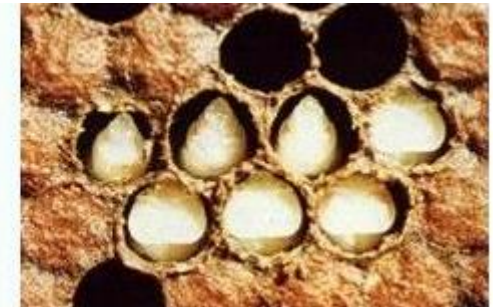


Parasite: Varroa destructor, Tropilaelaps mercedesae, nosema, wax moth

Viruses: deformed wing viruses, chronic bee paralysis virus, Israel acute paralysis virus, sacbrood disease

Fungal disease: chalk brood disease

Bacterial disease: European/American foulbrood disease



Varroa destructor

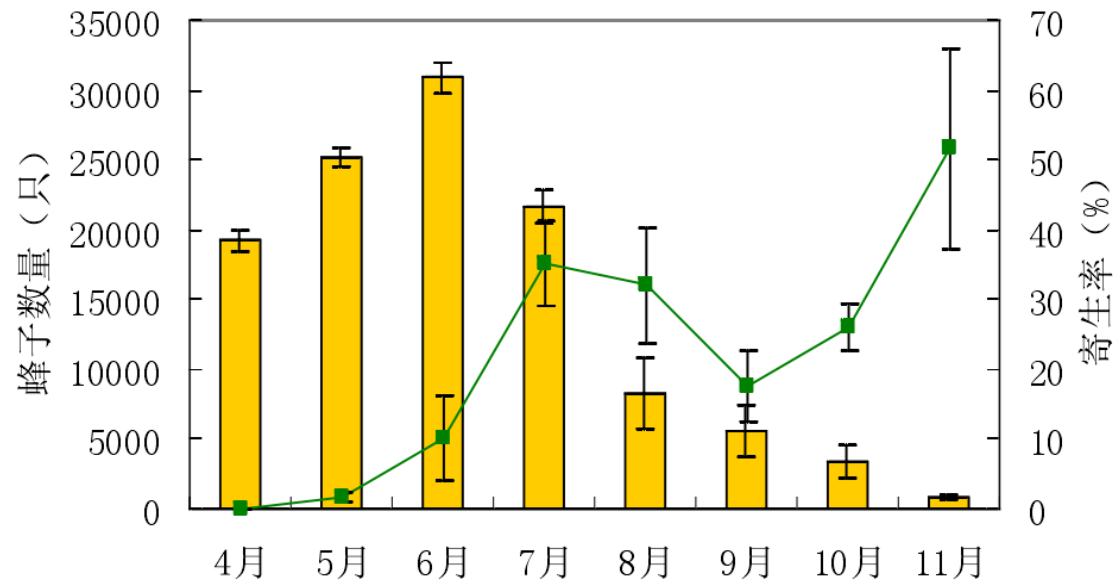


Fig 1 Prevalance rate of Varroa mites in China

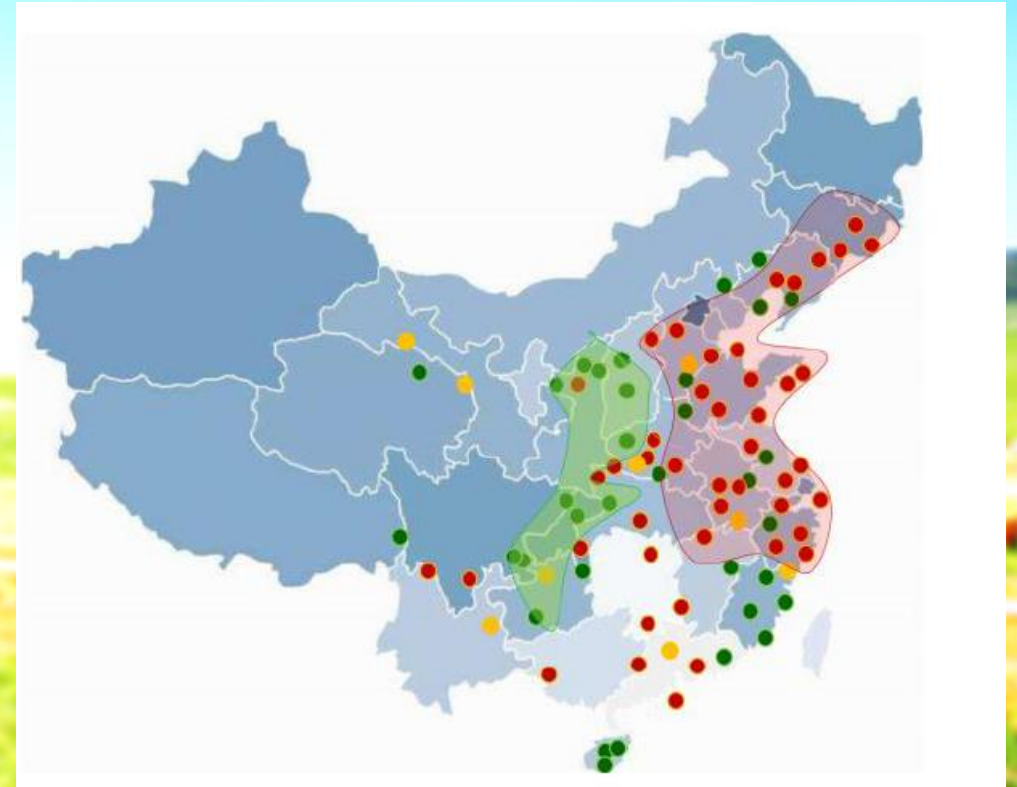
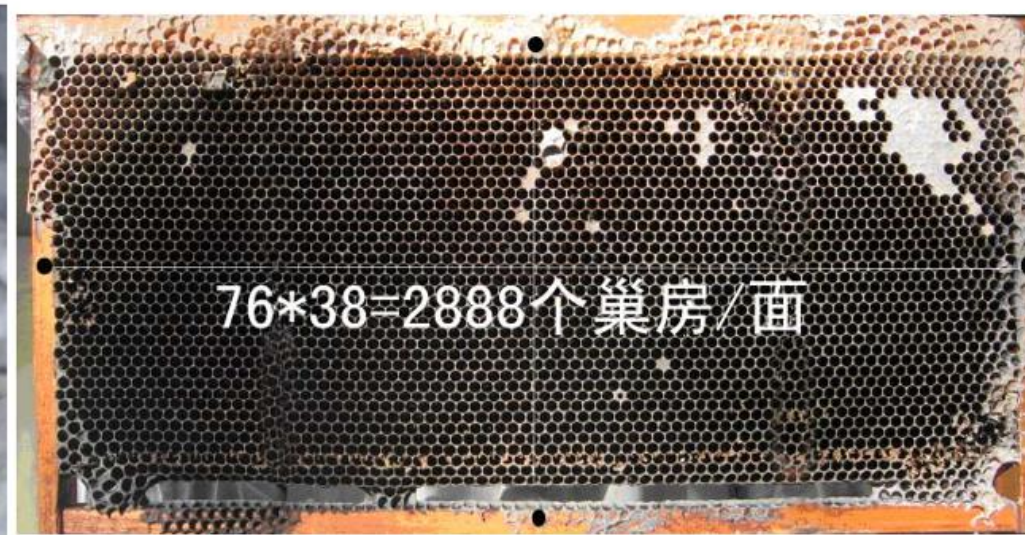
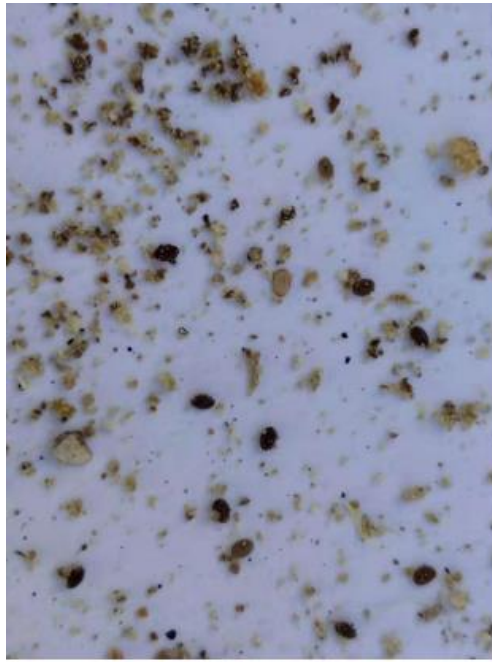


