



# CAAS ANNUAL REPORT

2017

Compiled by  
the Department of International Cooperation of CAAS



China Agricultural Science and Technology Press

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2017



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# Message from the President

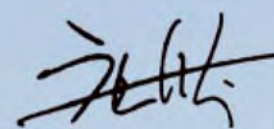
The year 2017 is historic for Chinese Academy of Agricultural Sciences (CAAS) to mark the 60th anniversary of founding. Building on its past glorious achievements, CAAS has been entrusted new missions and embraced new aspirations, as President Xi Jinping, also General Secretary of Central Committee of the Communist Party of China, sent a congratulatory letter, urging CAAS to speed up building world-leading disciplines and scientific institutes and push forward overall leapfrog development in China's agricultural science. CAAS should follow the latest trends of international agricultural science, meet the country's strategic demands and cater to the development of modern agriculture in China, Xi said in his letter. Inspired by the spirit of Xi's letter and the 19th National Congress of the Communist Party of China CAAS has gained new momentums and seen remarkable progress in the scientific research, transferring, alliance building, domestic and international cooperation, capacity building, and infrastructure improvement, further displaying its overall strength and international influence as the only national-level agricultural research institute in China.



In 2017, CAAS launched 2,222 scientific projects at different levels, with the total contract funding reaching 2.06 billion yuan (\$322 million). Regards to the number of National Key Research and Development Program launched in 2017, CAAS owned 22.8 percent of the total. As the leading research institution, CAAS was granted seven national science and technology achievement awards, accounting for 23.3 percent of the total number of awards in agricultural sector. Researchers at CAAS published 23 papers in top international academic journals, up 23.1 percent year-on-year.

Meanwhile, the National Agricultural Science and Technology Innovation Alliance has designated 20 model specialized alliances and carried out 12 integrated research and demonstration projects on green development technologies, which significantly increased the revenue generated from transferring research results. A raft of key projects, including national crops gene bank, have witnessed sound development. The high-level State Biosafety Laboratory of Animal Disease Prevention and Control has passed the examination of authorities. Through its cooperation with the local governments, CAAS has set up Chengdu National Agricultural Science & Technology Innovation Center, in Sichuan province, and a Western Agricultural Research Center in the Changji Hui Autonomous Prefecture in the Xinjiang Uygur autonomous region. Moreover, CAAS organized a number of high-level international conferences, including the Summit on Agricultural S&T Development that was attended by representatives from many countries involved in the Belt and Road Initiative. It has also built 23 new international joint laboratories and improved the infrastructure of 16 existing ones. The academy has actively launched and promoted a CAAS-led international mega program plan, and constructed a global S&T innovation system, which has further strengthened CAAS' leading role in international agricultural research cooperation.

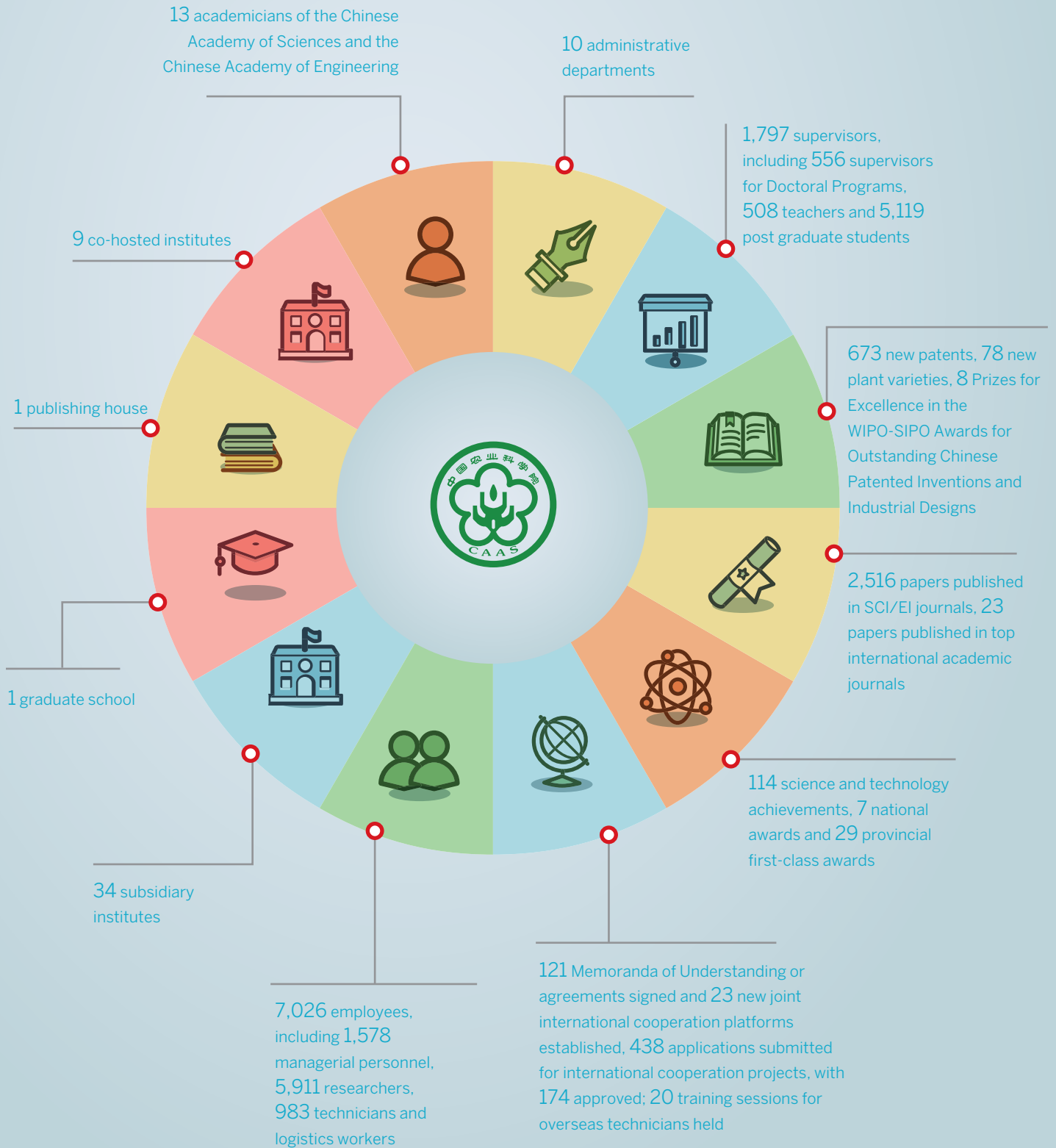
Lastly, I would like to take this opportunity to express my sincere gratitude and best wishes to friends from all sectors of society and to our overseas peers, who have long been helpful and supportive of CAAS' growth. Let's walk hand in hand on the path of discovery and explore the frontiers of agricultural research so we can help satisfy people's demands for better lives and environment, both today and in the future.



President of CAAS  
Academician of CAE



# 2017 IN NUMBERS





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# 2017 Summary

In 2017, CAAS implemented the spirit of President Xi Jinping's congratulatory letter for the 60th anniversary of the founding of CAAS. He urged CAAS to speed up building world-leading disciplines and scientific institutes and push forward the overall leapfrog development in China's agricultural science by following the latest trends of international agricultural science, meeting the country's strategic demand and catering to the development of modern agriculture in China. Over the past year, CAAS

has strengthened its role in engaging in scientific innovation projects, enhanced the utilization and distribution of scientific and technological resources, improved its capability in managing scientific and research projects, and promoted the implementation of the CAAS Science and Technology Development Plan for the 13th Five-Year Plan (2016-20). As a result, CAAS has continuously improved its capabilities in scientific innovation, and the transfer of the research achievements and scientific services.



## High-level papers:

CAAS published **2,516** papers in SCI/El journals, up **16.6** percent year-on-year. Of the papers, **23** were published in top international journals with CAAS as the signature unit of the first authors.



## Research achievements and awards:

CAAS was granted **114** scientific awards of various levels and **7** national science and technology achievement awards as the signature unit of the first authors, accounting for **23.3** percent of the total number of such awards in the agricultural sector. **11** of its scientific achievements won the first prizes of the China Agricultural Science and Technology Awards, accounting for **275** percent of such prizes, with another **29** of its achievements winning provincial first prizes. A total of **127** crop varieties developed by CAAS received national or provincial approvals. Two kinds of new veterinary drugs developed by CAAS were recognized as national first-class ones.



## Technology transfer:

CAAS promoted **190** new varieties, **650** new products and **230** new technologies nationwide in 2017. Of the new technologies, **27** were recommended as the major promoting by the Ministry of Agriculture (now the Ministry of Agriculture and Rural Affairs), accounting for **30** percent of such technologies. The total area of land that used the new research findings reached **27.33** million hectares and about **320** million livestock and poultry benefited from the new findings. CAAS sent researchers a total of **80,000** times to the countryside and staged **14,000** technique demonstration and training service in the countryside in 2017, benefiting **1.15** million grassroots technicians, farmers and herdsmen.



## Intellectual property:

CAAS was granted **673** patents and **905** utility model patents, with applications for another **1,807** patents published by the State Intellectual Property Office, up by **0.6** percent, **4.75** percent and **1759** percent respectively. CAAS was also granted **78** patents for new plant varieties, up **11.43** percent year-on-year. Moreover, **25** institutes of CAAS promoted the transfer of **247** scientific and technological achievements, generating revenue of **540** million yuan (\$84 million), up **17** percent year-on-year. CAAS also won **8** National Awards for Outstanding Patents in 2017.



# Key Events

## January

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- The CAAS 2017 Annual Congress was held in Beijing. Zhang Taolin, Vice-Minister of Agriculture, attended the meeting. Prof. Tang Huajun, CAAS President, delivered a work report at the meeting.



- The Shenzhen Agricultural Genomes Institute and the Institute of Vegetables and Flowers of CAAS made breakthroughs in research on the flavor changes of tomatoes and published a paper on the issue as a cover story in *Science*.
- The second plenary meeting of the CAAS Agricultural Science and Technology Training Steering Committee was held. The meeting summed up its training work performance in 2016 and arranged key training tasks in 2017. Prof. Wang Hanzhong, CAAS Vice-President attended the meeting.

## February

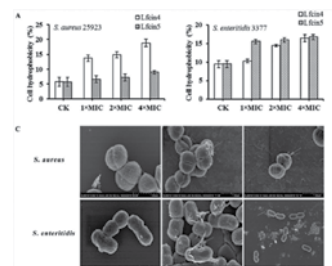
- The Institute of Plant Protection of CAAS found a new mechanism underlying CaM (calmodulin-like protein)-mediated post-transcription gene silencing suppression. The findings were published online in *PLoS Pathogens*.



- CAAS released its development plan for scientific and technological innovation projects during the 13th Five-Year Plan period (2016-20), which is expected to speed up the building of world-leading agricultural scientific institutes, boost the role of science and technology in contributing to agricultural industrial development and support the modernization of agriculture in China.
- Prof. Chen Mengshan, Secretary of the Leading Party Group of CAAS, and Prof. Wu Kongming, CAAS Vice-President, met with a delegation headed by Veronica Nataniel Macamo, speaker of Parliament of the Republic of Mozambique.

## March

- The Feed Research Institute of CAAS successfully developed an antimicrobial and anti-endotoxin dual-function peptide, a new substitute for antibiotics, and published the findings in *Scientific Reports*.



- Prof. Chen Mengshan, Secretary of the Leading Party Group of CAAS, attended an agricultural poverty relief work conference for regions surrounding Beijing and Tianjin, which was held by the Ministry of Agriculture in Fuping county, Hebei province. Chen also presided over a poverty relief coordination conference on CAAS assistance to Fuping. Prof. Wang Hanzhong, CAAS Vice-President, signed an agreement on poverty relief assistance with the Fuping county government.

## April

- The Institute of Crop Sciences of CAAS made breakthroughs in the research on the mechanism that regulates the width and weight of rice grains. Researchers from the institute found a new mechanism through which *GW5*, a major QTL associated with the width and weight of rice grains, acts in the brassinosteroid signaling pathway to regulate grain filling, and published the findings in the online edition of *Nature Plants*.
- The Harbin Veterinary Research Institute of CAAS identified an HIV-restricting innate immunity mechanism and published the findings in the online edition of *Journal of Virology*.
- The 2017 China Agricultural Outlook Conference, held by the CAAS Agricultural Information Institute, opened in Beijing. The China Agricultural Outlook (2017-2026) Report was released at the conference.



## May

- Xinhua News Agency reported on May 26, 2017, that President Xi Jinping, also general secretary of the Communist Party of China Central Committee and chairman of the Central Military Commission, sent a congratulatory letter to the Chinese Academy of Agricultural Sciences on the 60th anniversary of its founding, extending sincere greetings to the academy's agricultural scientific researchers and technicians around the country.
- Xinhua News Agency reported on May 26, 2017 that Li Keqiang, a member of the Standing Committee of the Political Bureau of the Communist Party of China Central Committee and the country's premier, extended congratulations on the 60th anniversary of CAAS founding.
- Chinese Vice-Premier Wang Yang inspected the CAAS headquarters on May 25.
- The Summit on Agricultural Science and Technology Development was held by CAAS on May 27 in Beijing. More than 180 representatives from seven international organizations, agricultural ministries and agricultural research institutes of 18 countries involved in the Belt and Road Initiative, as well as experts from over 30 provincial agricultural institutes and agricultural universities in China, participated in the summit.

## June

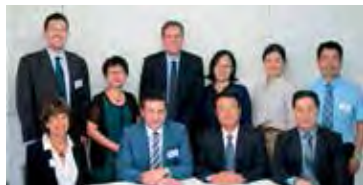
- Prof. Chen Mengshan, Secretary of the Leading Party Group of CAAS, met with a delegation headed by Charles Koffi Diby, President of Cote d'Ivoire's Economic and Social Council, and they held discussions on strengthening bilateral agricultural science cooperation.
- Prof. Wu Kongming, CAAS Vice-President, participated in the third EU-China Innovation Cooperation Dialogue in Brussels, Belgium, as a member of the Chinese Ministry of Science and Technology's delegation to the event.



- An international symposium on sustainable food security and nutrition in the context of agricultural transformation and urbanization, held by CAAS and the Committee on World Food Security of the Food and Agriculture Organization of the United Nations, opened in Beijing.

## July

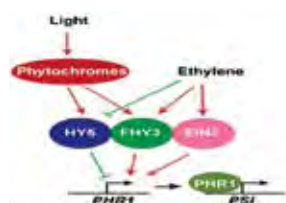
- Prof. Li Jinxiang, CAAS Vice-President, led a delegation on a visit to CAB International (CABI), Institut National de la Recherche Agronomique and the Consultative Group for International Agricultural Research.



