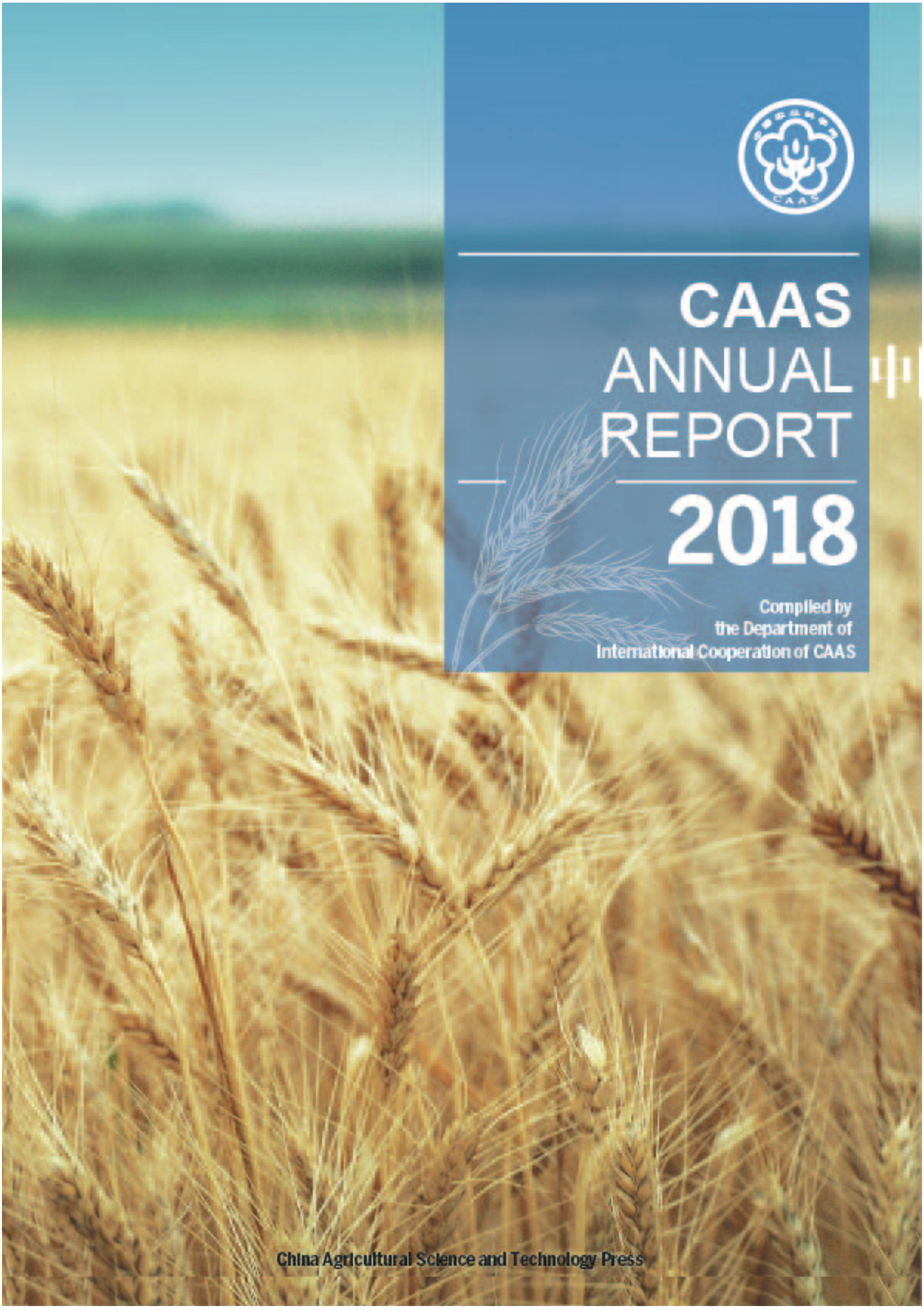

CAAS ANNUAL REPORT 2018

Compiled by
the Department of
International Cooperation of CAAS

China Agricultural Science and Technology Press

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图书在版编目（CIP）数据

中国农业科学院年度报告. 2018 = CAAS ANNUAL REPORT 2018 : 英文 / 中国农业科学院国际合作局编. -- 北京 : 中国农业科学技术出版社, 2019.10