Fig 2 Distribution of Varroa mites in China



Varroa mites (Varroa destructor)



Control Apistan, ApiGuard, Formic acid, Organic acid, Sublimed sulfur

Amitraz

Fluvalinate

别名:

Cyano-(3-phenoxyphenyl)methyl N-[2-chloro-4-(trifluoromethyl)phenyl]-D-valinate;

(RS)-alpha-Cyano-3-phenoxybenzyl N-(2-chloro-a,a,a-trifluoro-p-tolyl)-D-valinate

Tropilaelaps mercedesae

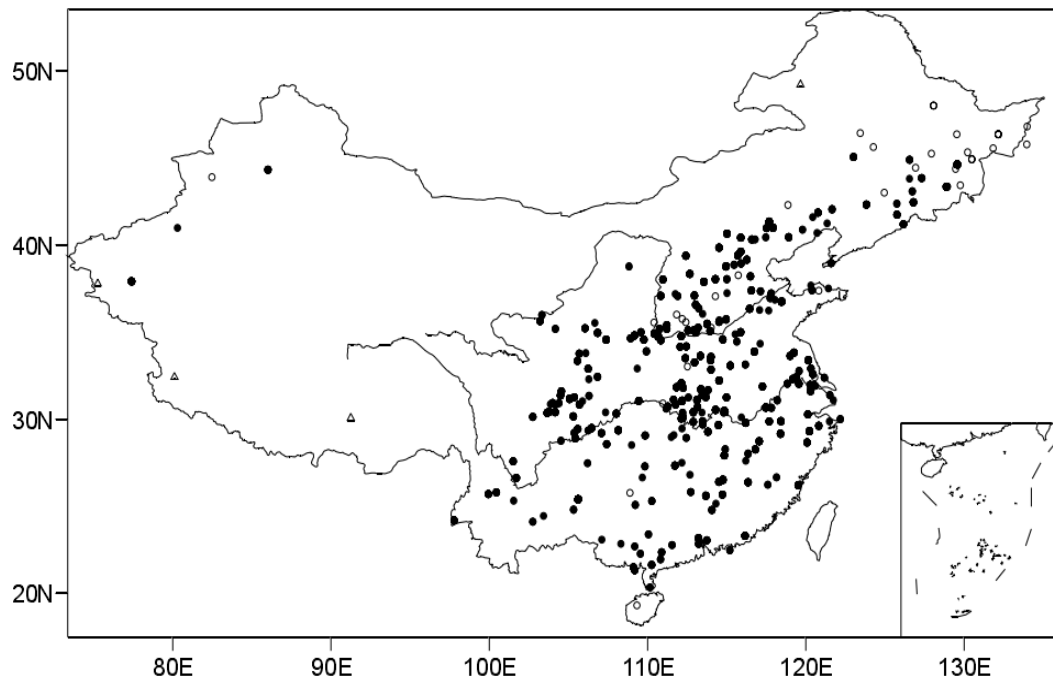


图 3.4 参与梅氏热厉螨流行病学调查的蜂场及梅氏热厉螨感染强度

注：“●”表示梅氏热厉螨严重感染，“○”表示轻微感染，“△”表示未发现感染

Fig 1 Infection and infectious status of *Tropilaelaps mercedesae*

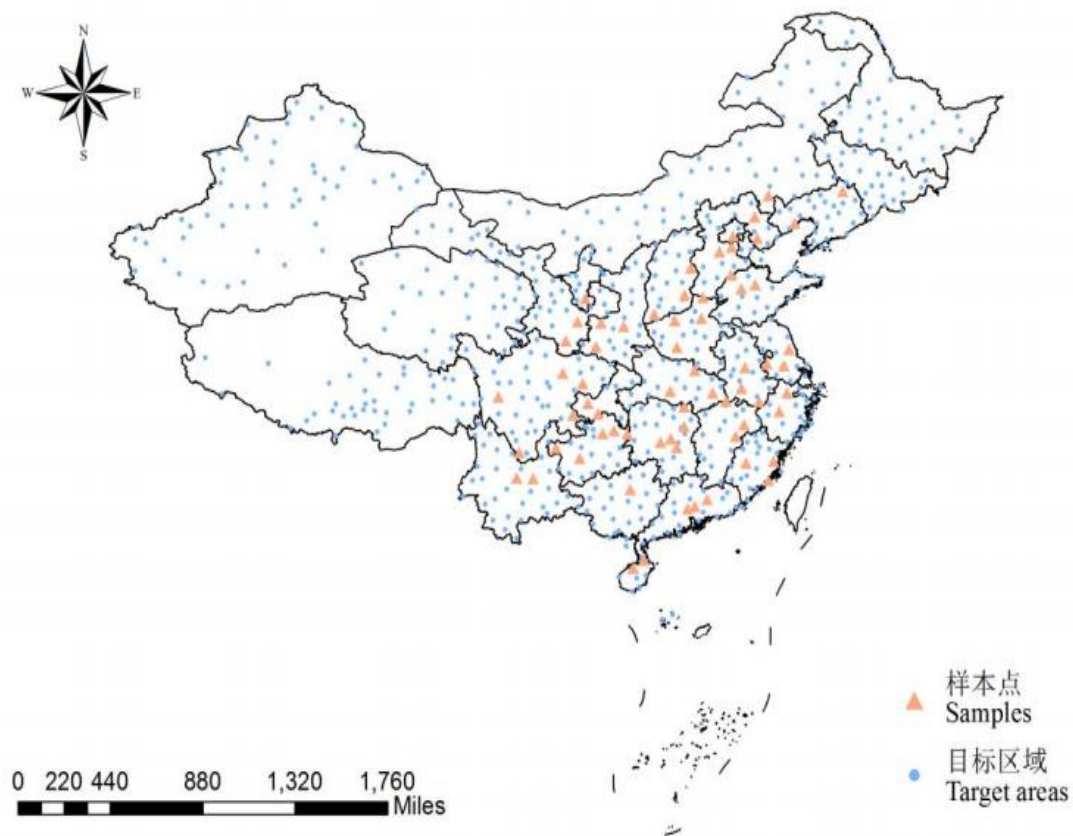
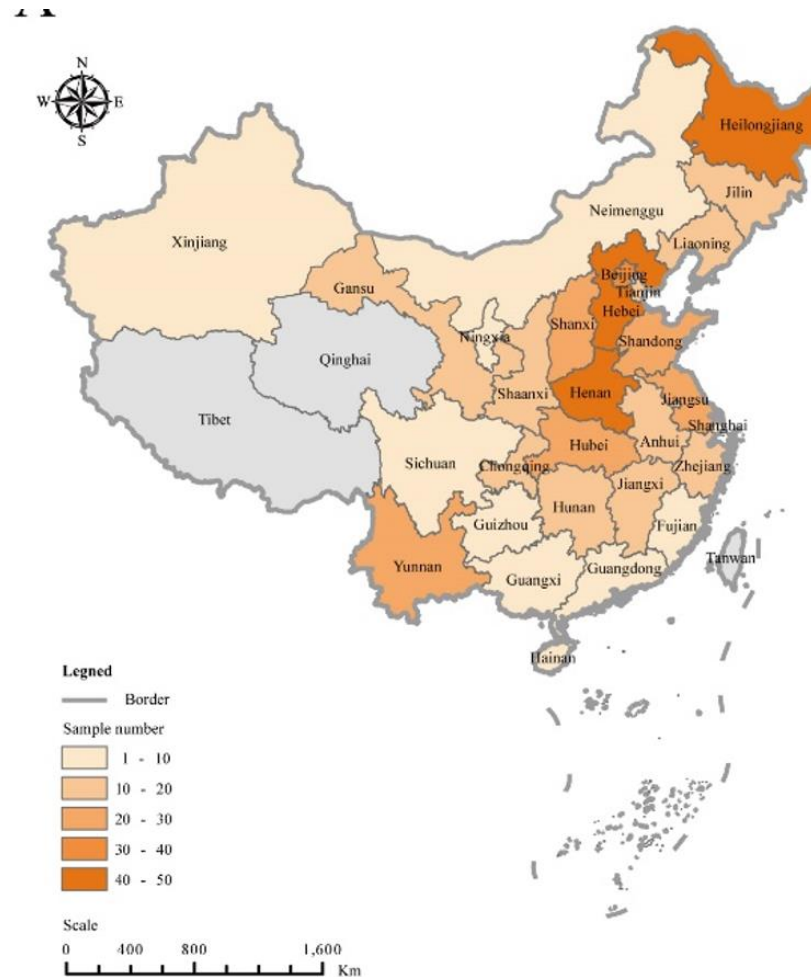


Fig 2 Distribution of *Tropilaelaps mercedesae* in China
(Linsheng Yu, 2015)