- Prof. Wu Kongming, CAAS Vice-President, visited to Uzbekistan and Kazakhstan, as a member of the delegation of the Ministry of Agriculture of the People's Republic of China. Consensus was reached on cooperation in a variety of areas, including cotton production, animal hygiene, the storage and processing of agricultural products, further processing of silk products, and fertilizer production.
- Prof. Wang Hanzhong, CAAS Vice-President, led a delegation to visit agricultural scientific and educational institutions in Bulgaria, Czech Republic and Germany, with preliminary intentions of building joint laboratories or research centers. The first Sino-Bulgaria agricultural science and technology symposium was held during the visiting.

## August

- A seminar on the going global strategy of Chinese agricultural science and technology was held by CAAS in Beijing. A number of issues, including the information service platform, expansion of a talent pool featuring internationalized agricultural scientific researchers, and innovation of the mechanisms and systems that facilitate implementation of the strategy, were intensively discussed at the seminar.



- The Biotechnology Research Institute of CAAS, made important progress in the research on using light to regulate the phosphate starvation response of plants and published the findings in *The Plant Cell*.
- A work conference on the management of CAAS experimental bases was held. The conference summed up the achievements that the bases had made in such aspects as promoting agricultural scientific innovation, training scientific research personnel, accelerating technology transformation and serving local agricultural development. Problems and shortcomings were also identified and future development approaches explored.

## September

- Prof. Wan Jianmin, CAAS Vice-President, attended the second China-Norway Joint Committee on Science and Technology and a China-Norway seminar on the influence of climate change on agriculture in polar region and innovative agricultural cooperation. A memorandum of understanding on agricultural scientific cooperation between CAAS and Norwegian Institute of Bioeconomy Research was signed during the events.
- Prof. Wu Kongming, CAAS Vice-President, attended a symposium for central, eastern Europe and central Asia, held by International Plant Protection Convention and the UN Food and Agriculture Organization in Tbilisi, Georgia. He also visited the the Ministry of Agriculture of Georgia and the Georgian Academy of Agricultural Sciences.
- Prof. Chen Mengshan, Secretary of the Leading Party Group of CAAS, visited scientific research institutions in Canada, Chile and Columbia and signed cooperation memoranda of understanding with these countries.



## October

- Prof. Tang Huajun, CAAS President, attended the 19th National Congress of the Communist Party of China as a deputy and participated in the fifth group interview held at the press center, together with four other deputies, like He Zhonghu and Wei Lingling.



- CAAS held a symposium on the operation and management of the national key laboratories. CAAS researchers were urged to follow the latest trends of scientific development, cater to the country's strategic demands, tackle major scientific issues and research orientations and seek to make high-level achievements and improve the quality of its laboratories.

## November

- The Institute of Special Animal and Plant Sciences of CAAS first decoded the whole genome sequence for animals of the deer family and published the findings in the online edition of *GigaScience*.
- Prof. Mei Xurong, CAAS Vice-President, met with a delegation headed by Michel Eddi, president of the French Agricultural Research Centre for International Development.
- Jia Guangdong, head of CAAS Personnel Department, led a delegation to visit the Crop Research Institute in the Czech Republic, the Food and Agriculture Organization of the United Nations, CABI and University of Reading in the United Kingdom.



## December

- The Sino-German Workshop on Food and Nutrition was held at CAAS. Development strategies of the country's food and nutrition industries were discussed at the event.
- Prof. Tang Huajun, CAAS President, led a delegation to visit agricultural scientific research and educational institutions and international agricultural research organizations in New Zealand, Australia and Indonesia. A total of seven memoranda of understanding were signed during the visit.



- The seventh meeting of the China-EU Food, Agriculture and Biotechnology (FAB) Task Force was held by CAAS and its Shenzhen Agricultural Genomes Institute in Shenzhen, Guangdong province. Such issues as a work plan for the China-EU joint funding mechanism for research and innovation cooperation were discussed at the meeting.



## New Academicians



**Wang Hanzhong**

Professor,  
Vice-President of CAAS

Wang Hanzhong, who has long been engaged in the research on genetic breeding of rapeseed, is in charge of more than 20 national key research projects or subjects, including the high-yield rapeseed project supported by the National Basic Research Program of China (973 Program). He has published a total of 123 papers in top international journals including *Nature Genet.*, *PNAS* and *Plant J.*, with the number of citations totaling 4,673, and the citations for the most-cited paper reaching 1,023. Wang was granted one invention patent in Europe and 15 invention patents in China as well as an excellence prize of the WIPO-SIPO Award for Chinese Outstanding Patented Invention and Industrial Design. Wang also won a second prize of the National Award for Technology Invention, a second prize of the National Science and Technology Progress Award and seven provincial or ministerial science and technology awards as the first accomplisher of the projects. He has developed 17 new double-low rape varieties as the first accomplisher, of which the total planting area has reached 6.67 million hectares.

Wang is also the chief scientist for the National Rapeseed Industrial Technological System, head of the oil plants experts team for the Ministry of Agriculture and Rural Affairs, a member of the ministry's scientific and technological committee, a member of the National Crop Germplasm Resources Committee and a council member for the International Consultative Group of Research on Rapeseed. He was also listed among the national outstanding professional and technical personnel, named a role model for engaging in the country's key scientific projects during the China's Ninth Five-Year Plan (1996-2000) period and received an outstanding youth award for technical transfer from the China Association for Science and Technology. He receives a special government allowance from the State Council.

In 2017, Wang Hanzhong was elected an academician of the Chinese Academy of Engineering.



**Chen Hualan**

Professor,  
Harbin Veterinary Research  
Institute of CAAS

Chen Hualan, who is engaged in basic research on the avian influenza virus and the research and development of vaccines, has made a number of important findings, which have improved cognition of the virus and provided the scientific basis for prevention and control measures for the disease and technical research and development of remedies. Chen won a second prize of the National Natural Science Award in 2013, and a second prize (first accomplisher) of the National Award for Technology Invention in 2007 as the first accomplisher. She also won the first prize of the National Science and Technology Progress Award in 2005 as the second accomplisher. She was also listed among the national outstanding professional and technical personnel in 1997 when the award was launched; and granted the China Award for Excellence in Agriculture in 2007 when the award was set up. She has also received the Ho Leung Ho Lee Science and Technology Innovation Award, the L'Oréal-UNESCO For Women in Science award, the Science and Technology Award for Chinese Youth and the Qiushi award for innovative youth.

In 2017, Chen Hualan was elected an academician of the Chinese Academy of Sciences.

## Honors and Awards

### 2017 National Technology Invention Awards (Second Prize)

Technologies on high-quality bee product safety production processing and quality control, a program headed by Wu Liming, a researcher at the CAAS Institute of Apicultural Research



### 2017 National Science and Technology Progress Awards (Second Prize)



Conservation and innovative utilization of wild rice germplasm resources in China, a program headed by Yang Qingwen, a researcher at the CAAS Institute of Crop Sciences



Breeding and application of new potato varieties with early maturity, good quality and high-resistance, a program headed by Jin Liping, a researcher at the CAAS Institute of Vegetables and Flowers



Key technology and system integration of LED intelligent plant factory with high luminous efficiency and low energy consumption, a program headed by Yang Qichang, a researcher at the CAAS Institute of Environment and Sustainable Development in Agriculture



Establishment and application of a technical system that monitors non-point source pollution from national farmland, a program headed by Ren Tianzhi, a researcher at the CAAS Institute of Agricultural Resources and Regional Planning



Mushroom Germplasm Identification and Evaluation Techniques and Breeding of Widely Adaptive Cultivars, a program headed by Zhang Jinxia, a researcher at the CAAS Institute of Agricultural Resources and Regional Planning



Breeding and application of aflatoxin-resistant peanut cultivars with improved quality and high-yield, a program headed by Liao Boshou, a researcher at the CAAS Oil Crops Research Institute



# Honors and Awards

## Winner of the National Science Fund for Distinguished Young Scholars



Wang Guirong, a researcher at the CAAS Institute of Plant Protection

## Key innovative team in the Innovators Promotion Program initiated by the Ministry of Science and Technology



A research team on healthy breeding, innovative preparation and application of new enzyme, led by Yao Bin, a researcher at the CAAS Feed Research Institute

## Winners of the National Science Fund for Outstanding Young Scholars



Tong Hongning, a researcher at the CAAS Institute of Crop Sciences



Cheng Feng, an associate researcher at the CAAS Institute of Vegetables and Flowers

## Honors and Awards

**Scientists listed in the National Hundred, Thousand and Ten Thousand Talents Program and named a National Young and Middle-aged Expert with Outstanding Contribution**



Li Xinhai,  
a researcher at the CAAS  
Institute of Crop Sciences



Wang Guirong,  
a researcher at the CAAS  
Institute of Plant Protection



Zhao Guiping,  
a researcher at the CAAS  
Institute of Animal Sciences



Zhang Chunyi,  
a researcher at the CAAS  
Biotechnology Research  
Institute



Cao Weidong, a researcher  
at the CAAS Institute of  
Agricultural Resources and  
Regional Planning



Yan Gentu, a researcher  
at the CAAS Institute of  
Cotton Research



## Honors and Awards

8

### Leading Young and Middle-aged Scientists in Science and Technology Innovation in the Innovators Talent Promotion Program



Li Wenxue,  
a researcher at the CAAS  
Institute of Crop Sciences



Gao Li,  
a researcher at the CAAS  
Institute of Plant Protection



Wu Liming,  
a researcher at the CAAS  
Institute of Apicultural  
Research



Luo Huiying,  
a researcher at the CAAS  
Feed Research Institute



Zhang Chunhui,  
a researcher at the CAAS Institute of  
Food Science and Technology



Zhang Ruifu,  
a researcher at the CAAS  
Institute of Agricultural  
Resources and  
Regional Planning



Li Chengjun,  
a researcher at the CAAS  
Harbin Veterinary  
Research Institute



Guo Huichen,  
a researcher at the CAAS  
Lanzhou Veterinary  
Research Institute

# Honors and Awards

## Leading Young and Middle-aged Scientists in Science and Technology Innovation in the Innovators Talent Promotion Program



Cheng Guofeng,  
a researcher at the CAAS  
Shanghai Veterinary  
Research Institute



Li Shengben,  
a researcher at the  
CAAS Shenzhen  
Agricultural  
Genomics Institute

## First National Award for Excellence in Innovation (Medal winners)



Li Shaokun,  
a researcher at the  
CAAS Institute of  
Crop Sciences



He Zhonghu,  
a researcher at the  
CAAS Institute of  
Crop Sciences

## First National Award for Excellence in Innovation (Certificate winners)



Hou Shuisheng,  
a researcher at the  
CAAS Institute of  
Animal Sciences



Yan Gentu,  
a researcher at the  
CAAS Institute of  
Cotton Research





# CAAS 60th Anniversary: Progress and Influence

Established in 1957, CAAS has made a glorious journey of 60 years with the development of China's science and technology cause. Under the guidance and care of the Central Committee of the Communist Party of China and the State Council, CAAS has always borne in mind its mission as a national team for agricultural sciences, assumed its duty of serving agriculture, rural areas and farmers, and constantly improved its science and technology innovation ability and comprehensive strength, leading the progress of national agricultural science and technology. Through the unremitting efforts of generations of researchers, CAAS has accumulated deep cultural deposits and developed into a national comprehensive agricultural scientific research institute with important international influence.

Over the past 60 years, CAAS has made 6,131 science and technology achievements, 310 science and technology achievements that have been recognized with national awards, 16.2 percent of the total national awards in the agricultural field, with one outstanding national award, and 19 first prize national science and technology awards, 24 percent of the total national first prize awards in the agricultural sector.

**Developing important cultivars to support food security:** CAAS has conducted large-scale investigations, collections and innovative applications of crop germplasm resources, and has 480,000 accessions in long-term storage, which ranks second in the world in terms of quantity. CAAS has developed 360 new varieties of rice, wheat and corn that exhibit the desirable characteristics of high yields, good quality, multi-resistance, and wide adaptability, and the total sown area for the varieties is 160 million hectares. CAAS has researched and developed comprehensive prevention and control technology against the main plant diseases and insect pests, realizing the matching of good seeds with good methods, and has made important contributions to the improvement of the average output of main food crops from 1,662 kilograms per hectare in 1957 to 6,058.5 kilograms per hectare in 2017.



The exploitation and application of ID-type rice male sterile cytoplasm won first prize in the 2005 National Prizes for Progress in Science and Technology



Dwarf male sterile wheat and the creation of its highly efficient breeding method won first prize in the 2010 National Prizes for Progress in Science and Technology



The construction and application of the comprehensive treatment technology system of the source base for Chinese wheat rust won first prize in the 2012 National Prizes for Progress in Science and Technology



**Accelerating transferring of its research findings to support the supply of agricultural products:** CAAS, through importing and improving Simmental Cattle, has popularized 8 million cattle of that breed over the year, with the breed accounting for 52 percent of the national market. The Datong Yak can be found in 75 percent of the yak-producing areas in China. CAAS has researched and produced insect-resistant cotton with proprietary intellectual property, which has put an end to the foreign monopoly, and developed more than 200 varieties of new transgenesis insect resistance cotton with high yields, early maturing and multi-resistance features, which are sown in a total area of 40 million hectares, accounting for more than 97 percent of the total area planted with insect-resistant cotton in the country.



New breeds of Datong Yak and their breeding technology won second prize in the 2007 National Prizes for Progress in Science and Technology

**Developing characteristic industries to increase farmers incomes:** CAAS has cultivated more than 390 new varieties of vegetables, fruits and special economic husbandry plants, among which the annual sown area of kale has reached 1 million hectares, accounting for 60 percent of the total kale planted area in China. Through organizing the demonstration and integration of green technologies that help to enhance agricultural efficiency and output, precise poverty alleviation using science and technology, and providing science and technology assistance to the Tibetan and Xinjiang Uygur autonomous regions, CAAS has cultivated a series of local characteristic industries, effectively boosting the country's total vegetables output from 340 million tons in 1997 to 790 million tons in 2017, which helped to increase farmers' incomes.



Breeding of cabbage self-incompatible inbred-lines and seven derived varieties won first prize in the 1985 National Awards for Technological Invention



Construction and application of a virus-free, three-level reproducing system for quality oranges won second prize in the 2012 National Prizes for Progress in Science and Technology



Efficient and value-added techniques for breeding sika deer and red deer won second prize in the 2004 National Prize for Progress in Science and Technology

**Preventing and controlling major animal epidemics, safeguarding public hygiene and safety:** CAAS has analyzed the pathogenesis of major animal epidemics, created and produced safe and efficient vaccines to treat bird flu, foot-and-mouth disease, equine infectious anemia and blue-eared pig disease, and has industrialized the production of vaccines for these diseases. Among these, the bird flu vaccine developed by CAAS has more than 95 percent of the domestic market, and has been introduced to and applied in Southeast Asian countries including Vietnam and Indonesia. The foot-and-mouth vaccine developed by CAAS has been widely used in areas affected by the disease in China. CAAS vaccines have helped to eliminate cattle plague and cattle pleuropneumonia, and effectively control the epidemic zoonosis of bird flu and foot-and-mouth disease, effectively safeguarding national public hygiene and safety.