ISBN 978-7-5116-4486-2

Ⅰ. ①中… Ⅱ. ①中… Ⅲ. ①中国农业科学院－研究报告－2018－英文 Ⅳ. ①S-242

中国版本图书馆CIP数据核字(2019)第226752号

英文版翻译　中国日报社
设　　计　苏靖博
责任编辑　张志花
责任校对　贾海霞
出 版 者　中国农业科学技术出版社
　　北京市中关村南大街 12 号　邮编: 100081
电　　话　（010）82106636（编辑室）（010）82109702（发行部）
　　（010）82109709（读者服务部）
传　　真　（010）82106631
网　　址　http://www.castp.cn
经 销 者　各地新华书店
印 刷 者　北京科信印刷有限公司
开　　本　880毫米 ×1230毫米　1/16
印　　张　3.5
字　　数　100千字
版　　次　2019年10月第1版 2019年10月第1次印刷
定　　价　68.00 元

Editorial Board of CAAS Annual Report

2018

Message from the President

2018 was the first year for China to put the guiding principles from the 19th National Congress of the Communist Party of China into action and witness the 40th anniversary of the country's reform and opening-up. It also marked the first anniversary for Chinese Academy of Agricultural Sciences (CAAS) to thoroughly study and implement the call of President Xi Jinping, also General Secretary of CPC Central Committee, in his congratulatory letter.

Following the leadership of the Ministry of Agriculture and Rural Affairs, CAAS made remarkable achievements over the past year. Notable advances were made in fundamental research; fresh breakthroughs were marked in technological innovations of strategic significance; remarkable outcomes involved in agricultural science and technology; further progress has been achieved in talent strategy; CAAS has build on its strength in supporting rural revitalization and targeted poverty alleviation; forged ahead with postgraduate education and talent cultivation; and saw continuous improvement in its ability to provide support, guarantee and service for its institutes. Those efforts and achievements further displayed CAAS' overall strength as China's only national-level agricultural research institute.

In 2018, CAAS launched 2,840 scientific projects at different levels, 27.8 percent up in year-on-year growth, and annual funding grew 27.9 percent from 2017. The academy won eight national science and technology achievement awards as the signature unit of the first authors. It was the first time in five years that its awards once again covered all three major categories - the State Natural Science Awards, National Technology Invention Awards and National Science and Technology Progress Awards.

CAAS published 22 papers in top journals including *Cell*, *Nature* and *Science* as the signature unit of the first authors, a leading position in the country. A total of 46 scientists won accolades as national-level talents, and 22 young agricultural elites newly joined CAAS in the year, which further optimized the structure of CAAS' talent pool. Also, CAAS offered firm support to 4 demonstration counties in terms of rural revitalization, studied and demonstrated 16 integrated technology-based projects on green development, as well as established 20 model innovative alliances.

CAAS received 6 heads of state/government, including British Prime Minister Theresa May and Chairman of the State Affairs Commission of the DPRK Kim Jong-un, as well as more than 30 ministerial officials from different countries. It also initiated the effort to establish an alliance for China's agricultural science and technology to go global and hosted more than 30 global academic meetings. Those efforts further showed CAAS' leading role in international agricultural research cooperation and its growing influence across the globe.

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 can help satisfy people's demands for better lives and environment, both today and in the future.