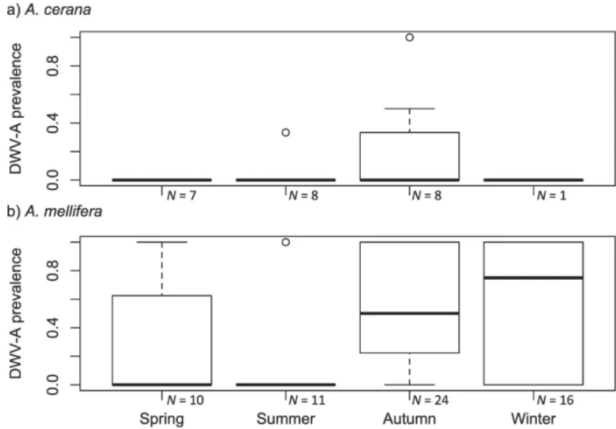
Viruses



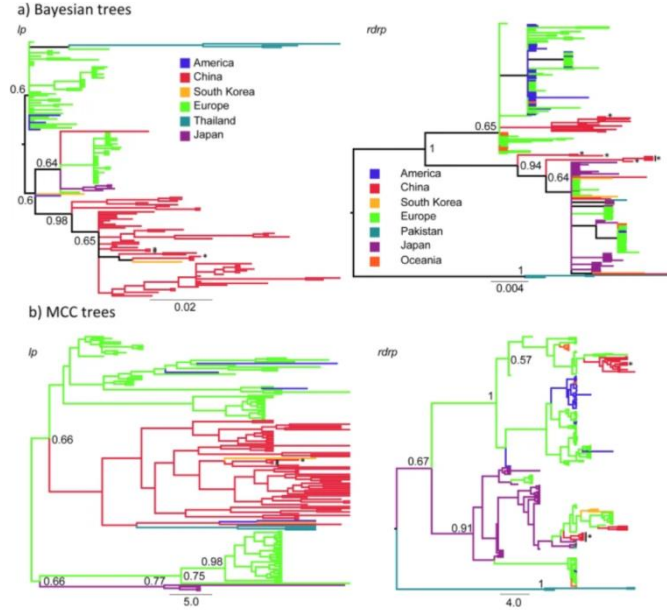
We collected honeybee samples with typical symptoms of viral diseases from 2008 to 2020, and detected seven honeybee viruses by using RT-PCR with specific primers (Figure 1A and 1B). In 492 samples, The positive results of the seven viruses were as follows: LSV (380), BQCV (336), SBV (294), DWV (281), IAPV (228), CBPV (110), ABPV (18)

Prevalence of deformed wing virus

Figure 1



Apiary-level DWV-A prevalence in *A. cerana* and *A. mellifera* across seasons; Sample sizes indicate the number of apiaries per site per species ($N_{\text{apiaries}} = 85$, $N_{\text{hives}} = 167$). Both host species and season affect prevalence, with prevalence significantly higher in autumn than in spring and summer, and in winter than in summer.



Sampling locations; *A. mellifera* sites are indicated in red, *A. cerana* in black and sites where both *A. mellifera* and *A. cerana* were collected are indicated in blue.

Prevalence and population genetic structure of the emerging honey bee pathogen DWV in Chinese honey bees

Yongqiang Yang^{1,2}, Hongxia Zhao³, Shuai Deng^{1,2}, Xinling Wang^{1,2}, and Wilfried H. Konrad^{4,5}

Honey bees are ecologically and economically important, both as pollinators and by providing products such as honey. Beekeeping is at risk through factors of global change such as habitat loss, as well as infectious diseases. In China and other parts of Asia, beekeepers rely both on non-native *Apis mellifera*, putting bee populations at particular risk of disease from introduced pathogens. Indeed, two important honey bee parasites have emerged in China, the mite *Varroa destructor* and the microsporidian *Nosema ceranae*. As *V. destructor* and *N. ceranae* have also originated in East Asian honey bee populations, we investigated whether another key bee pathogen, Deformed Wing Virus (DWV), also has originated in East Asian honey bee populations. We use a large-scale survey of DWV in managed *A. mellifera* colonies in China to investigate the prevalence and seasonality of DWV in managed *A. mellifera* colonies, showing that DWV-A prevalence was higher in *A. mellifera*, with prevalence in autumn and winter. Using phylogenetic and population genetic analyses, we show that DWV-A in while China and East Asian DWV isolates show comparatively high levels of genetic diversity, suggesting that Chinese bee populations are not a source for the current global DWV epidemic.

Pathogens in *A. cerana*

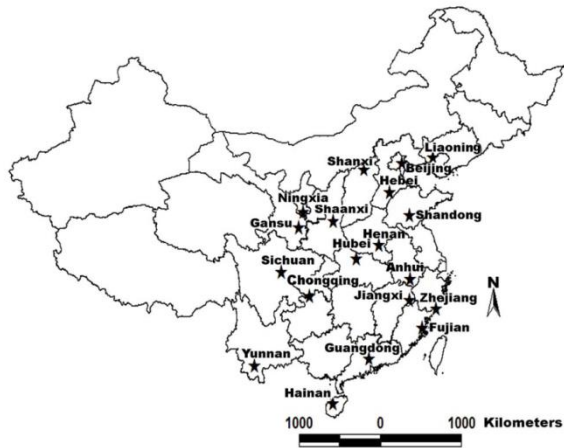


Figure 1. Sampling locations in China. See Table 2 for collection details of location. doi:10.1371/journal.pone.0047955.g001

OPEN ACCESS Freely available online



The Prevalence of Parasites and Pathogens in Asian Honeybees *Apis cerana* in China

Jilian Li¹, Haoran Qin¹, Jie Wu¹, Ben M. Sadd³, Xiuhong Wang¹, Jay D. Evans², Wenjun Peng^{1*}, Yanping Chen^{2*}

¹ Key Laboratory of Pollinating Insect Biology of the Ministry of Agriculture, Institute of Apicultural Research, Chinese Academy of Agricultural Science, Beijing, China, ² United States Department of Agriculture (USDA) – Agricultural Research Service (ARS) Bee Research Laboratory, Beltsville, Maryland, United States of America, ³ Experimental Ecology, Institute of Integrative Biology, ETH Zürich Universitätsstrasse, Zürich, Switzerland

Abstract

Pathogens and parasites represent significant threats to the health and well-being of honeybee species that are key pollinators of agricultural crops and flowers worldwide. We conducted a nationwide survey to determine the occurrence and prevalence of pathogens and parasites in Asian honeybees, *Apis cerana*, in China. Our study provides evidence of infections of *A. cerana* by pathogenic *Deformed wing virus* (DWV), *Black queen cell virus* (BQCV), *Nosema ceranae*, and *C. bombi* species that have been linked to population declines of European honeybees, *A. mellifera*, and bumble bees. However, the prevalence of DWV, a virus that causes widespread infection in *A. mellifera*, was low, arguably a result of the greater ability of *A. cerana* to resist the ectoparasitic mite *Varroa destructor*, an efficient vector of DWV. Analyses of microbial communities from the *A. cerana* digestive tract showed that *Nosema* infection could have detrimental effects on the gut microbiota. Workers infected by *N. ceranae* tended to have lower bacterial quantities, with these differences being significant for the *Bifidobacterium* and *Pasteurellaceae* bacteria groups. The results of this nationwide screen show that parasites and pathogens that have caused serious problems in European honeybees can be found in native honeybee species kept in Asia. Environmental changes due to new agricultural practices and globalization may facilitate the spread of pathogens into new geographic areas. The foraging behavior of pollinators that are in close geographic proximity likely have played an important role in spreading of parasites and pathogens over to new hosts. Phylogenetic analyses provide insights into the movement and population structure of these parasites, suggesting a bidirectional flow of parasites among pollinators. The presence of these parasites and pathogens may have considerable implications for an observed population decline of Asian honeybees.