Equine Infectious Anemia Live Attenuated Vaccine won the first prize of the 1983 National Award for Technological Invention

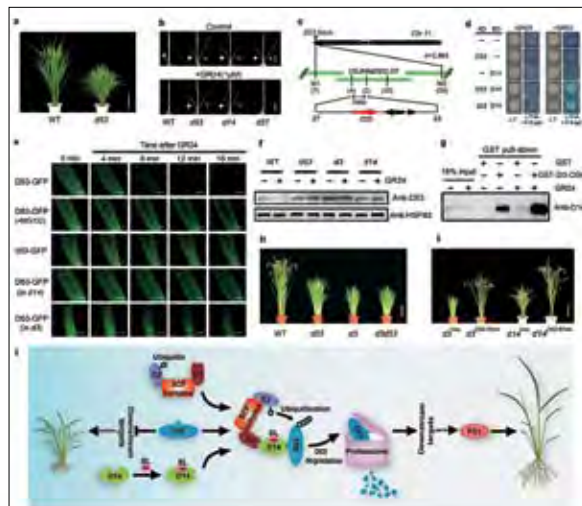


Serial inactivated vaccine for foot-and-mouth disease won second prize in the 1999 National Awards for Technological Invention, and the second prize in the 1987 and 2016 National Prizes for Progress in Science and Technology

**Strengthening original research and innovation to make breakthroughs in science and technology:** CAAS utilized the new generation sequencing techniques to finish genomic sequencing and frame diagram construction of wheat (D genome), rape plant, cotton, cucumber, potato, tomato, Chinese cabbage and kale; analyzed the genetic control network and mechanism for the characteristics of some agricultural animals and plants, and cloned more than 30 key genes for important characteristics related to output, quality and disease resistance. CAAS has published more than 20 papers in top international academic journals, such as *Science* and *Nature*. Ten CAAS experts were listed as the most quoted Chinese scholars in 2016 by Thomson Reuters.



*Bt* insect-resistant cotton risk assessment mechanism studies was selected as one of the top 10 news on science and technology progress in 2008



Signaling pathway of strigolactone in the adjustment and control of the tillering and plant type of rice was evaluated as one of the top 10 progresses in science and technology in China in 2014



**Making breakthroughs in key technology to promote sustainable development:** Through its R&D efforts, CAAS has developed and applied new technology to improve medium- and low-yield farmland. In particular, CAAS has helped to raise the yield of low-quality farmland. CAAS researched and developed the technology to improve winter-drying duck feces mud to solve the problem of the decline in rice yield in the autumn, and the technology to improve low-yield farmland in the 1960s, which doubled the per unit area yield of rice. The academy researched and developed water-saving and dry-land farming technology, markedly increasing the efficiency of agricultural water use. The technology has been applied yearly on nearly 6.67 million hectares of farmland, and the yield in total has increased by 3 billion kilograms. CAAS has founded a national agricultural remote monitoring system, providing technological support for the response to climate change, agricultural disaster prevention and reduction, and the alleviation of water shortages for the realization of sustainable agricultural development.



The research and application of key technologies for the remote sensing and monitoring of major crops won second prize in the 2012 National Prizes for Progress in Science and Technology, and the technology for remote sensing and monitoring technology of agricultural droughts and floods won second prize in 2014

**Prompting the going global of agricultural science and technology to increase China's international influence:** CAAS has actively taken part in the country's Belt and Road Initiative and exported more than 60 kinds of technologies and products to over 150 countries in Asia, Africa, the Americas and Europe. The academy has developed 64 varieties of green super rice for African and Asian countries, which have been sown in an area of more than 2 million hectares. The new varieties of China Cotton, have been widely planted in Central Asian countries, increasing the per unit area yield by 60 percent. CAAS' highly pathogenic avian influenza vaccine has been widely used in Egypt and Southeast Asian countries, and the total exports have hit more than 570 million doses, contributing to global food security and the sustainable development of agriculture.



New varieties of China Cotton have been planted in Central Asia, helping local farmers to increase yields and incomes



Green super rice varieties help to alleviate food shortage in Asia and Africa



The high-efficiency production technology of feed phytase has been widely promoted and adopted in Europe and North America

Looking toward the future, CAAS will always bear in mind its mission, move forward, assume its duties in the vanguard of reform, as part of the national innovation team, and as a think tank for decision-making, and make more contributions to the implementation of the rural revitalization strategy and accelerate the modernization of agriculture.





# Strategic Programs

## Talent Project

### 1. Young talent project Plan (2017-30)

The Young Talent Project Plan (2017-30) is an important, forward-thinking project that CAAS initiated in 2017 to strengthen its core competitiveness and realize leapfrog development. CAAS will construct an all-round talent system and build an innovative, transformative and supportive talent team that is of the proper scale, with clear structure and functions, a rational layout of disciplines, that can serve the causes of agriculture, villages and farmers. It is planned that by 2030, CAAS will have a young talent team of 4,750 people under 45 years old, which should account for at least two-thirds of the total number of frontline research professionals. At the same time, the number of innovative young talents will reach 3,450, the number of transformative young talents will reach 340, the number of supporting young talents will reach 960, and outstanding young talents will reach 570.

### 2. Special support policies for outstanding agricultural talent

CAAS has come up with a set of policies to support both domestic and foreign outstanding agricultural talents, including leading high-level talents, giving priority support to jointly promote and construct a complete talent development system, as well as a talent cultivation mechanism, which are of equal importance, so as to attract and cultivate high-end science and technology talents and stimulate their innovative and creative vitality.

The special support policies are mainly extended to full-time science and technology professionals working in research posts at CAAS, who can be divided into three levels: top talents, leading talents and young talents. CAAS provides these talents with research funds and annual subsidies. For top talents, the research funds are 2 million yuan (\$312,500) (per person a year), and they receive an annual subsidy of 500,000 yuan (\$78,138) (per person a year). The research funds for leading talents in Class A are 1.5 million yuan (\$234,415) (per person a year), and their annual subsidy is 300,000 yuan (\$46,883) (per person a year). The research funds for leading talents in Class B are 1 million yuan (\$156,276) (per person a year), and their annual subsidy is 250,000 yuan (\$39,069) (per person a year). The research funds for leading talents in Class C are 800,000 yuan (\$125,021) (per person a year), and their annual subsidy is 200,000 yuan (\$31,255) (per person a year). The research funds for the young talents are 600,000 yuan (\$93,736) (per person a year), and their annual subsidy is 100,000 yuan (\$15,622) (per person a year).

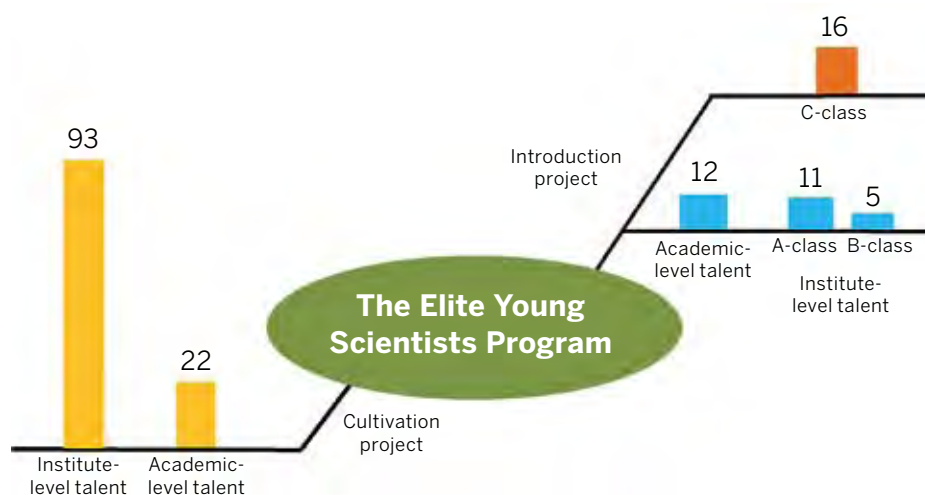


CAAS selected 259 outstanding agricultural talents in 2017, including 12 top talents, 154 leading talents and 93 young talents, making its talent pool bigger and stronger.

### 3. The Elite Young Scientists Program

The Elite Young Scientists Program is a young science and technology talent introduction program initiated by CAAS in 2013 that features high goals, high standards and high intensity. The plan was listed as one of China's first 55 key initiatives aimed at recruiting high-level overseas experts and specialists in 2014, attracting wide attention both at home and abroad. In 2017, CAAS amended the program to further improve the quality of young talents introduced and speed up the

recruitment process. It now consists of two projects: introduction project and cultivation project. It aims to attract both domestic and foreign high-level leading scientists and innovative talents in various disciplines who are under 40 years old and have an international view. In 2017, 12 young talents were introduced at the academy-level through the introduction project, and 22 people were introduced at the academy-level through the cultivation project.



#### 4. Post-doctoral work

CAAS center for post-doctoral studies was established in 1991. It covers four academic fields, namely natural science, engineering, agronomy agriculture, science and management, and includes mobile research centers for post-doctoral studies in veterinary medicine, animal husbandry, crop science, plant protection, agriculture and forestry management, biology, horticulture, agrostology and agricultural engineering. In total, 1,463 post-doctoral researchers have been enrolled, including 127 Chinese graduating from foreign universities and 48 foreigners. In 2017, CAAS enrolled 152 post-doctoral researchers, and there are currently 470 post-doctoral researchers in the centers for post-doctoral studies of CAAS.



**ASTIP has three phases concurrent with the 12th, 13th, and 14th Five-Year plans (2013-25).**

**The first phase of ASTIP (2013-15)** focuses on exploration of a new and more efficient organization to support agricultural innovation.

**The second phase (2016-20)** will review and adjust lessons learned during the first phase, and international cooperation, capacity development, and the improvement of research facilities and infrastructure are expected to reach their peak.

**The third phase (2021-25)** will feature the expansion of all parts of the program.

## Agricultural Science and Technology Innovation Project

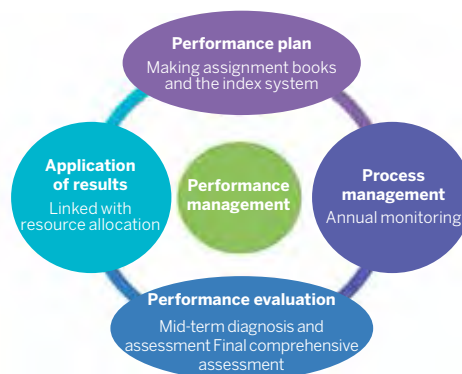
### 1. Assigning missions during the overall pushing-forward period

2017 was an important turning point for the Agricultural Science and Technology Innovation Project (ASTIP) to transfer from the pilot phase to the overall advancement phase. CAAS organized a work conference that clarified the key tasks for the ASTIP in the overall advancement phase.



### 2. Strengthening performance management

The academy has designed a performance management plan for the overall advancement period, held performance management training courses, and organized academy and institute level managements to sign assignment books for evaluating performance. CAAS conducts annual monitoring of the progress of the ASTIP at institute levels; and the academy conducts a mid-term evaluation of the ASTIP to assess the performance of the institutes.



### 3. Promoting collaborative innovation

CAAS has organized the general directors and chief technicians of 19 collaborative innovation tasks to sign assignment books, initiated cooperation with the Shandong Provincial Academy of Agricultural Science, and explored ways to establish collaborative innovation mechanisms with parties outside the academy, so as to promote alliances and foster collaboration in agricultural scientific research.

### 4. Organizing the pilot work of the agricultural genome research institute

CAAS organized the Agricultural Genomes Institute to apply for the pilot program of seven ministerial departments including the Ministry of Science and Technology, in which the ministries have decided to expand university and research institutes right to manage their own affairs, and entitle the leading talents more right in disposing of personnel and properties, and more power in the decision-making for technological orientation.



### Research and Demonstration Program on Integrated Technology-based Green Production

CAAS continues to advance the existing nine research and demonstration programs for more efficient production of rice, corn, wheat, soybean, rape, potato, cotton, milk cows and sheep. It has newly initiated three industrial programs for vegetables, pigs and ducks, which have made technological reserves for the implementation of China's rural revitalization strategy, and provided strong science and technology support to the promotion of green development and quality agricultural products.

The 12 programs have integrated more than 180 advanced and applicable technologies, formed 38 sets of replicable, comprehensive technology production modes and brought about more than 120 experimental and demonstration bases, covering an area of 28,700 hectares with 450,000 cattle, sheep and pigs for demonstration; 18 provinces and regions are under the program and demonstration.



### Intellectual Property Achievements

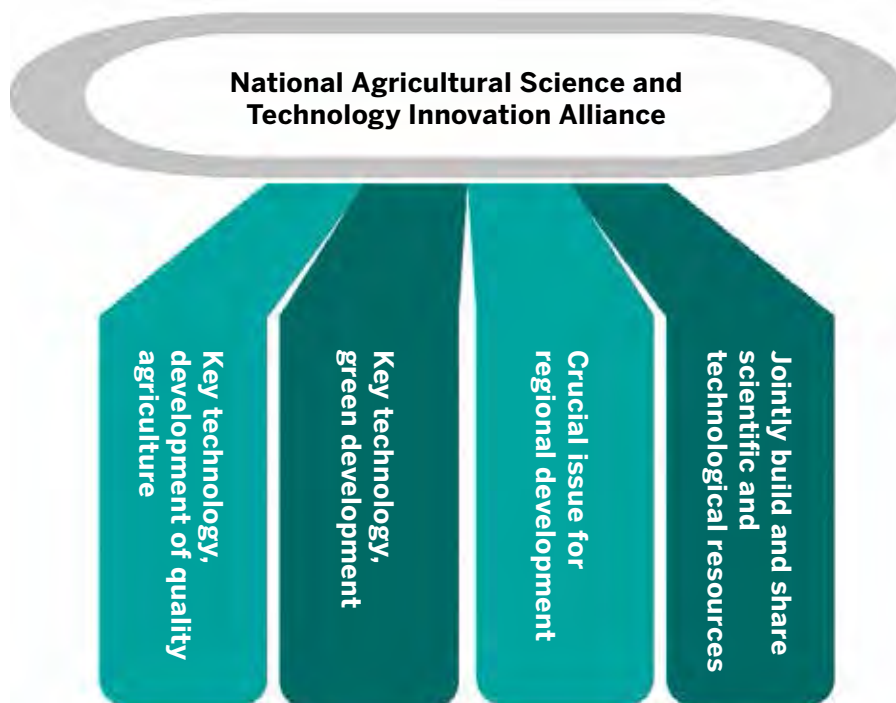
**Strengthening guidance and coordination.** CAAS employed experts to provide instruction for its affiliated research institutes and to conduct patent analysis in the fields of crude fiber crops, agricultural machinery, agricultural product processing and livestock breeding waste disposal.