Member of CPC Leading Group,
Ministry of Agriculture and Rural Affairs
President of CAAS
Academician of CAE

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Significant Progress

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- 2018 Summary on Scientific Research
- Key Events in 2018

2018 In Numbers

8 national awards

CAAS made new breakthroughs in key strategic technology innovation, with eight scientific research findings winning national science and technology achievement awards. It was the first time in five years that the awards covered all three major categories - the State Natural Science Awards, National Technology Invention Awards and National Science and Technology Progress Awards. These awards displayed CAAS' overall strength as China's only national-level agricultural research institute.

10 major sci-tech achievements

CAAS selected ten significant scientific and technological achievements in 2018 including four in the category of key scientific issues; two in the category of major varieties and products; and four in the category of key technologies and equipment. They have laid a foundation for developing major scientific and technological achievements.

20-plus high-level academic papers

Significant advances were made in fundamental research of agriculture with more than 20 papers published in top journals including *Cell*, *Nature* and *Science* as the signature unit of the first authors. CAAS' independent innovation capacity has been further enhanced and the overall level of science and technology has been raised dramatically, maintaining CAAS in the leading position in the country.

30-plus heads of state/government and ministerial officials visiting CAAS

CAAS received six heads of state/government - British Prime Minister Theresa May; Chairman of the State Affairs Commission of the DPRK Kim Jong-un; Kyrgyz President Sooronbay Jeenbekov; Malaysian Prime Minister Mahathir Mohamad; Somali President Mohamed Abdullahi Mohamed and El Salvador's President Salvador Sanchez Ceren. CAAS also welcomed more than 30 ministerial officials from different countries.

nearly 100 outstanding talented people

46 people won national titles and awards for talents; 22 young elites were introduced from the Cold Spring Harbor Laboratory in the United States, the Max Planck Institute in Germany and other foreign research institutes; 30 people were selected as leading and outstanding agricultural talents. The structure of CAAS' talent pool has been further optimized.

3,300 scientific researchers devoting to poverty alleviation

CAAS dispatched more than 650 teams of experts and 3,300 scientific researchers to carry out poverty alleviation projects in several regions like Qinling-Daba and Wuling mountainous areas. They have made suggestions for industrial development and provided scientific services and technological demonstrations to firmly support the implementation of the rural revitalization strategy.

2018 Summary on Scientific Research

In 2018, CAAS optimized and reshaped its academic discipline systems with forward-looking ideas. It formed a new three-level layout of the system, which consists of nine discipline clusters, 57 disciplines and 302 key research directions. The leading role of disciplines has been further highlighted in adjusting the layout of scientific research and allocation of scientific resources, to power the academy in building world-class disciplines and scientific institutes.

Last year, CAAS launched 2,840 new scientific projects at different levels, with an increase of 27.8 percent year-on-year, and its annual funding reached 860 million yuan ($127.72 million), up 27.9 percent year-on-year. It took the lead in 18 National Key Research and Development Projects and 342 projects of the National Natural Science Foundation of China.

Research Achievements and Awards

CAAS was granted 89 scientific awards and 8 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. It won 45 provincial- and ministerial-level science and technology awards, including 9 first prizes.

High-level Papers

2,858 papers with CAAS as the signature unit of the first authors were published in SCI/EI journals, up 13.5 percent year-on-year, among with 22 were published in top international journals, such as *Science, Nature, PANS* and *Cell Research*.

Intellectual Property

CAAS identified or registered 388 new crop varieties, developed one new poultry breed and obtained 29 new certificates of veterinary drugs, pesticides, fertilizers and feed additives. It also published 272 scientific works and was granted 732 invention patents, 99 new plant varieties rights and 17 foreign patents.

Technology Transfer

CAAS promoted 325 new varieties, 836 new products and 234 new technologies nationwide in 2018. Of the new technologies, 19 were recommended as the major promoting by the Ministry of Agriculture and Rural Affairs, accounting for 27 percent of such technologies. The total area of land that used the new research findings reached 30.67 million hectares and about 360 million livestock and poultry benefited from the new findings.