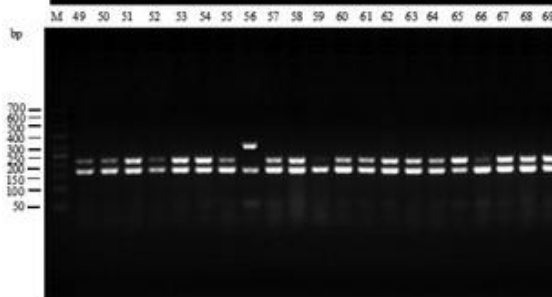
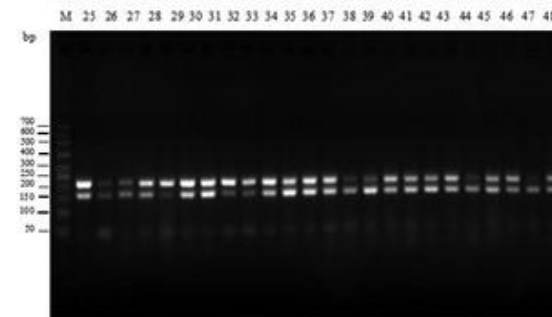
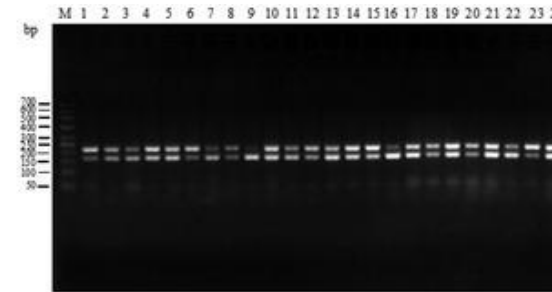
Citation: Li J, Qin H, Wu J, Sadd BM, Wang X, et al. (2012) The Prevalence of Parasites and Pathogens in Asian Honeybees *Apis cerana* in China. PLoS ONE 7(11): e47955. doi:10.1371/journal.pone.0047955

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Nosema detection



Journal of Apicultural Research



ISSN: 0021-8839 (Print) 2078-6913 (Online) Journal homepage: <https://www.tandfonline.com/loi/tjar20>

***Nosema ceranae*, the most common microsporidium infecting *Apis mellifera* in the main beekeeping regions of China since at least 2005**

Qiang Wang, Pingli Dai, Ernesto Guzman-Novoa, Yanyan Wu, Chunsheng Hou & Qingyun Diao

To cite this article: Qiang Wang, Pingli Dai, Ernesto Guzman-Novoa, Yanyan Wu, Chunsheng Hou & Qingyun Diao (2019) *Nosema ceranae*, the most common microsporidium infecting *Apis mellifera* in the main beekeeping regions of China since at least 2005, Journal of Apicultural Research, 58:4, 562-566, DOI: 10.1080/00218839.2019.1632148

To link to this article: <https://doi.org/10.1080/00218839.2019.1632148>

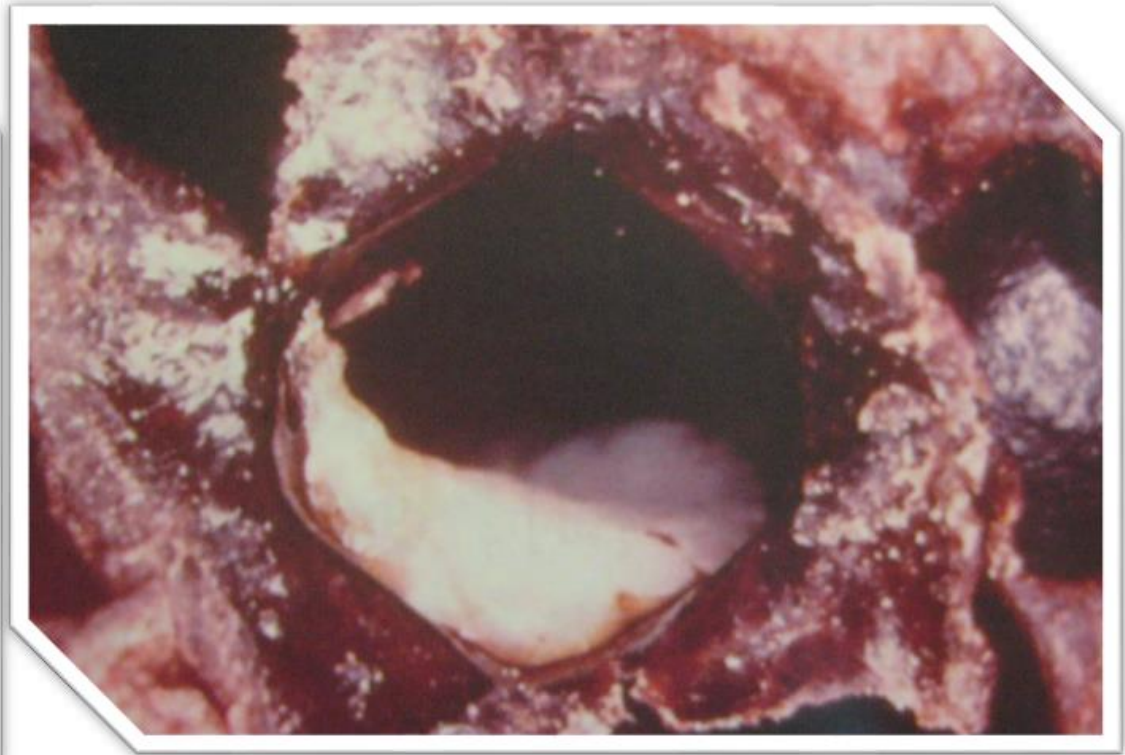
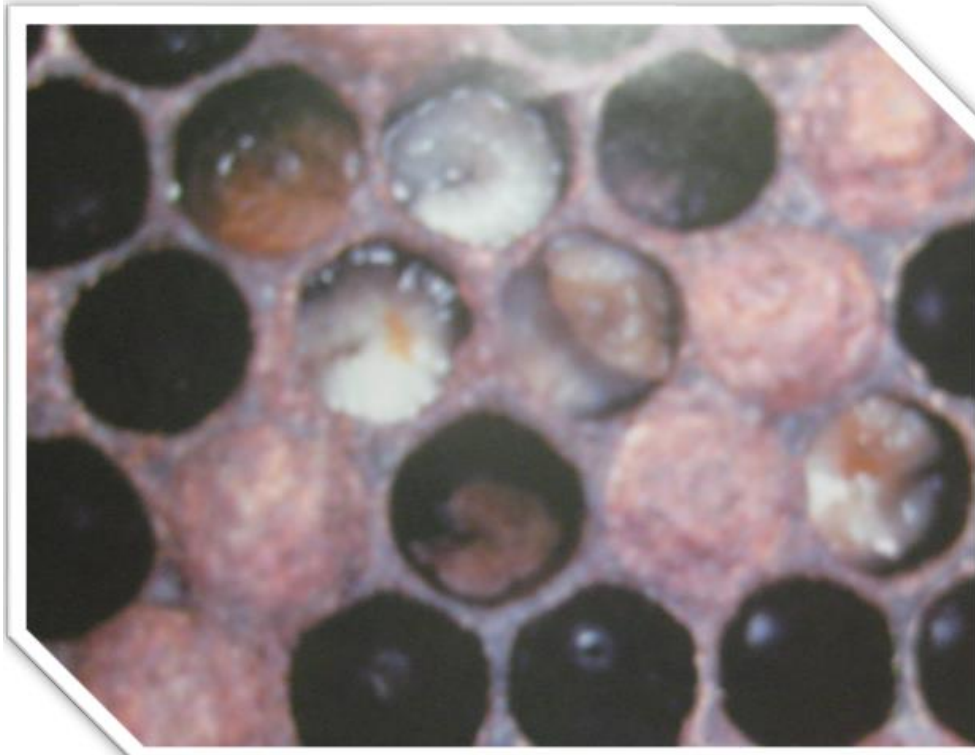
Published online: 12 Jul 2019.