**Strengthening training and education.** CAAS hosted three academic-level training classes, including a patent retrieval analysis practice training class, an IPR management and achievement transformation senior international training class with PIPRA of University of California, Davis, and an IPR promoting agricultural innovation training class with Monsanto company.

**Strengthening the transformation and application of research results.** Through a national agricultural science and technology achievement transformation service center, CAAS has organized and taken part in 28 provincial- and city-level exhibitions, 10 technology fairs, and introduced its technology and research findings to more than 10,000 people, which has greatly advanced the transformation of scientific and technological achievements of CAAS and other agricultural research institutes.







**National Agricultural Science and Technology Innovation Alliance**

In 2017, the National Agricultural Science and Technology Innovation Alliance paid special attention to fulfilling important tasks, initiated collaborative efforts to tackle key technologies in green development, quality agriculture development and sharing scientific and technological resources. The academy strengthened its mechanism for innovation and performance monitoring, gradually regulating the management and operation of the alliance.

**First, the alliance has tackled some key technologies crucial for quality-oriented agriculture, and created a batch of technological products.** The dairy industry alliance has researched and developed raw milk grading technology, and drawn up production and processing standards for quality milk, which have been piloted in 23 dairy enterprises. The cotton industry alliance has demonstrated and spread some sets of new technology of cotton planting. The area of farmland for ordered quality cotton hit 26,700 hectares, and the quality of the commodity cotton rose one to two ranks.

**Second, the alliance has made breakthroughs in a batch of key technologies for the development of green ag-**

**riculture, and integrated and demonstrated a batch of technologies.** The alliance for the utilization of recycled agricultural waste established methods for calculating the carrying capacity of land for livestock waste, integrated the utilization technology for seven kinds of livestock wastes on various breeding scales, and demonstrated that the county implementation mode, and the Jing an mode have become the main methods popularized nationwide. The alliance of green rice producers has enhanced efficiency and made breakthroughs in seven sets of core technologies for mechanized rice planting, fertilizer utilization and the prevention and control of diseases, insects and weeds, increasing Northeast China's rice yield by 5 to 10 percent, and reducing the usage of both chemical fertilizers and pesticides by 10 percent.



**Third, the alliance has focused on important regional issues, forming a batch of technological solutions.**

The alliance for Northeast China maize straw has researched and integrated 10 sets of key technologies for transforming straw into bio-fuel, base stock, fodder and fertilizer, which has been used in 180,000 hectares and utilized 9 million tons of straw for feedstuff. The alliance of North China for agricultural water conservation and improved efficiency has proposed the rain-adjusting planting system of triple cropping in two years, and made an efficient water-saving technological mode that can save 50-100 cubic meters of groundwater when irrigating 0.07 hectares of farmland.



**Fourth, the alliance has strengthened the sharing of scientific and technological resources and increased innovation efficiency.**

The alliance for agricultural big data and information services has integrated more than 20 million pieces of documents of various kinds and more than 600 data sets of agricultural sciences. The document and information resource services are available in one hour at most within the alliance, and 99.9 percent of the alliance members' information needs can be satisfied. A central-provincial-regional three-level linked working system has been established to meet the needs of the long-term fundamental agricultural science and technology work, forming a national agricultural science monitoring network with one chief data center as the core, 10 data centers as support sites and 456 monitoring experimental stations as the base points.







### Major New Scientific Projects

Under the guidance of new concepts and adhering to the principle of serving innovation projects, CAAS made breakthrough progress with a new overall arrangement of important scientific research in 2017.

#### National (Chengdu) Agricultural Science and Technology Center

CAAS signed a strategic cooperation agreement with the Chengdu city government to jointly build the National (Chengdu) Agricultural Science and Technology Center, for which the Chengdu government is providing 1 billion yuan (\$156 million) as infrastructure construction investment, 200 hectares of land and a special annual research fund of 30 million yuan (\$4.7 million) to create a 'silicon valley' of agricultural science and technology and a national demonstration base for modern agriculture, in an effort to solve the sustainable development issue that restricts the development of rural areas and agriculture in Southwest China and the whole country.

#### Western China Agricultural Research Center

CAAS has been building the center together with the National Agricultural Science and Technology Park of Changji, Changji Hui autonomous prefecture in the Xinjiang Uygur autonomous region. The center is joining hands with related research, education institutes and agricultural enterprises in Northwest China and Central Asian countries, to focus on the construction of 'one core, four platforms, eight projects', and push forward national agricultural modernization. The center was founded in September 2017, with 13.67 hectares of construction land and 133.33 hectares of land designated for experimental planting. Construction work has commenced smoothly.





**Project for a national high-grade laboratory for animal epidemic and disease prevention and bio-safety control**

The lab has been completed and is now in use. It has a total area of 20,000 square meters, and is the only highest level bio-safety lab for large animals that has been checked and accepted by the State for the first time. Meanwhile, it is the third bio-safety facility in the world that can conduct research on horses, cattle, pigs, camels and the other large animals.

**The national livestock and poultry improvement research center project**

The center has been completed and put into use, with a total construction area of nearly 30,000 square meters. The center is currently China's largest development, utilization and sharing platform for livestock and poultry resources. It can conduct genetic mechanism research on the characteristics of animal germplasm and quality gene discovery, animal molecular breeding, genetically modified animal breeding and safety evaluation, experimental animal model construction and utilization, and other tasks, which will gradually form a three-in-one open research center integrating germplasm resources, technology support and personnel training.



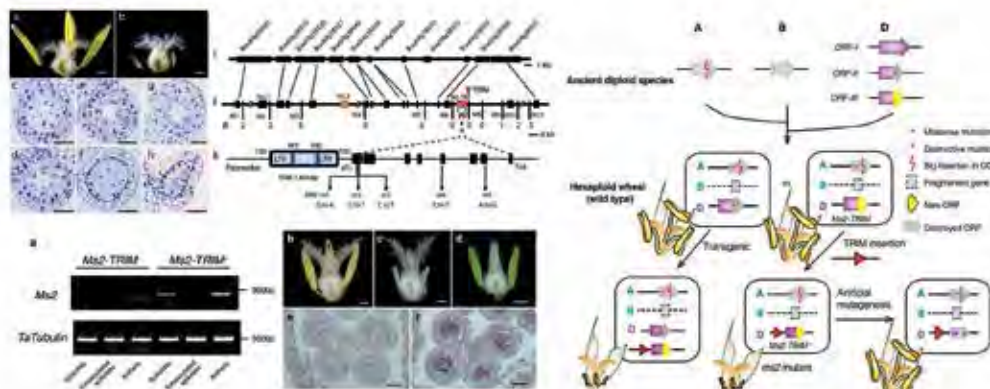


# Research Progress

## Crop Science

### (1) Discovery and use of wheat gene resource

The Crop Gene Resource Innovation Team is led by Prof. ZHANG Xueyong at the Institute of Crop Sciences, Chinese Academy of Agricultural Sciences. The team constructed the second version of the genome sequence for the wheat D genome donor, *Aegilops tauschii* and developed a 660K SNP chip for wheat with the collaboration of Prof. JIA Jizeng and Prof. KONG Xiuying. This innovation provides genomic tools for genotyping wheat germplasm on a large scale. They also isolated the *Ms2* gene from the Taigu male sterility wheat by map-based cloning. This will significantly widen the application range of crop recurrent selective breeding, and raise breeding efficiency. In genetic effect dissection of starch synthesis pathway to yield, Prof. ZHANG Xueyong et al. found that haplotypes of the key enzyme coding genes in the pathway such as *TaSus1*, *TaSus2*, *TaAGP-L*, and *AGP-S1* have profound additive effects on wheat grain size and weight. These loci experienced strong selection during wheat domestication and breeding. Prof. JING Ruilian et al. found that breeding favored haplotypes of *TaSPL20* and *TaSPL21* providing more functional stability on yield under drought or heat stress environments. In addition, Zhongmai 66 was commercialized in Henan Province, China in 2017.



Map-based cloning of dominant male sterile gene *Ms2* (*Nature Communications*, 2017, 8: 15407)





## (2) Development of genetically modified soybean with herbicide resistance

Great progress on large scale soybean genetic transformation using genes of *G2-EPSPS/GAT* or *G10-EPSPS* with the independent intellectual property rights was made by the research team led by Prof. QIU Lijuan at the Institute of Crop Sciences, Chinese Academy of Agricultural Sciences. They developed a number of genetically modified soybean new events which were tested to have tolerance to the herbicide glyphosate. Three events of GE-J3, GE-J12, and GE-J16 transformed with *G2-EPSPS/GAT* genes have been approved for biological safety evaluation for environmental release field testing. One event of ZH10-6 with high glyphosate tolerance applied for test production for biological safety evaluation and was used for breeding glyphosate resistant soybean varieties suitable for different ecoregions. These transgenic soybean events were tested having high tolerance to herbicide of glyphosate, and their utilization could reduce the costs of production and environmental pollution, suggesting they have big potential for industrialization.



Comparison of ZH10-6(right)and ZH10(middle) spraying with glyphosate, and ZH10-6 without spraying glyphosate (left)

## (3) Breeding of good quality, high-yield, and high fertilizer use efficiency (super efficiency) *indica* rice varieties in the middle and lower Yangtze River region, China

Through the integration of conventional breeding techniques and modern biotechnology, Prof. HU Peisong's research team from China National Rice Research Institute established a highly efficient breeding technology system which can be applied to *indica* rice breeding in the middle and lower Yangtze River region in China. The team has already produced a series of new breeding materials which pyramided many good agronomy characteristics such as disease resistance, insect resistance, water-saving ability, drought tolerance, high and low temperature tolerance, high nitrogen and phosphorus use-efficiency, and heavy metal low-accumulation. Currently, 11 varieties with good quality, high-yield, and high fertilizer use-efficiency (super-efficiency) have been certified and planted in a large area through the utilization of these materials.





#### **(4) Collection, documentation, banking, and conservation of crop germplasm resources**

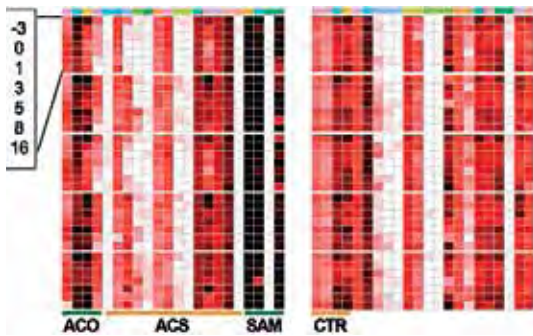
A research team led by Prof. LU Xinxiong at the Institute of Crop Sciences, Chinese Academy of Agricultural Sciences, made important progress in the Collection, Documentation, Banking and Conservation of Crop Germplasm Resources, a National Key Technology R&D Program of China. The team collected, documented, and conserved in the long-term storage of the China National Crop GeneBank, 11,000 accessions of crop germplasm resources. And it made a breakthrough in the theoretical and technical fields of the seed safe conservation: It was the first to report a critical node exists in the process of vigor loss during seed conservation, and the critical node is the regeneration value, thereby prejudging the period of safe conservation. Four key technologies of seed vigor monitoring and early warning were developed, which can rapidly and non-destructively detect and give early warning of any changes to seed vigor of soybean, and so on. The technical system for safe conservation, early warning, and regeneration could be the reliable technical guarantee for long-term storage of 420,000 accessions in the China National Crop GeneBank. In addition, the *in vitro* conservation technology system was also established, which holds *in vitro* conservation of 398 accessions (37 crops) and cryopreservation of 166 accessions (12 crops).



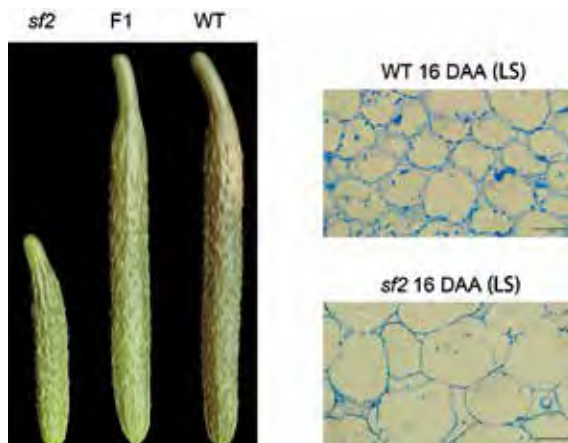
## Horticulture Science

### (1) Genetic mechanism of cucumber fruit morphogenesis

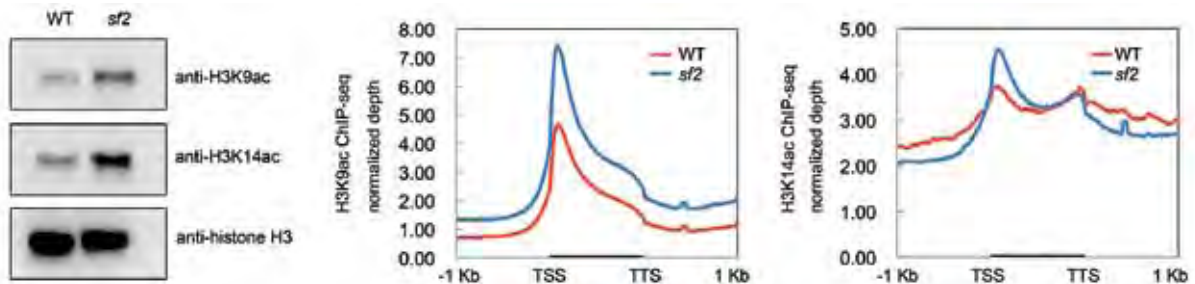
Prof. HUANG Sanwen's group from the Institute of Vegetables and Flowers, Chinese Academy of Agricultural Sciences, made progress on the genetic mechanism of cucumber fruit morphology. They conducted transcriptional analyses on 105 samples, including pericarp and placenta tissues from the head part, middle part and stalk part of fruits in the critical developmental period of the S curve of cucumber (three days before anthesis, and 0, 1, 3, 5, 8, and 16 days after anthesis). The expression network of important genes in cucumber fruit development was constructed, and the differentially expressed genes in different developmental stages and different fruit regions were excavated, in which a group of histone deacetylase complex proteins was found. The result showed that the short mutant fruit results from a G540E mutation of RXT3. The team also found that ethylene may play an important role in the development of cucumber fruit. The key gene *SF1* controlling the early cell division of the fruit was cloned, and it was proved to be a new RING-type E3 ligase that controls the length of cucumber by regulating ethylene dosage.