Key Events in 2018

January

The National Science and Technology Awards Ceremony was held by the CPC Central Committee and the State Council in Beijing. CAAS was granted eight awards: a second-place prize of the National Natural Science Awards, two second-place prizes of the National Technological Invention Awards and five second-place prizes of the National Science and Technology Progress Awards.

The Agricultural Genomes Institute of CAAS made breakthroughs in research on tomato metabolome and quality inheritance. The findings were published in the *Cell journal*.

The CAAS 2018 Annual Meeting was held in Beijing. The meeting reviewed its work performance of 2017 and arranged key tasks in 2018.

February

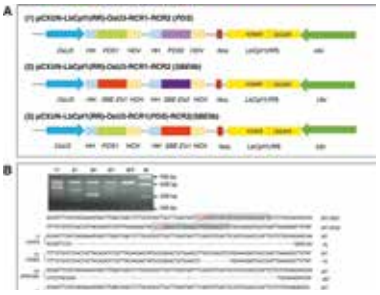
British Prime Minister Theresa May visited the National Modern Agricultural Science and Technology Innovation Park of CAAS to promote Sino-UK cooperation in the agricultural sector. May was accompanied by Han Changfu, Minister of Agriculture and Rural Affairs and Liu Xiaoming, Chinese Ambassador to the United Kingdom.

The World Bank hosted a seminar at CAAS to exchange knowledge on improving agricultural water management technologies in the Middle East and North Africa. The seminar discussed cooperation on the management of water resources between CAAS and countries in the two areas.

An academic conference celebrating the 20th anniversary of the National Wheat Improvement Center and a high-quality wheat industry development forum were held at the Institute of Crop Sciences, CAAS. Prof. Chen Mengshan, the then Secretary of the Leading Party Group of CAAS, attended the events.

March

The Institute of Crop Sciences of CAAS and Huazhong Agricultural University generated *LbCpf1*(RR) variant which enables the multi-editing of target genes containing TYCV PAMs in rice. The demonstration of genome editing at this non-canonical PAM site expands the scope of Cpf1-mediated genome editing in rice, and will be beneficial to the basic plant research and crop improvement in the future. The results were published in *Molecular Plant*.



The Center for International Agricultural Research of CAAS organized the first meetings of Expert Committee and Management Committee in Beijing.

April

CAAS' Vice-President Wan Jianmin led a delegation to visit Bangladesh and Thailand to deepen cooperation in agricultural science and technology between CAAS and countries and regions involved in the Belt and Road Initiative.

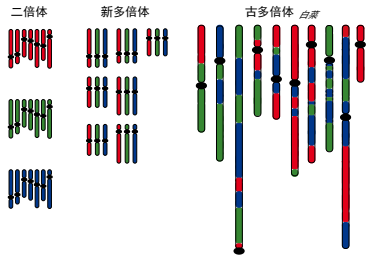
Dutch Deputy Prime Minister Carola Schouten, who is also Minister for Agriculture, Nature and Food Quality for the Netherlands, led a high-level delegation to visit CAAS, together with Arthur Mol, President of Wageningen University and Research. Mrs. Schouten planted a friendship pine tree on the campus of CAAS in Beijing with Prof. Tang Huajun, President of CAAS.

The first Australia-China Sustainable Agricultural Technology Forum kicked off on April 29 in Australia. Prof. Mei Xurong, Vice-President of CAAS, attended the forum.

The 2018 China Agricultural Outlook Conference was held in Beijing. During the event, the *China Agricultural Outlook Report* (2018-2027) was released.

May

The Institute of Vegetables and Flowers of CAAS and the University of California, Berkeley carried out an in-depth analysis of the plant polyploidy. The results were published in *Nature Plants*.



Chinese Vice-Premier Hu Chunhua, who is also a member of the Political Bureau of the CPC Central Committee, visited CAAS to see its works on agricultural science and technology.