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American foulbrood disease

European foulbrood disease



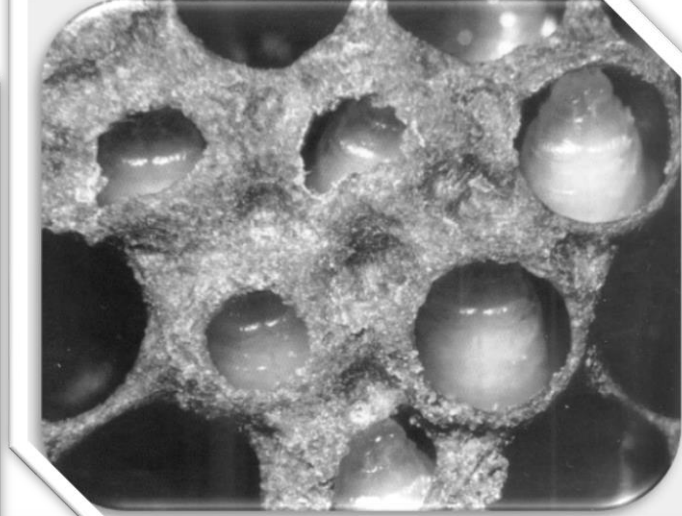
Diagnose:

- Clinical detection
- PCR method

Control:

- Chinese herb medicine,
- Biological agents,
- Antibiotics

Chinese Sacbrood virus disease



Chinese Sacbrood virus disease
Recently, caused serious problem to *Apis cerana*, in Asian apiculture

Control:

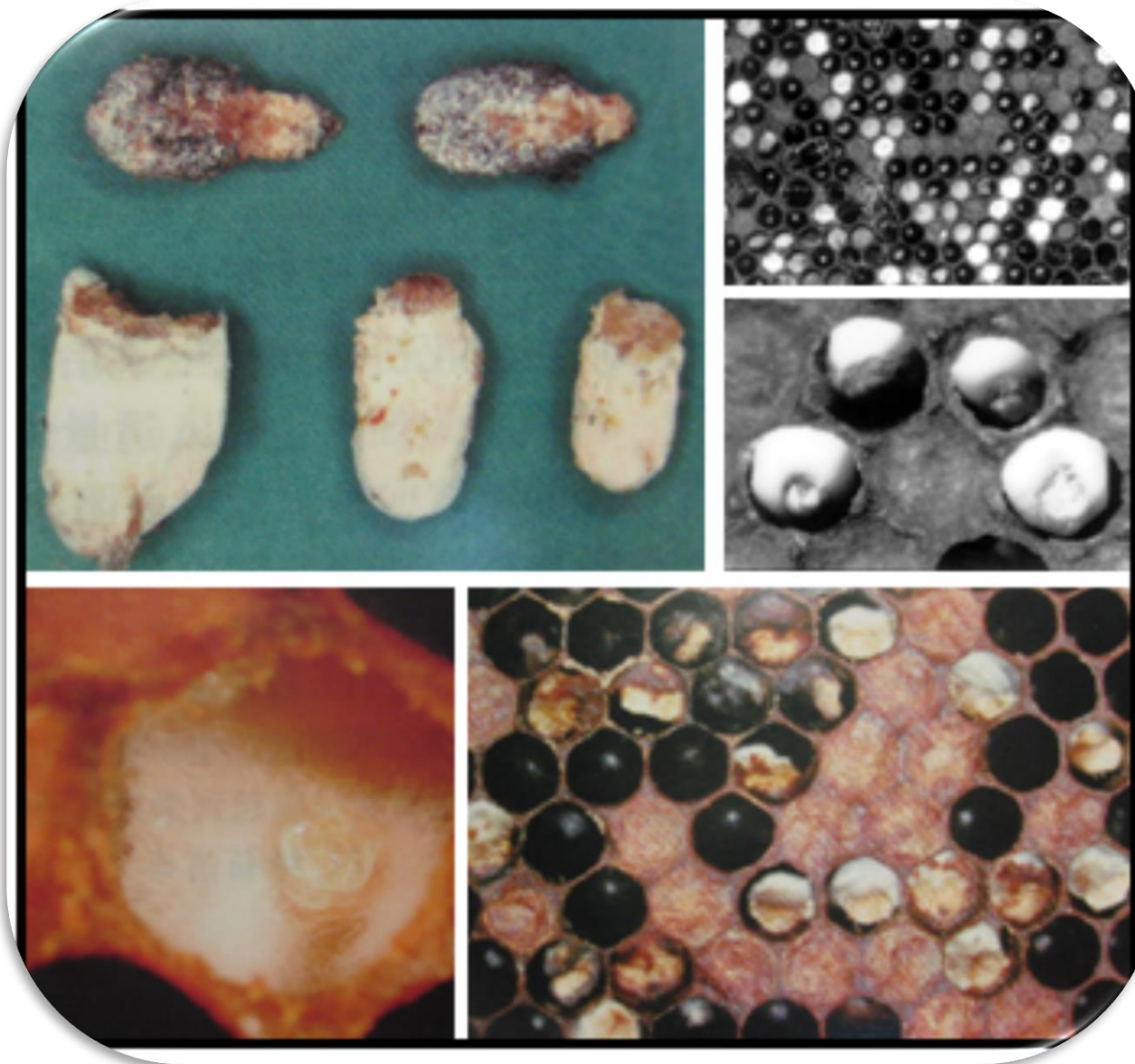
- Chinese herb medicine
- biological agents.