Differential expression of ethylene related genes at early stage of fruit development



Cell division of *sf2* is significantly inhibited



*SF2* protein regulates histone deacetylation in fast division of fruit cells



## (2) Innovation of high-strength hybrids and technologies for utilization of heterosis in vegetable crops

A research team led by Prof. LI Junming from the Institute of Vegetables and Flowers, Chinese Academy of Agricultural Sciences, has focused on the study of vegetable heterosis and breeding in recent years. Presently heterosis populations from 883 germplasms of Chinese cabbage, 1,037 germplasm of cabbage, 205 germplasm of tomato, 1,904 germplasm of hot pepper and 459 germplasm of cucumber were constructed. The heterosis populations from 120 germplasms of Chinese cabbage and 502 germplasms of cucumber were used to forecast the heterosis of several key traits for the late maturity Chinese cabbage, and flowering time and yield for cucumber. The related technologies for microspore embryogenesis of Chinese cabbage and cabbage, anther culture of hot pepper and microspore culture of cucumber, were further developed and improved. Genes involved in resistance to bacterial wilt in hot pepper, male sterility restoration in hot pepper, Chinese cabbage (*BrRfp1* gene), male sterility (*ms-15<sup>26</sup>* gene) in tomato and cucumber, hard spin (*Hard* gene) and fruit spin in cucumber, were mapped or finely mapped. High-density genetic maps of pepper and cucumber and an informatics hub for pepper were constructed. By combing these technologies, inbred lines including eight varieties of Chinese cabbage with self-compatible index (SI)>5, eight varieties of cabbage, eight tomatoes, six hot peppers, and 100 elite cucumber germplasms with several types were obtained. More than 50 high-strength hybrids were released and promoted on 20.3 thousand hectares up to now.



Microspore embryogenesis ability of different genotypes in Chinese cabbage



High through isolation of microspores in Chinese cabbage



The significantly improved embryogenesis of recalcitrant genotypes

The technology of high-through microspores embryogenesis in Chinese cabbage





### (3) Investigation and collection of indigenous varieties of deciduous fruit trees in the predominance region

A research team led by Prof. CAO Shangyin at the Zhengzhou Fruit Research Institute, Chinese Academy of Agricultural Sciences, conducted a survey on the distribution areas of fruit trees across 210 counties in 21 provinces and cities. They collected 1,400 fruit varieties. Then, 351 cultivars were observed by pollen electron microscopic, and more than 500 cultivars analyzed by ploidy analysis. Additionally, a database of fruit tree resources was constructed, which contains the biological information of 1,400 varieties. The GIS information management system of pomegranate has also been developed, and 844 samples have been prepared with specimens. Five varieties have been approved by Henan Province. A huge monograph entitled *Chinese Fruit Trees Pomegranate Volume* and 14 illustrated monographs on Chinese pomegranate cultivars have been published.

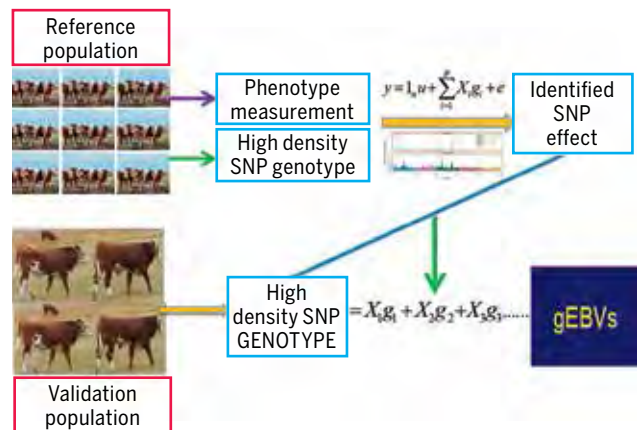




## Animal Science

### (1) The construction and application of whole genome selection technology system for molecular breeding in beef cattle

There is still a large gap between the production performance of beef cattle between China and developed countries. An innovation team of cattle genetic breeding led by Prof. LI Junya from the Institute of Animal Sciences, Chinese Academy of Agricultural Sciences, has constructed the first resources of beef cattle population for genomic selection in China, and estimated the technology platform for genomic prediction. Meanwhile, several new methods for genome-wide association study and the genomic selection index (GCBI) were proposed. Moreover, many candidate markers were identified for economically important traits, and the 10K low density SNP array for genetic evaluation was designed, which can effectively substitute the Bovine high density SNP array. This genomic selection technology platform has been widely utilized in eleven Bull Stations and Simmental nucleus breeding farms in the Inner Mongolia and Xinjiang Uygur autonomous regions, and Jilin, Henan, Shandong and other provinces, and produced economic benefits of about 1.148 billion yuan (\$179 million).



## (2) The research and application of new alternatives to antibiotics (ATA) for feed usage

The ATA group led by Prof. WANG Jianhua from the Feed Research Institute, Chinese Academy of Agricultural Sciences, has established antimicrobial peptides (AMPs) technology platform. The anti-*Staphylococcus aureus* peptides MP and DLP (MIC 0.063-8  $\mu\text{g mL}^{-1}$ ), anti-*Escherichia coli* (MIC 0.25-2  $\mu\text{g mL}^{-1}$ ) and Salmonella (MIC 0.125-2  $\mu\text{g mL}^{-1}$ ) peptides N and CPP/T11-N, and broad-spectrum AMPs with nutrition enhancing were designed to treat the cow mastitis, broiler necrotic enteritis, piglet diarrhea and the intracellular escape of pathogens. The AMPs preparation system was established with a 2-3  $\text{g L}^{-1}$  of high pilot yield, they could effectively replace feed antibiotics. Some papers were cited positively by the top academic journals like Lancet Infectious Diseases. In addition, the universal subunit vaccines for enterobacteriaceae infection were developed from the outer membrane proteins with a protection percentage of 50-80 percent for infected mice. And the *Saccharomyces boulardii* with dual-function of probiotic and anti-diarrheal activity for animal was developed. Totally, 25 types of novel feed ATAs were developed. The yields, output value, incremental direct and indirect profits reached up 169,900 tons, 767 million yuan (\$120 million), 147 million yuan (\$23 million) and 30 billion yuan (\$4.7 billion), respectively. About 20,400 tons of feed antibiotics were replaced. As a result, the excellent economic, ecological and social benefits were realized.



## (3) The research and application of key technology of high quality forage in the semi-arid area of North China

A research team led by Prof. HOU Xiangyang at the Grassland Research Institute, Chinese Academy of Agricultural Sciences, has carried out a joint study on the key technologies for forage focusing on resistant varieties, the production and processing technology for high quality forage, and the factors that restricted the development of grass and animal husbandry in the semi-arid area of North China. Currently, 13 new varieties of forage have been cultivated and the Forage Germplasm Bank and Chinese Alfalfa Core Germplasm Bank were constructed. The high efficiency cultivation technology system of high quality forage was established in the semi-arid area of North China. Ten sets of high efficiency and low loss economic series harvester suitable for small-scale forage production in semi-arid areas and two kinds of special microbial inoculants for corn silage with silage inoculant preparation and high quality grass product processing technology were developed. The technology system of dry farming and water-saving forage production was formed in different areas. From 2008 to 2015, the new forage varieties and production and processing technology were demonstrated and extended in total 1.65 million hectares pastures and 1.04 million tons of silage was produced with a profit of 11.57 billion yuan (\$1.81 billion), which has played an important role in promoting the transformation and upgrading of agricultural structure, rapid development of grass and animal husbandry, and regional sustainable development in the arid area of North China.





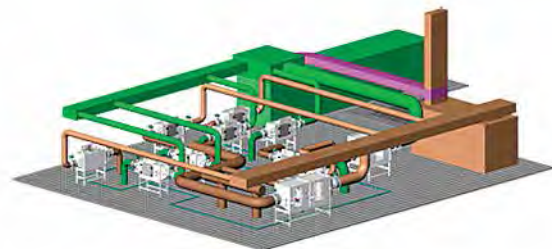
## Veterinary Medicine

### (1) Localization study of simulation BSL-4 laboratory

The first localization simulate of a biosafety level 4 (BSL-4) laboratory was completed in the National Key R&D Program during the 13th Five-Year Plan Period (2016-20). It was Localization Study of Simulation BSL-4 Laboratory led by Prof. WANG Xiaomei of Harbin Veterinary Research Institute, Chinese Academy of Agricultural Sciences. The enclosure construction has been completed, sewage treatment systems and other primary protective equipment for the laboratory have been developed and installed. Researchers drew up risk assessments to handle the Hendra virus and another two infectious agents and risk control measures for work on Nipah virus-, and Brucella-infected animals, such as pigs and sheep. In this program, the key parts of bioreactor and fermenter were modified to control potential risks. Researchers also developed first BSL-4 laboratory information management systems such as maintenance management of facility and equipment systems, and the biosafety management system, as well as development of the main framework for the collaborative laboratory network system and the data interface standards. The VR simulation training system and the training exam bank for working in high containment laboratory has been completed and used for practical training. All the achievements supported by this program will lay the foundation for fully localization of the high containment laboratory in the near future.



Exterior of simulation BSL-4 laboratory



Layout of simulation BSL-4 laboratory



Homemade sewage treatment systems



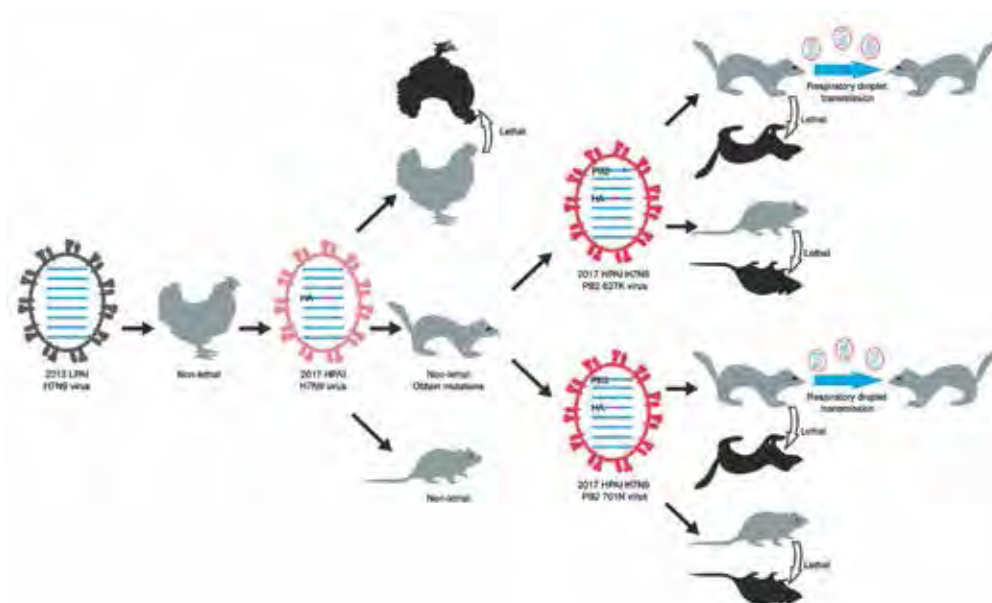
## (2) Studies on the new diagnostic and detection technology of important infectious diseases of poultry

Through the efforts of a research team led by Prof. WANG Yunfeng at Harbin Veterinary Research Institute, Chinese Academy of Agricultural Sciences, 15 diagnostic markers for the avian influenza virus, Newcastle disease virus, avian pathogenic *Escherichia coli* and other pathogens were screened. Besides, over 30 related diagnostic techniques and methods of important poultry diseases, important respiratory system diseases, important immunosuppressive diseases, important bacterial diseases, important waterfowl diseases, and newly emerging diseases were developed, and a new veterinary drug certificate was obtained. In addition, nucleic acid ligand selection and diagnostic labeling techniques of *Mycoplasma gallisepticum* were preliminarily completed. Moreover, a high-throughput poultry disease microfluidic chip was preliminarily designed, with five specific antigens synthesized and four specific antibodies prepared. Also, a visualization gene chip of avian immunosuppressive diseases was preliminarily developed. The technology for a constant temperature amplification microfluidic chip was also developed, and the assembly and testing of the principle test instrument has been completed. Furthermore, the expression and purification technology of important pathogenic antigens of the avian leukosis virus, and antibody-labeling technology were both developed. A veterinary technical resource library and basic information library for important epidemic foci were also established and improved, and websites for internet-based self-help diagnostic systems and expert-help diagnostic systems were also designed and set up.



## (3) Study on the evolution and mechanism of pathogenesis and transmission of animal influenza viruses

The research team led by Prof. CHEN Hualan from Harbin Veterinary Research Institute, Chinese Academy of Agricultural Sciences, found that some H7N9 viruses isolated in early 2017 obtained an insertion of multiple amino acids in their hemagglutinin (HA) cleavage site and were lethal in chickens. Such H7N9 variants were not lethal in mice or ferrets, but readily obtained key adaptive mutations in its PB2 segment upon replication in ferrets, causing it to become highly lethal in mice and ferrets and to be transmitted efficiently in ferrets by respiratory droplet. This study indicates that the new H7N9 mutants pose an increased threat to human health. Because of the implications in major animal disease control and public health security, the relevant research findings were reported to government departments in real time, and therefore provided an important scientific basis for the development of prevention and control policy for H7N9 avian and human influenza. In the study of transmissibility in mammalian host of Eurasian Avian-like H1N1 swine influenza viruses, they revealed that amino acid glutamic acid at position 225 in the HA protein promoted the virus transmission by increasing the efficiency of viral assembly and budding. Moreover, they also found that the G158N mutation introduced an N-linked glycosylation at positions 158 to 160 of the viral HA protein and that this N-linked glycosylation contributed to the high pathogenicity of H5N1 virus in mice.



#### (4) Research on the development and industrialization of the new animal-specific chemical drugs

Led by Prof. ZHANG Jiyu from the Lanzhou Institute of Husbandry and Pharmaceutical Sciences, Chinese Academy of Agricultural Sciences, the laboratory preparation and pilot production process of *oxyclozanide* suspension were perfected further, and the quality standard for controlling the quality of the drug was formulated. The HPLC/MS method was established for determining the drug residue, and the study on the residues elimination of *oxyclozanide* was carried out in bovine edible tissue and in milk for formulating the withdrawal time. The safety test for target animals and clinical trial of drug were completed, meanwhile, all studies for the pharmaceutical and clinical trials of gamithromycin were completed, and the new drug is in the stage of declaration and quality check. The study on pharmacokinetics of *vitacoxib* was completed in the target animal of cats, the methods for quantitative detection and analysis were established and verified, and the oral tablet production line was established, and 100,000 tablets come were produced. At present, the three national new veterinary drugs have been obtained, and one pilot production line has been set up.