The Institute of Quality Standard and Testing Technology for Agro-products of CAAS revealed, for the first time in the world, how the dielectric barrier discharge (DBD) traps, releases and transports arsenic. The related achievements were published in *Analytical Chemistry*.

June

Kyrgyz President Sooronbay Jeenbekov visited CAAS on June 8. The two sides reached consensus on strengthening Sino-Kyrgyz cooperation in agricultural science and technology.

Prof. Liu Daqun, Dean of the Graduate School of CAAS and a member of the Leading Party Group of CAAS, led a delegation to visit Massey University, the New Zealand Institute for Plant and Food Research, the University of Tasmania and the Natural Resource Management South in Australia.

Kim Jong-un, Chairman of the Workers' Party of Korea and Chairman of the State Affairs Commission of the DPRK, visited the National Modern Agricultural Science and Technology Innovation Park of CAAS.

July

Prof. Tang Huajun, President of CAAS and a member of the Leading Party Group of the Ministry of Agriculture and Rural Affairs, led a delegation to visit Tajikistan, Uzbekistan and Kazakhstan. A series of cooperative agreements were signed to boost cooperation between CAAS and Central Asian countries.

The 2018 China Engineering Technology Forum - Smart Agriculture was held in Beijing. The forum was hosted by the Chinese Academy of Engineering and sponsored by the CAAS Institute of Agricultural Resources and Regional Planning and the National Agricultural Science and Technology Innovation Alliance.

CAAS and the International Center for Tropical Agriculture held a symposium in Beijing. They exchanged ideas on boosting cooperation in agricultural science and technology in the context of South-South cooperation and the Belt and Road Initiative.

August

Prof. Wu Kongming, Vice-President of CAAS, met with a Panamanian delegation led by Eduardo Carles, the country's Minister of Agricultural Development. They exchanged opinions on cooperation in agricultural science and technology.

Malaysian Prime Minister Mahathir Mohamad led a delegation to visit CAAS and took a discussion on strengthening cooperation with the academy in agriculture science and technology.

Prof. Zhang Hecheng, Secretary of the Leading Party Group of CAAS, met with Salimzoda Olim, Chairman of the Foreign Affairs Committee of the Lower Chamber of the Tajikistan Parliament, and his delegation.

September

Somali President Mohamed Abdullahi Mohamed led a delegation to visit the National Modern Agricultural Science and Technology Innovation Park of CAAS and had in-depth exchanges with the academy in enhancing cooperation in agricultural science and technology.

Prof. Li Jinxiang, Vice-President of CAAS, led a delegation to visit agricultural research and educational institutions in Canada and the United States, and the US-headquartered International Food Policy Research Institute.

The first China Agricultural and Rural Science and Technology Development Summit was held in Beijing. The event was held by CAAS, the Development Center for Science and Technology of the Ministry of Agriculture and Rural Affairs and the China Association of Agricultural Science Societies. The *China Agricultural and Rural Science and Technology Development Report (2012-2017)* was released at the event.

October

Prof. Zhang Hecheng, Secretary of the Leading Party Group of CAAS, attended the 2018 Yangtze River Economic Belt Industrial Financial High-end Dialogue. Zhang also visited a citrus industry park in Cuiping district of Yibin and the Sichuan Tea Group to investigate rural revitalization and modern agricultural development.

The Feed Research Institute of CAAS has developed a high-throughput screening platform by coupling the surface display of a red fluorescence protein DsRed through fluorescence assisted cell sorting. The findings were published in *Biotechnology for Biofuels*.

Prof. Wang Hanzhong, Vice-President of CAAS, and Gilles Saindon, Associate Assistant Deputy Minister of Agriculture and Agri-Food Canada, signed a cooperative agreement on building a joint lab (Wuhan) of genetic improvement and utilization of rapeseed.

November

President Salvador Sanchez Ceren of El Salvador led a delegation to visit CAAS to discussed cooperation in projects, expert exchanges and personnel training.