Diagnose:

- Clinical detection
- PCR method
- electron microscope
- Real time RT PCR

Chalkbrood disease



Diagnose:

- Clinical detection
- PCR method
- Fungal culture in plates

Control:

- Chinese herb medicine,
- Biological agents
- Chemicals



Other diseases

- Deformed wing virus
- Chronic bee paralysis virus
- Iserael acute paralysis virus
- Acute bee paralyti virus
- Black queen cell virus
- Lake Sinai virus
- Acaroid mites
- Nosema
- Hornet



Loss of bee colony caused by insecticide

Bee diseases can be diagnosed/tested in China

- Varroa destructor
- Tropilaelaps mercedesae
- Nosema
- Wax moth
- Deformed wing viruses
- Chronic bee paralysis virus
- Israel acute paralysis virus
- Sacbrood disease (totally more than 8 viruses can be diagnosed by PCR)
- Chalk brood disease
- Bacterial diseases (by PCR method and clinical diagnose)

.....

the **other agents** which related to the bee diseases.

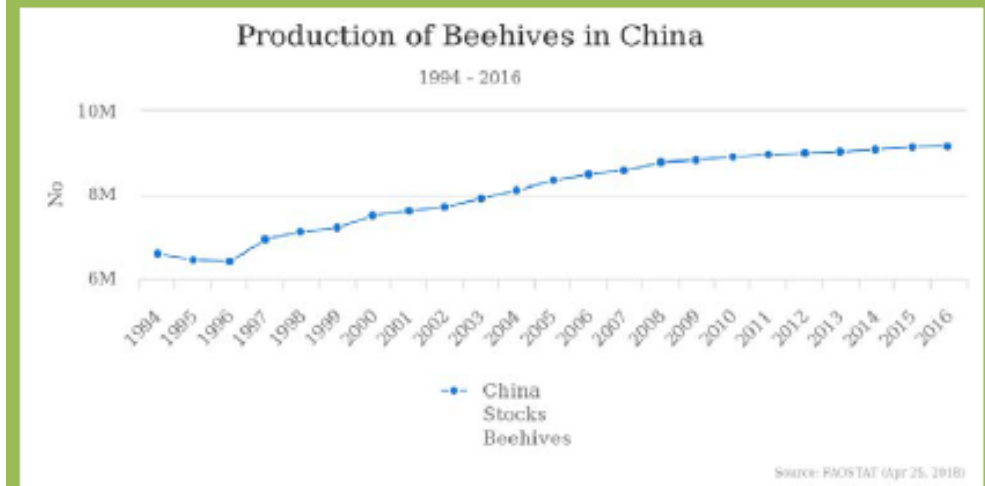
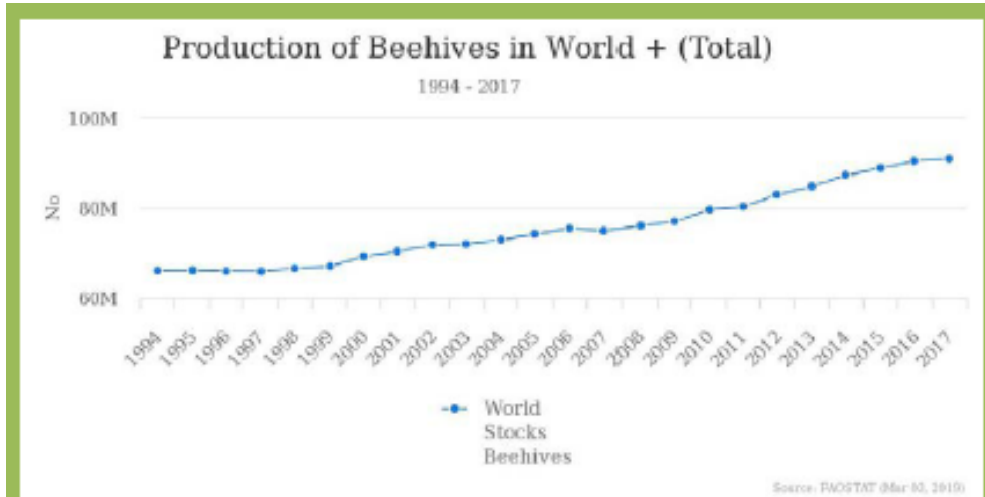
OIE recommended method!