## Agricultural Resources and Environment

### (1) Accounting method of environmental pollution of livestock and poultry manure and research and development of the key treatment and application technology

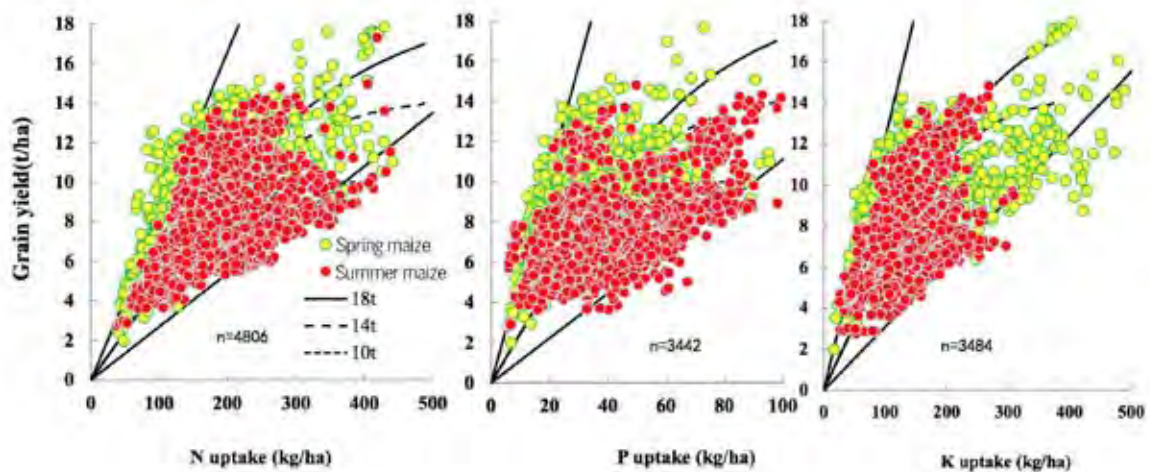
A research team led by Prof. DONG Hongmin from the Institute of Environment and Sustainable Development in Agriculture, Chinese Academy of Agricultural Sciences, has made notable progress in animal manure treatment and utilization. The main achievements include: ① established the first set of pollution accounting methods for the source and discharge coefficients of animal husbandry in China; ② established a three-reform and two-separation wastewater reduction technology for animal farms; ③ developed three types of manure treatment and utilization models, including a combination of plant and animal husbandry model based on Comprehensive Nutrient Management Plan (CNMP), a clean reuse model centering on the three-reform two-separation technology, a centralized treatment center mode with the collection and transportation equipment and cooperation mechanism. The achievements have been applied to 2,687 farm waste treatment projects in 11 provinces in China, with annual reduction of chemical oxygen demand of 1.59 million tons, total nitrogen of 124,000 tons, total phosphorus of 24,000 tons, and an economic benefit of 3.26 billion yuan (\$509 million). At the same time, this achievement was used in the *Bulletin on the First National Census on Pollution Sources* issued by the State Council of China, and was included in the *Agricultural Environment Outstanding Issues Governance Master Plan (2014-2018)* and the program *Implementation Opinions of the Ministry of Agriculture of China on Fighting Against Agricultural Nonpoint Source Pollution*. The achievements provide a scientific basis for the prevention of animal husbandry pollution and sustainable development of agriculture.





## (2) Fertilizer recommendation approach and directives

A research team led by Prof. He Ping from the Institute of Agricultural Resources and Regional Planning, Chinese Academy of Agricultural Sciences, has made notable progress in the development of the fertilizer recommendation approach and integrated technologies in fertilizer-saving and efficiency improvement. The main achievements include: ① established fertilizer recommendation models, and the Nutrient Expert Decision Support System based on the WeChat platform for wheat, maize and rice; ② obtained the optimum nutrient uptake parameters for potato, soybeans, cotton in Xinjiang and winter canola in the Yangtze River Basin; ③ preliminarily explored the quantitative relationship between the yield response and agronomic efficiency and the parameters of fertilizer recommendation model for radish and cabbage; ④ determined the nitrogen, phosphorus and potassium fertilizer recommendation for three grain crops on the regional scale in China; ⑤ revealed the nutrient release pattern from organic fertilizers and the succession characteristics of humic substances in typical Fluvo-aquic soil; and thus constructed integrated technology package of Nutrient Expert based fertilizer recommendation, organic fertilizer application, straw return and deep plowing in order to achieve chemical fertilizer reduction and efficiency improvement.



QUEFTS model simulated optimal nutrient uptake



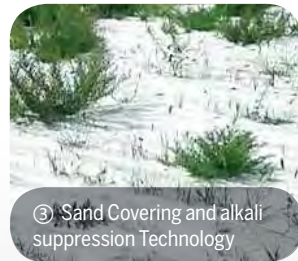


**(3) Northern degraded meadow grassland treatment technology and demonstration**

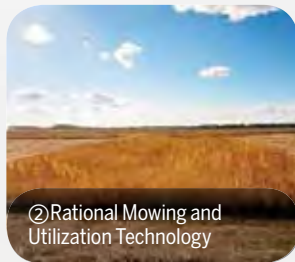
In light of the research status of relatively weak research on meadow and meadow steppe degradation mechanism and restoration mechanism and lack of systematic theoretical results, the research team led by Prof. Tang Huajun from the Institute of Agricultural Resources and Regional Planning, Chinese Academy of Agricultural Sciences, has excavated and analyzed long-term dynamic data of meadow and meadow steppe by integrating with the existing long-term field experimental platform. The team has preliminarily explored the quantitative index and the grading and classification system for the degradation assessment on northern meadow grassland, and the quantitative evaluation criterion for the restoration of degraded meadow and meadow steppe. Centering on the degradation features of the meadow grassland in such key areas as Hulun Buir, Xilingol, Horqin, Songnen Plain and cold area with black soil, the team has designed experiments on grassland restoration and treatment technology, and conducted research on the treatment of degraded meadow and meadow steppe. It also researched post-restoration utilization technology, and quantitatively analyzed the ecological effect, productive results and economic benefits of different improvement measures in different areas. Six areas have been preliminary selected for restoration and treatment technologies and 6,000 mu (about 400 hectares) of degraded meadow grassland reclaimed for the demonstration of restoration and treatment technology.



Experiment on Vegetation Restoration and Improvement Technology



Experiment on Soil Restoration and Cultivation Technology

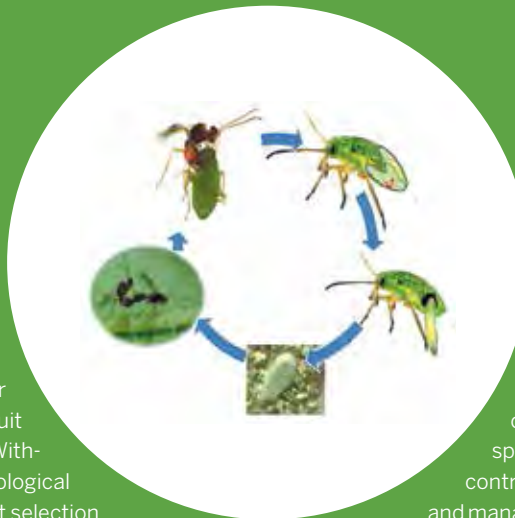


Experiment on Grassland Rational Utilization Technology



**(4) The outbreak mechanisms and green control techniques of key mirid pests**

A research team led by Prof. WU Kongming from Institute of Plant Protection, Chinese Academy of Agriculture Sciences, systematically studied the mirid pests which endanger the production of cotton, fruit trees, tea trees and alfalfa. Within the study, the major biological habits of mirids, such as host selection, pheromone chemical communication, phototaxis behavior were illustrated and the population occurrence rule mediated by adult flower preference was revealed. The reduction of pesticide application in *Bt* cotton fields, the banning of highly toxic pesticides and the expansion of suitable host crops, such as fruit trees, are the principal ecological mechanisms for the regional mirid outbreak. The team developed the investigation technology and forecasting method for mirids, by facilitating the establishment of a fore-



casting technique and national monitoring network. The mirid green control technology system takes behavior manipulation and biological control as the focus, including the application of sex pheromone attractants, specialized trap lamps and other control products. The forecasting and management techniques have been applied to approximately 4.8 million hectares so far. The short-term and middle-term forecasting accuracy rates were 95 and 90 percent, respectively, and 85 mirids on the fruit and tea trees, 90 percent in the cotton and alfalfa were under control. The yield loss rate was controlled to a range of 3-5 percent. The use of chemical pesticides was reduced by 30-50 percent. The achievements provided the successful experience and example for realizing the goal of zero growth of pesticides usage by 2020 in China.





## Agricultural Mechanization and Engineering

### (1) The key technology and equipment of no-till clean area planting under full straw mulching dry farmland

A research team led by Prof. HU Zhichao from the Nanjing Research Institute for Agricultural Mechanization, Chinese Academy of Agricultural Sciences, has developed the key technology and equipment of no-till clean area planting under full straw mulching dry farmland, which solved the problems of straw winding, seed supporting and seed uncovering when traditional no-till seeding equipment is used in full straw mulching dry farmland. This achievement has satisfied the market requirement for no-till planting under full straw mulching dry farmland, and provided strong technical and equipment support for straw burning prohibition and straw returning fertilizer utilization. The technology has been listed as main technology for extension by the Ministry of Agriculture of China for three consecutive years, and additionally it has been transferred to five agricultural companies. A technical advisory service was provided to the enterprises during the implementation of the projects, which markedly improved the performance and quality of these products. Moreover, 1,291 products have been sold in the past two years, with a direct economic benefits of 45.3 million yuan (\$7.08 million). The products were popularized and applied in Tianjin and Jiangsu, Henan, Anhui, Shandong, Hebei, Tianjin, Liaoning, and Heilongjiang provinces. These areas have obtained better economic, social and ecological benefits.

### (2) Techniques for monitoring crop water status information for intelligent irrigation

A research team led by Prof. DUAN Aiwang from the Farmland Irrigation Research Institute, Chinese Academy of Agricultural Sciences, has developed a set of new techniques for automatically monitoring crop water status and controlling an intelligently irrigation system, which is much-needed for the development of modern water-saving agriculture in China. The application of the techniques has not only obviously improved the precision of irrigation water application, but also increased crop yields and raised the quality of the crops. It has remarkably improved the efficiency of irrigation water and fertilizer use, which is very helpful to reducing pollution from agriculture. The new techniques have been widely used in Beijing, the Xinjiang-Uygur autonomous region, and Shaanxi and Henan provinces, covering 18,713 hectares of winter wheat/summer maize and 330 hectares of cotton. The results show that the new techniques may increase yield by about 1,800 kg per ha<sup>-1</sup> for grain crops and reduced water consumption 1,500-2,250 m<sup>3</sup> ha<sup>-1</sup> annually. By the end of 2016, the total effects of the new techniques had been accumulated, showing increased grain production of 33.71 million kg and increased lint cotton production of 0.14 million kg, with water consumption reduced by 70.78 million m<sup>3</sup>, and pure income increased by about 79.45 million yuan (\$12.41 million).





## Agro-product Quality, Safety and Processing

### (1) The development and application of key technologies for potato processing as a staple food

A research team led by Prof. ZHANG Hong from the Institute of Food Science and Technology, Chinese Academy of Agricultural Sciences, carried out systematic studies on the processing of potatoes as a staple food, including screening of potato varieties, the creation and application of key technologies, core equipment, and production lines for potato staple food product. Up to now, the evaluation methods for both raw materials and final processed potato products have been developed. The technical bottlenecks, including the difficulties of being shaped and fermented and high viscosity, have been broken through. The critical components and core equipment were invented for special purpose matching with the potato staple foods processing (PSFP) unit and the PSFP lines were then established. Now we have created five categories of more than 200 kinds of staple potato food products. The technological achievement has been transformed and applied in more than 50 enterprises in seven cities in nine provinces in China, leading and supporting the development of Chinese potato staple food industry. The total production is 189,000 tons and the cumulative sales are 4.54 billion yuan (\$709 million) which increased the new economic benefits to 890 million yuan (\$139 million). It has impelled 200,000 farmers to cultivate potatoes and increased farmers' incomes by 400 million yuan (\$62.48 million).