Martin Kropff, Director-General of the International Maize and Wheat Improvement Center (CIMMYT), Matthew Morell, Director-General of the International Rice Research Institute (IRRI) and Tony Simons, Director-General of the World Agroforestry Center (ICRAF), visited CAAS. They reached consensuses on deepening cooperation with each other.

The 2018 International Cooperation Working Conference of CAAS was held in Changchun, Jilin province. Prof. Wu Kongming, CAAS Vice-President, attended the conference and delivered a speech.

December

Zhang Shizhen, Vice-Governor of Gansu province, headed a delegation to visit CAAS. The two sides discussed selecting high-level talents for temporary posts in the province.

Han Changfu, Minister of Agriculture and Rural Affairs, visited the Harbin Veterinary Research Institute of CAAS. He gave guidance on strengthening the prevention and control of African swine fever and promoted the research of animal vaccines.

Prof. Tang Huajun, President of CAAS and a member of the Leading Party Group of the Ministry of Agriculture and Rural Affairs, hosted the first meeting of a scientific research leading group of African swine fever prevention and control.

Science and Technology Innovation

- National Science and Technology Awards
- Top 10 Research Progress in 2018
- Frontier Scientific Breakthroughs in 2018
- Agricultural Science and Technology Achievements and Contributions

National Science and Technology Awards

Studies on genome and important trait genes of cucumber (*Cucumis sativus L.*) led by Prof. Huang Sanwen at the Institute of Vegetables and Flowers of CAAS placed second for the National Natural Science Awards of China.

The project applied the latest sequencing technology to uncover the genomic code of cucumber for the first time, and identified the important trait genes that control the fruit's size and bitterness. The discoveries open a new era for molecular assistant breeding of cucumbers, and make China a world leader in vegetable genomics research. The project found nine bitterness biosynthetic genes and their regulators in cucumber. The "Shuyan" series cultivated in the project successfully solved the severe problem that cucumbers would turn bitter and thereby lose their commodity value. The total promotion area of "Shuyan" series reaches about 66,700 hectares, which have created nearly 8 billion yuan ($1.16 billion) of economic value and achieved remarkable social benefits.

▲ Breeding and extension of new cucumber varieties with high yield and non-bitterness in southern China

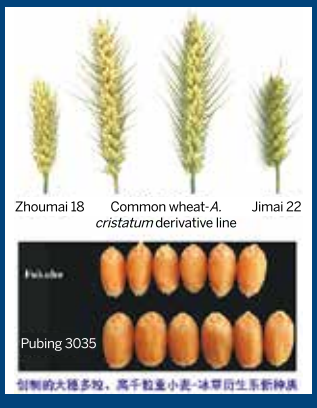
Research on the development and application of a live vaccine against swine-transmissible gastroenteritis, porcine epidemic diarrhea and porcine rotavirus was completed by Prof. Feng Li at the Harbin Veterinary Research Institute of CAAS. It won second prize in the National Technology Invention Awards of China.

The project created the first safe and effective triple-combined live vaccine for swine viral diarrhea in China. The active and passive immunization rates of the new vaccine are as high as 96.15 percent and 88.67 percent respectively. A total of 25.6 million vaccines have been used nationwide, with 154 million piglets under protection. Sales revenue has reached 201 million yuan ($29 million).

▲ Picture for the vaccine

Researches on distant hybridization techniques between common wheat and *Agropyron cristatum* and on new germplasm production by transferring alien genes of A. cristatum into wheat, which were led by Prof. Li Lihui at the Institute of Crop Sciences of CAAS, won the second prize of the National Technology Invention Awards of China.