Achievement and challenge



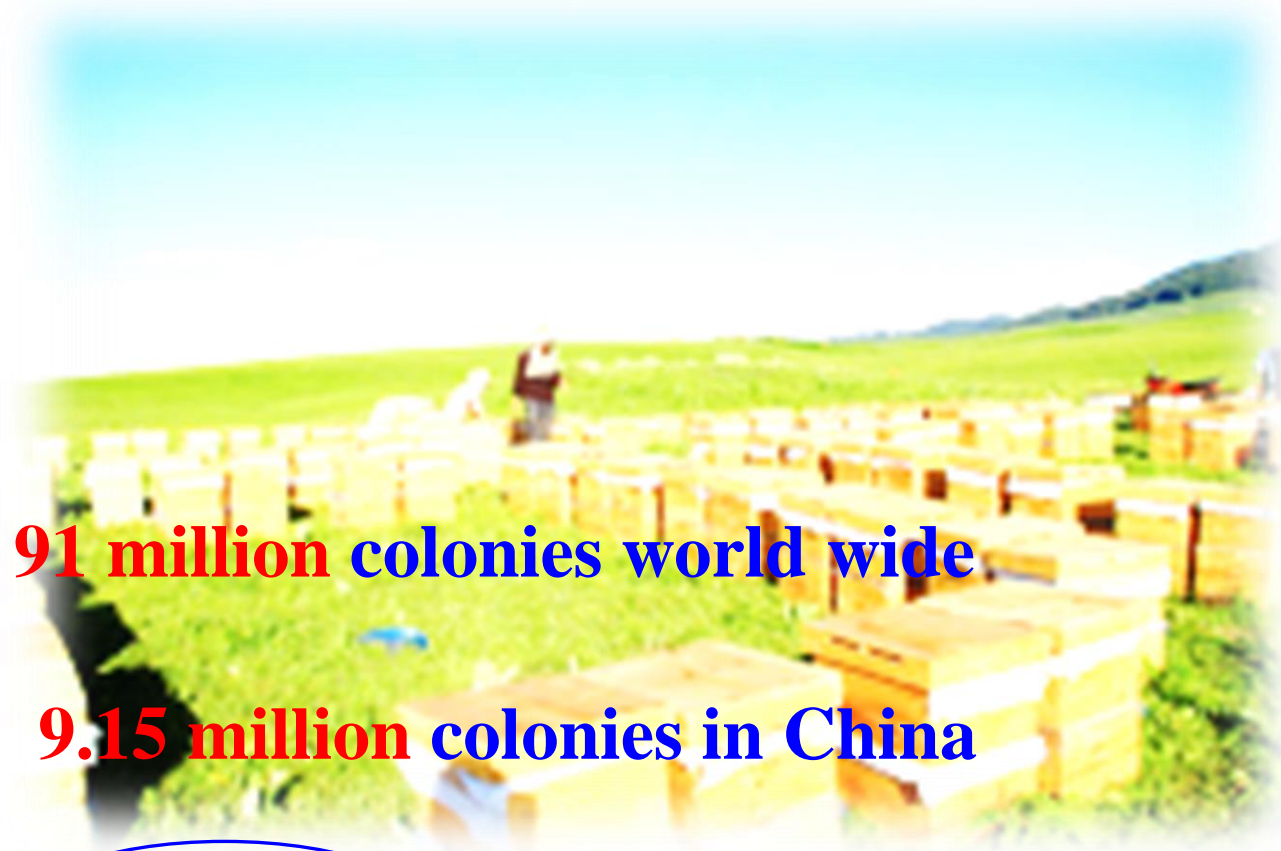
Bee colonies



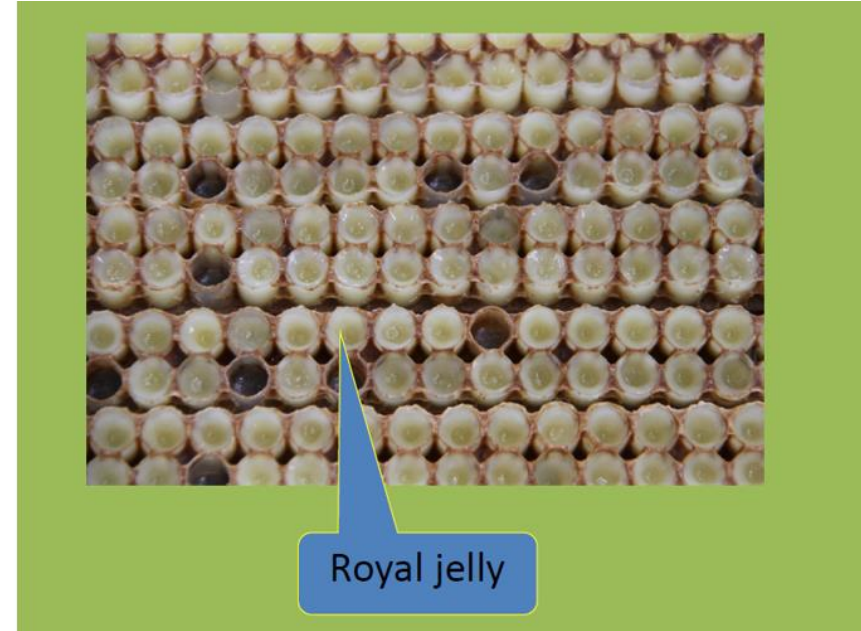
91 million colonies world wide

9.15 million colonies in China

10 percent



Bee products



- **Royal jelly production** **45,000 ton / year**
- **Honey production** **540,000 ton/ year**
- **Bee pollen production** **4500 ton / year**
- **Propolis production** **5000 ton/ year**
-
- **Others**

Challenges

- **New emerging diseases of bees**
- **Pesticides**

We have established bee disease diagnose system and surveillance system, which successfully prevent and control the damages of bee diseases, including the OIE listed and the other bee diseases in China.

Future:

- **On line diagnose and detection techniques, combined with the disease surveillance techniques, is the most important measure for prevention and elimination to the infection and infectious agents in China.**

All over China, people who **CARE ABOUT BEES** are acting !



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衷心感谢!

FOR BEE HEALTH,

WE TOGETHER!



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