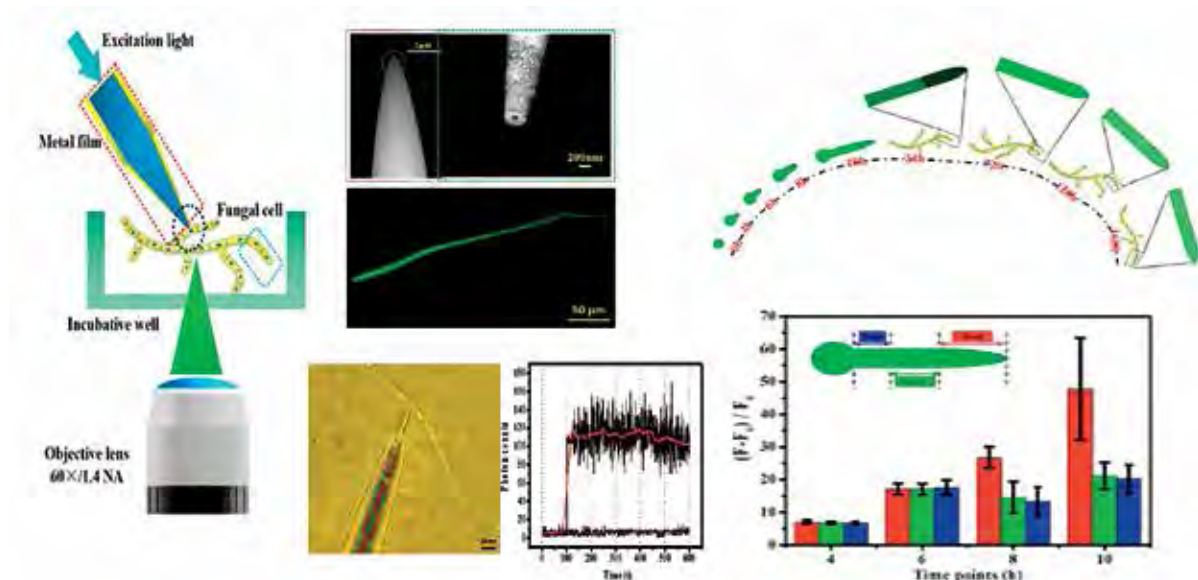






## (2) The formation and control mechanism of mycotoxins during the storage of major grains and oil products

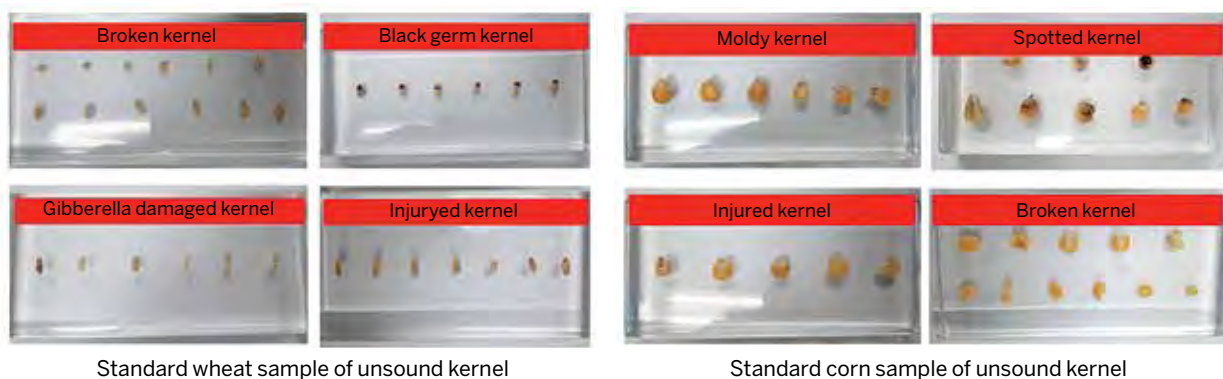
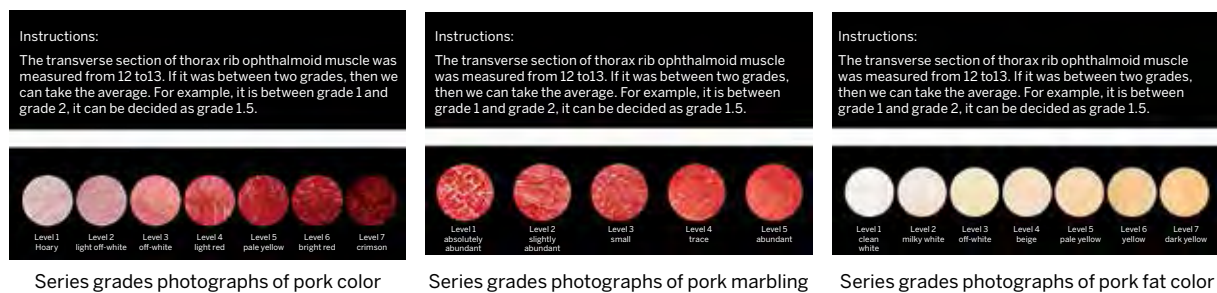
Prof. LIU Yang's group from the Institute of Food Science and Technology, Chinese Academy of Agricultural Sciences deciphered the mechanism underlying the formation of fungal communities, mycotoxin synthesis, accumulation and detoxification and its interaction with environmental factors such as light, temperature and relative humidity during the storage of main grains and oil seeds in China. A monitoring, early warning, control technology system for mycotoxin and mycotoxin-producing fungi was built based on the characteristics of the stored grains and oil seeds in China. All these provided solid technical support for the storage and processing of main grains and oil seeds in China, promoted the quality and safety of the corresponding products, and achieved good economic and social benefits.



Inhibition effects of cinnamaldehyde on growth and aflatoxin production of *Aspergillus flavus* by regulating intracellular reactive oxygen

**(3) Study on state or industry standards and reference materials for the quality evaluation of novel additives and superior agricultural products**

A research team led by Prof. YANG Shuming from the Institute of Quality Standards and Testing Technology for Agro-Products, Chinese Academy of Agricultural Sciences, conducted a study on setting the state or industry standards for novel fertilizers, feed and other additives; rice, corn, pork, and other advantageous agricultural products; and tea, dendrobium, tobacco and other characteristic agricultural products, which provided a reference foundation and standard support for quality control and product quality evaluation in the production of agricultural products. They have developed eight national standards, 10 industry standards and 23 approved standard samples. Among them, the standard for the detection of new inputs, such as gibberellic acid, plant growth regulator and glucose oxidase for feed, and the product standard for feed additive-*Lactobacillus acidophilus* provide a strong technical support for the state to strengthen the regulations of new fertilizer and feed inputs. The standard samples such as amylose and chalkiness in rice, sensory evaluation for imperfect kernels in wheat and corn, pork marbling, meat color and fat color for pork classification and the standard samples of gastrodin, ginsenoside and theaflavin provide a favorable technical guarantee for further improving the quality control and evaluation of advantageous agricultural products, classifying the level of agricultural products and promoting the improvement of agricultural quality and efficiency in an all-round way in China.





## Agricultural Information and Economics

### (1) The Creation and Application of the Internet+Agricultural Technologies Extension Cloud Platform

A research team led by Prof. WANG Wensheng from the Agricultural Information Institute, Chinese Academy of Agricultural Sciences, pioneered the creation of the first national Internet+Agricultural Technologies Extension cloud platform based on cloud computing and big data processing supporting tens of millions of users, and established an application method for information technologies for grass-roots agricultural technologies extension management and services based on the mobile internet. They developed a dynamic, directional, portable, and miniaturized intelligent terminal for fast farming acquisition, and also developed a variety of mobile clients with more than 40 functions for different user groups used by nearly tens of millions users. The information service of the Internet+Agricultural Technologies Extension has covered more than 2,600 agricultural counties in China. The platform has achieved remarkable results in demonstration applications across the country. It has been selected as a National Eleventh Five-Year Major Scientific and Technological Achievement, and chosen into the 10-Year Scientific and Technological Achievements Exhibition of the Ministry of Agriculture of China. It has received high attention and recognition from the leaders of the Communist Party of China and the State, which has significant economic and social benefits.

### (2) Research on the Benefit Compensation Mechanism in the Grain Production Functional Zone and the Protection Zone of Important Agricultural Products

Based on the national strategy of establishing a functional grain production zone and protection zone for important agricultural products (Two Zones for short), several kinds of interest gaps were compared and analyzed by Prof. WANG Jimin's research team from the Institute of Agricultural Economics and Development, Chinese Academy of Agricultural Sciences. In China, such interest gaps exist between the main and the non-main grain producing provinces, between the key and the non-key counties in the Two Zones, and between the grain farmers and non-grain farmers. The financial and the economic compensation schemes were measured respectively from two aspects including local government and farmer household to ensure their interest in planting grain. And some suggestions were put forward to improve the interest relationship in the Two Zones. This study provided decision support and empirical reference for the construction of the differential policy systems of Two Zones.

## Domestic Cooperation



### (1) Pragmatic cooperation with local governments

CAAS has carried out pragmatic cooperation with Ankang in Shaanxi province, Xinxiang in Henan province and Dezhou in Shandong province. Fourteen leading experts in fields such as tea cultivation, plant protection, food processing, corn and rice growing have been dispatched to Ankang. CAAS has been working closely with the local government of Ankang to construct a research institute for selenium-rich foods and the implementation of cooperative R&D projects. CAAS also held training sessions for local agricultural technicians and management staff to enrich their science and technology knowledge and boost the development of modern agriculture in the region.

CAAS also made great efforts to support the Xinjiang Uygur Autonomous Region and the Tibet Autonomous Region by enhancing the self-development capability of these border areas. The academy has signed a strategic cooperation agreement with the Xinjiang Production and Construction Corps. To boost the corps' capabilities to develop modern agriculture, CAAS has adopted a series of measures such as the co-establishing of a demonstration and technology conversion base, cooperating in science and technology projects and jointly cultivating talents.

### (2) Targeted poverty alleviation with science and technology

CAAS has organized experts to launch targeted poverty alleviation projects in Fuping in the Taihang Mountain area, Xiangxi and Enshi in the Wuling Mountain area, and the area on the southern side of the Greater Hinggan Mountains, greatly enhancing the self-development capabilities of these poverty-stricken areas. In Fuping, research teams from CAAS launched support work in army group style. Institutes under CAAS, such as the Institute of Vegetables and Flowers, the Zhengzhou Fruit Research Institute and the Institute of Apicultural Research, have organized 27 special technology training sessions. More than 2,800 agricultural technicians and farmers have attended the sessions, which has helped accelerate the ability of local farmers to escape poverty.



## International Cooperation

In 2017, CAAS gave a big push to the implementation of the Belt and Road Initiative. The academy has achieved a lot in building an innovation cooperation network that has an international outlook. It has spared no effort to enable its achievements in agricultural science and technology to go global. Together with global partners, the academy has explored measures to strengthen innovation and seek new knowledge. These moves have contributed a lot to boosting its scientific and technological innovation capabilities and are helping to build CAAS into a first-class global academy.

### (1) Organizing a series of important international activities for the 60th anniversary of CAAS

CAAS organized a series of academic exchange activities to mark its 60th anniversary. Xi Jinping, general secretary of CPC Central Committee, sent a congratulatory letter for the anniversary. A series of agricultural technology cooperation meetings, such as the Summit on Agricultural Science and Technology Development, China-EU Agricultural Technology Cooperation Working Group Meeting, China-Africa Agricultural Research Institutes 10+10 Cooperation Mechanism Construction, were all held last year. The academy also hosted many international academic meetings such as the GreenSys 2017 (International Symposium on New Technologies for Environment Control, Energy-saving and Crop Production in Greenhouse and Plant Factory) and the Third International Congress on Biological Invasions. These meetings have expanded the channels for agricultural science and technology cooperation between China and countries participating in the Belt and Road Initiative and also pushed forward the work of building CAAS into a first-class agricultural science center in the world.



**(2) Advancing the work of the CAAS Center for International Agricultural Research**

CAAS has drawn up and carried out its Development Plan for the CAAS Center for International Agricultural Research (CIAR). CIAR published demand reports on 15 types of agricultural products and country reports for 65 countries involved in the Belt and Road Initiative. It has offered technological support for 32 companies, which are exploring overseas markets. CIAR successfully held a news conference on its research on overseas agricultural products markets. It also hosted the first session of *Setting Sail to the Sea*, a project that trains agricultural talents who will be sent overseas. CIAR has been built into a high-end overseas agricultural think tank, an overseas agriculture cooperation platform and a center for cultivating global agriculture talent.





### (3) Leading the work of organizing international cooperation on agricultural technology nationwide, actively pushing forward and cultivating international cooperation on big science projects

The 22nd meeting of the foreign affairs coordination network of the academies of agricultural sciences in China was held last year. CAAS also proposed the setting up of a national alliance for agricultural technology to go global. The academy has integrated the agricultural technology innovation forces nationwide and cooperated with many international organizations such as CGIAR, CABI, the European Union, G20, APEC Agricultural Technology Working Group and IAEA, which has reaped remarkable results. CAAS also led the establishment of the China-Africa Agricultural Research Institutes 10+10 Cooperation Mechanism, and inked eight related agreements. The academy actively communicated with the Ministry of Science and Technology and Ministry of Agriculture and Rural Affairs to push forward or initiate big science projects in which China is playing the leading role. CAAS has also made efforts to dock big science projects proposed by the academy with key projects of CGIAR, special agriculture and food projects of the European Union, big science plans of the INRA in France, flagship projects of the Commonwealth Scientific and the Industrial Research Organization in Australia and projects of the Newton Fund between China and the United Kingdom.



#### (4) Actively expanding international partner relations, optimizing its globalization layout

CAAS has signed 23 institute-level cooperation agreements and memos with many overseas agricultural research institutes such as Agriculture and Agri-Food Canada, the Crop Research Institute of the Czech Republic, Massey University of New Zealand, the Academy of Agricultural Sciences of Columbia, the Center for International Forestry Research and the National Agricultural Sciences and Production Center of Uzbekistan. Twenty-three new joint international platforms have been set up, such as the China-Czech Republic Agricultural Research Center, China-Chile Joint Agricultural Research Center, China-Republic of Korea Joint Laboratory on Medicinal Plants, the China-Russia Joint Laboratory on Cold-Resistant Grapes and Grape Wine, and the China-Norway Joint Laboratory on Feed Processing. Another 16 laboratories were enhanced and upgraded. The academy has also set up a new cooperative mechanism to form international cooperation platforms with countries such as Uzbekistan, Columbia and Chile and international organizations such as the FAO, IAEA, CGIAR and CABI. Through these efforts, CAAS has greatly enhanced its international cooperation capabilities and global influence.



#### (5) Implementing international cooperation projects and carrying out talent training

CAAS has communicated with the Ministry of Science and Technology about the work of talent selection in the implementation of the Belt and Road International Cooperation Strategy. The academy organized the applications for the talent introduction program and the success rate of applications for its international talent training programs has greatly improved. In 2017, CAAS submitted 438 applications of various international projects and gained approval for 174 projects with a total expenditure of 104 million yuan (\$16.24 million). The academy also hosted 20 foreign-aid training classes and offered special technological training for 629 students from 28 countries.





**(6) Pushing forward the going global of agricultural science and technology**

In 2017, CAAS localized manufacturing of avian influenza vaccines in Russia, Pakistan and Indonesia. It also set up a plant in Indonesia and began to produce vaccines there. Construction of the China-Kazakhstan Agricultural Science Joint Laboratory, which is a CAAS aid project, has basically been completed.

Meanwhile, CAAS has provided more than 70 varieties of hybrid rice to multiple Southeast Asian countries and started pilot plantation experiments in these countries. It has also set up a plant in Indonesia to produce rice seeds.

As part of its green super rice program, CAAS has carried out demonstration and promotion work for 68 varieties of green super rice in 18 countries in Asia and Africa.

The academy has also started overseas tests of new varieties. Two varieties of cotton and three related growing techniques; seven varieties of apple and two varieties of peach have been included in the going global strategy. The academy also published a book, *International Standards for the Seeds and Seedlings of Chinese Magnoliavine Fruit*. The academy recruited 203 new international graduate students from 32 countries involved in the Belt and Road Initiative.



**(7) Telling good stories about Chinese agricultural technology**

CAAS cooperated with China Daily and provided content for the publishing of special pages on the commemorative activities for the academy's 60th anniversary. An English promotional video was also produced to show the achievements of CAAS in science and technology innovation, commercialization of technology, platform construction, talent training and the construction of its global cooperation partner network, which has greatly enhanced the global influence of the academy.

Scientific advances make rich harvests

CAAS has provided major contributions to the industry

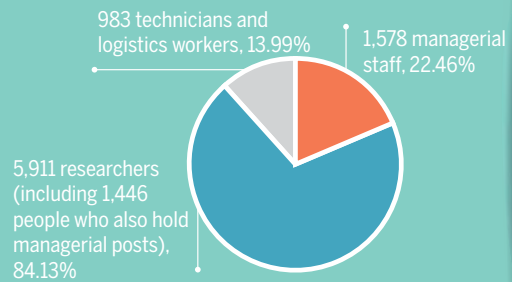
**CELEBRATING 60 YEARS OF SUCCESS**

Through decades of groundbreaking research and innovation, CAAS has contributed to improving food supply, security and safety worldwide.

What they say

# Staff

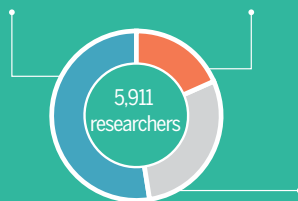
**01** CAAS had **7,026** members of staff by the end of 2017.