The project has lasted for 30 years and established a new germplasm production technology for wide cross between wheat and wild relatives. It solved the international problem of using alien genes of *A. cristatum* for wheat germplasm enhancement. A total of 392 new varieties featuring large spike, high thousand seed weight, broad spectrum resistance and small flag leaf of plant architecture traits were produced. Li's team used the new varieties as breeding parents for new cultivars carrying the alien genes of *A. cristatum*, which led a new direction of wheat breeding. The research has enhanced China's innovation capacity in wheat germplasm resources and its international influence in this field. It has also significantly increased the country's social and economic benefits.



▲ Representative new germplasms with large spike and high thousand-grain weight traits produced by wide cross between wheat and *Agropyron cristatum*

Research on the identification, innovation and utilization of elite soybean germplasm led by Prof. Qiu Lijuan at the Institute of Crop Sciences of CAAS was awarded the second prize of the National Science and Technology Progress Awards of China.

This project developed an identification system of soybean germplasm evaluation by integrating the phenotyping and genotyping techniques. It also was the first to establish and analyze soybean pan-genome in the world, identified 72 QTL/genes related to resistance/tolerance and oil contents, built molecular marker-assisted breeding system, created eight elite lines and 17 disease-resistant, high-quality and high-yielding cultivars. These new cultivars were planted in total of 8.33 million hectares from 2006 to 2017, resulting in nearly 9.8 billion yuan ($1.42 billion) of social and economic benefits.

▲ Demonstration field of Zhonghuang 57 resistant to a variety of diseases

Research and application on the monitoring and accounting methods of livestock and poultry manure pollution, and on key technologies for mitigating pollution and increasing efficiency led by Prof. Dong Hongmin at the Institute of Environment and Sustainable Development in Agriculture of CAAS placed second in the National Science and Technology Progress Awards of China.

The project developed a method to monitor and account for animal manure pollution for the first time in China, created a process to reduce sewage from the source, invented key technologies and equipment for the reuse of wastewater and biogas, compost odor reduction and ammonia nitrogen recycling. The project also innovated three series of technical models covering planting and breeding, clean production and recycling, and centralized treatment. They have been widely promoted and applied nationwide, providing sci-tech support to make national policies and implement major actions.

▲ Demonstration project for centralized treatment of livestock and poultry manure for energy production

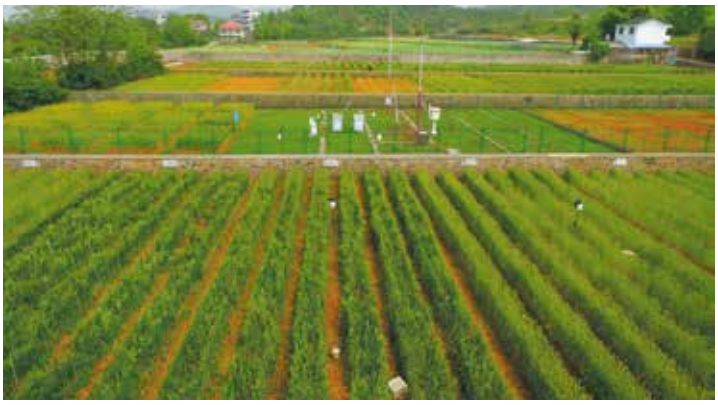
Studies on the development of high-quality and multi-resistant germplasm of cucumber and related breeding technologies of new varieties led by Prof. Gu Xingfang at the Institute of Vegetables and Flowers of CAAS placed second in the National Science and Technology Progress Awards of China.

The project develops an efficient cucumber disease resistance identification and quality evaluation technology, creates a world-leading molecular marker technology for cucumber multi-genes pyramiding breeding, and overcomes the difficulty of integrating the high-quality and disease-resistant genes. Eight varieties with different ecological types have been bred and their total planting areas come up to 790,000 hectares. The project has achieved a breakthrough of breeding the acantha cucumber with high-quality and multi-resistance.