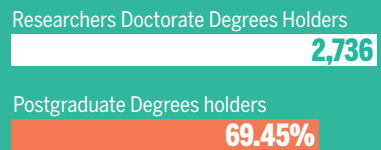
**02**

2,958 hold research assistant title or below, accounting for 49.96%

Of all the researchers at CAAS, 1,142 are professors, accounting for 19.32%



1,811 are associate professors, accounting for 30.64%



**03**

Postgraduate degree holders account for 51.64 percent of the total managerial staff at CAAS. Of them, 517 have doctorates and 407 have master s degrees. A total of 675 managerial staff members are 45 years old or younger, accounting for 42.77 percent of the CAAS management group.

Among the technicians and logistics workers at CAAS, 2 received special government allowances from the State Council; 14 are in first-class technical posts, 198 in the second-class technical posts; 190 technicians have college degrees and above, accounting for 19.33 percent of the total number of this group. There are 110 technicians and logistics workers aged 45 or below at CAAS, accounting for 11.19 percent of the total.

**04**

Currently, 13 academicians of the Chinese Academy of Sciences and the Chinese Academy of Engineering work in CAAS. Of the CAAS staff, 28 scientists have been listed in the National Ten Thousand Talents Program; 26 have been honored as National Young and Middle-aged Expert with Outstanding Contributions to China; 108 have received special government allowances from the State Council; 66 have been listed in the National Hundred, Thousand and Ten Thousand Talents Program; 33 individuals and 8 teams have been ranked in the Innovative Talents Growth Program initiated by the Ministry of Science and Technology; 11 have won the China Agricultural Elite Award presented by the Ministry of Agriculture, and 82 have been included in the Outstanding Talents for Agricultural Scientific Research.



## Graduate Education

In 2017, the Graduate School of the Chinese Academy of Agricultural Sciences (GSCAAS) made huge progress in the construction of its college system. The veterinary college is running well, while the construction of an international education college has been actively pushed forward. It has also begun to build its Graduate School in Shenzhen. And it has enacted *Proposals on Consolidating the Construction of a Graduate Teaching Quality Assurance System*. According to the results of the fourth national disciplines evaluation published by the Ministry of Education in 2017, four of the first-level disciplines of the CAAS Graduate School—Crop Science, Plant Protection, Animal Husbandry and Veterinary Science—were rated as A<sup>+</sup>. Two first-level disciplines—Biology, and Agricultural Resources and the Environment—were rated A. Four first-level disciplines—Food Science and Engineering, Horticulture, Ecology and Agrostology—were rated B<sup>+</sup>. One first-level discipline—The Economy and Management of Agriculture and Forestry—was rated B.

At present, the Graduate School has 1,797 supervisors, including 556 supervisors for doctoral programs and 508 teachers (full-time and part-time). A total of 5,119 students

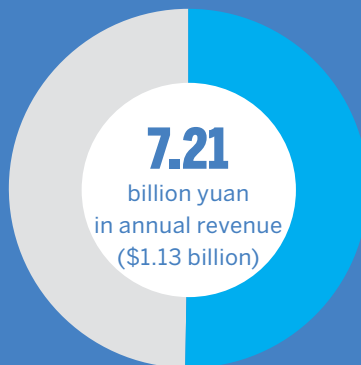
are currently studying at the school. The students in doctoral programs numbered 1,595 and those in postgraduate programs numbered 3,524. In 2017, the Graduate School enrolled 1,591 students (335 for doctorates, 754 for master's degrees, 258 for specialized master's degrees, 203 international students and 41 for doctorates under international cooperation programs). A total of 1,083 students, including 231 PhD holders and 852 master's degree holders, graduated last year.

In 2017, the Graduate School enrolled 203 international students. Of the new students, 184 are PhD candidates and 101 were awarded Chinese Government Scholarships. The Graduate School currently has 394 international students, including 357 doctorate candidates. The students are studying in 38 disciplines among 30 CAAS institutes. They come from 53 countries of Asia, Africa, Europe, America and Oceania. A total of 46 international students, including 39 PhD holders and 7 master's degree holders, graduated from the CAAS Graduate School last year. Three overseas doctorate candidates received Chinese Government Scholarships for Excellent Overseas Students in 2017.



## Budget

The revenue of CAAS in 2017 was 7.21 billion yuan (\$1.13 billion). The year's government grant was 3.55 billion yuan (\$555 million), which included a special fund of 800 million yuan (\$125 million) for the science and technology innovation program (ASTIP).



**3.55**  
billion yuan  
(\$555 million)  
in government grant

## Research Facilities

**Major Science & Technology Facilities:** CAAS has two major national key scientific facilities; a national high-level biosafety laboratory for prevention and control of epidemics of animal diseases, six state key laboratories, a state key laboratory jointly built with provincial governments, 22 comprehensive key laboratories under the Ministry of Agriculture, 40 special key laboratories under the Ministry of Agriculture, 30 agri-products quality safety risk evaluation laboratories under the Ministry of Agriculture and Rural Affairs and 52 academy-level key laboratories.

**Major technology innovation platforms:** CAAS now has five national engineering technology research centers, five national engineering laboratories, two national engineering research centers, 22 national centers (sub-centers) for the improvement of varieties, 18 national agricultural industry technology research and develop-

ment centers, 32 academy-level engineering technology research centers.

**Major supporting platforms:** CAAS now has four national science and technology foundation platforms, 11 national crop seed quality resource banks, 12 national nurseries for quality crop seed resources. The academy boasts 480,000 accessions of crop germplasm resources under long-term preservation, which ranks second in the world. It also has five national field stations for scientific observation and experiment, three national product quality supervision and inspection centers, 31 ministerial-level quality supervision and inspection test centers, three national reference laboratories, two FAO reference centers and seven OIE reference laboratories. CAAS owns the National Agricultural Library, in which the collection of agricultural books and journals ranks top in Asia and the third in the world.





## Field Stations

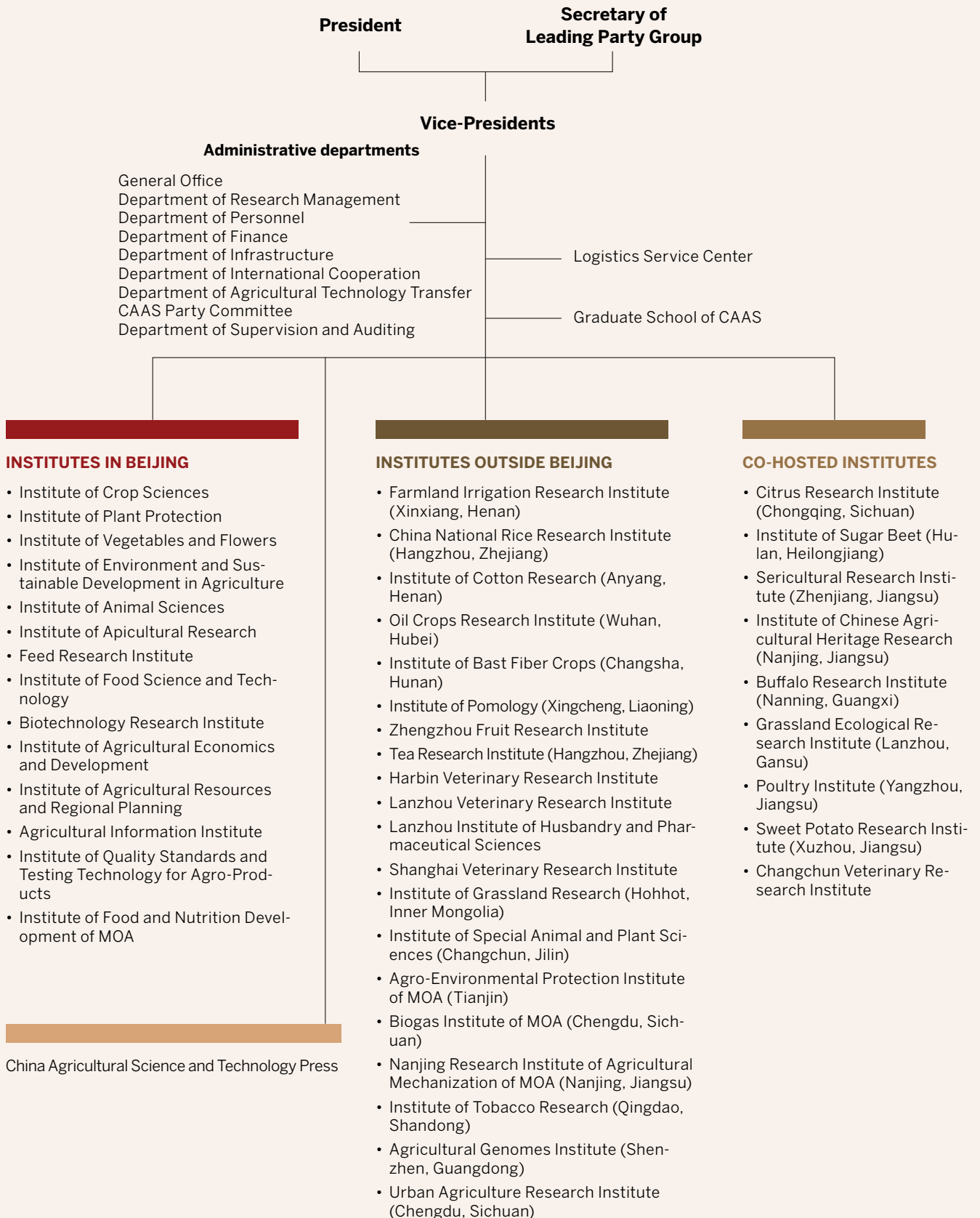
The CAAS field station network consists of three basic systems – experiment demonstration; observation and monitoring; pilot projects and conversion. There are 103 field stations in 27 provinces (municipalities, autonomous regions), covering an area of 6,074 hectares and have a total staff of 1,250.

In 2017, CAAS spent 220 million yuan (\$34.36 million) and launched 67 projects for the construction, maintenance and purchase of field stations. The area of newly added field stations reached 21,700 square meters. The academy also improved 112.93 hectares of experimental fields and purchased 77 pieces of agricultural implements, 370 sets of instruments and equipment. It carried out 1,429 scientific research projects with a total expenditure of 566 million yuan (\$88.41 million). With the support of data collected from these field stations, CAAS received 49 scientific awards of ministerial-level or above and published 2,253 high-quality papers. It also examined and approved 153 new varieties and received 567 patents.

The academy held 274 on-the-spot meetings and demonstrations in its field stations, with the attendance of 21,000 people in total. It also organized 189 training classes and trained 22,000 farmers and agricultural technicians. It promoted 279 new varieties and planted them in an area of 3.84 million hectares. It promoted 96 new agricultural techniques and adopted them on 3.86 million hectares of land and applied them to 1.04 million livestock and poultry. It also promoted 36 new products which were planted on 3.07 million hectares of land.



# Organizational Structure of CAAS





## Key Laboratories and Centers

### 1 Major national facilities

No.	Facilities	Research	Institutes
1	National Key Facility for Crop Gene Resources and Genetic Improvement	New gene discovery and germplasm innovation; crop molecular breeding; crop functional genomics; plant proteomics; and crop bioinformatics.	Institute of Crop Sciences Biotechnology Research Institute
2	National Center for Agricultural Biosafety Sciences	Significant agricultural and forestry diseases and insect pests; invasive alien species; and genetically modified organism biosafety for agriculture and forestry.	Institute of Plant Protection

### 2 Key national laboratories

No.	Facilities	Research	Institutes
1	State Key Laboratory for Biology of Plant Diseases and Insect Pests	The mechanisms of calamities caused by important crop diseases and insect pests, monitoring and forecasting, and control technologies; the mechanisms of invasive alien species; functional genome for plant protection, and gene biosafety.	Institute of Plant Protection
2	State Key Laboratory of Animal Nutrition	Nutritional requirements and metabolic regulation; feed safety and evaluation; animal nutrition and environment; animal nutrition and immunology; molecular nutrition and genetics.	Institute of Animal Sciences
3	State Key Laboratory of Rice Biology	Genetic basis of rice germplasm improvement and innovation; physiological and the biochemical mechanism of rice growth and development; interrelation studies between rice plants and environment, and rice molecular breeding.	China National Rice Research Institute
4	State Key Laboratory of Veterinary Biotechnology	Genetic engineering of animal pathogens, cell engineering, molecular biology, and other areas of basic research in veterinary medicine.	Harbin Veterinary Research Institute
5	State Key Laboratory of Veterinary Etiological Biology	Infection and pathogenesis; etiological ecology, immunity, early warning and prophylaxis of veterinary and major zoonotic diseases.	Lanzhou Veterinary Research Institute
6	State Key Laboratory of Cotton Biology	Cotton genomics and genetic diversity research; cotton quality biology and functional genes research; cotton fiber yield biology and genetic improvement research; and cotton stress biology and environment regulation research.	Institute of Cotton Research

### 3 International reference laboratories

No.	Facilities	Research	Institutes
1	FAO Reference Center of Animal Influenza	The Laboratory is in charge of the confirmative diagnosis of highly pathogenic avian influenza, animal influenza surveillance, development and update of vaccines and diagnostic reagents.	Harbin Veterinary Research Institute
2	FAO Reference Center of Biogas Technology Research and Training	Policy study and technology research in biogas-related sectors.	Biogas Institute of the MOA
3	OIE Reference Laboratory for Equine Infectious Anemia	Research focused on epidemiology and immunology of Equine Infectious Anemia. An equine infectious anemia virus vaccine model is used to study the mechanism of protective immunity for lentiviruses.	Harbin Veterinary Research Institute
4	OIE Twinning Laboratory for Equine Influenza	The laboratory is to carry out the research on the epidemiology, etiology, and diagnosis of Equine Influenza and development of a vaccine and diagnostic reagent.	Harbin Veterinary Research Institute
5	OIE Foot and Mouth Disease Reference Laboratory	Technical consultations and services, etiology studies, molecular epidemiology research and immunology research; R&D on techniques and products for FMD prevention and control.	Lanzhou Veterinary Research Institute
6	OIE Ovine Theileriosis Reference Laboratory	Pathogen identification, epidemiology, diagnosis, prevention and control of ovine theileriosis.	Lanzhou Veterinary Research Institute
7	OIE Reference Laboratory for Infectious Bursal Disease	Studies related to basic pathogen research, epidemiological studies and the prevention and control of the infectious bursal disease virus.	Harbin Veterinary Research Institute
8	OIE Reference Laboratory for Avian Influenza	In charge of the confirmative diagnosis of avian influenza, avian influenza surveillance, development and update of vaccines and diagnostic reagents.	Harbin Veterinary Research Institute
9	OIE Collaborating Center for Zoonoses of Asia-Pacific	Carries out research on the regional epidemiology, etiology, the mechanism of inter-species pathogen transmission, molecular mechanism of pathogenesis and immune mechanism.	Harbin Veterinary Research Institute

### 4 High Containment Facilities

No.	Facilities	Research	Institutes
1	National High Containment Facilities for Animal Diseases Control and Prevention	To meet the demands of the national biosafety strategy and public health. To carry out related basic and applied research of major zoonoses and severe exotic diseases.	Harbin Veterinary Research Institute

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