▲ Eight cultivated Zhongnong cucumber varieties with high-quality and multi-resistance

Research on the characteristics of farmland acidification and on related key control technologies in typical red soil region of China, conducted by Prof. Xu Minggang's team at the Institute of Agricultural Resources and Regional Planning of CAAS, placed second in the National Science and Technology Progress Awards of China.

The team, after carrying out nearly 30 years of inspection on experimental sites in six typical provinces, has found spatial and temporal variations of farmland acidification, established three key technologies centering on the accurate application of lime materials and animal manure, and the reduction of chemical nitrogen fertilizers application to control such acidification. The team also developed new amendments for acid soil and integrated farmland acidification control technology modes featuring regional characteristics. These models have been widely promoted for their prominent economic and ecological effects.



▲ The demonstration base of control soil acidification by applying manure and soil amendments

Innovation and industrialization of key technologies of the lamb stepwise processing led by Prof. Zhang Dequan at the Institute of Food Science and Technology of CAAS won second place in the National Science and Technology Progress Awards of China.

The project has interpreted China's lamb procession characteristics for the first time, established a lamb processing evaluation system suitable for Chinese people's eating habits and developed key technologies and equipment for lamb stepwise processing. These achievements have solved three major technological problems - ambiguous lamb processing characteristics and low accuracy of grade cut, deterioration of the lamb quality and short shelf life, low industrialization and quality stability. The project makes a great stride toward lamb processing from handwork experience to standardized industrialization.

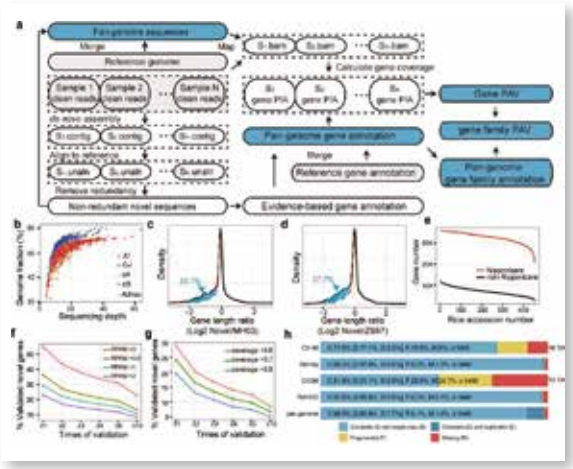
▲ Non-destructive near-infrared grading equipment for sheep carcass

Top 10 Research Progress in 2018

Comprehensive analysis of genetic diversity of Asian cultivated rice

A research group led by Prof. Li Zhikang at the Institute of Crop Sciences of CAAS has completed the study on genome variation of 3,010 Asian cultivated rice samples, making it the largest plant genome sequencing project in the world so far. Li's group also built the world's first near-complete, high-quality Asian cultivated rice pan-genome and deeply analyzed the genetic diversity of Asia cultivated rice genome. Related data and application platforms have been established.

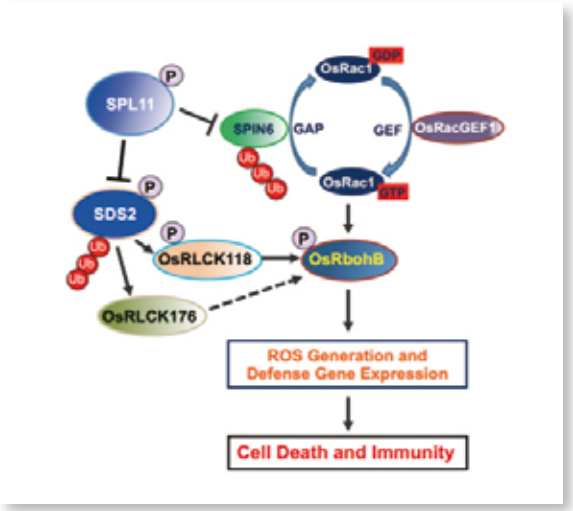
Map-to-pan strategy for rice pan-genome analyses



Discover new mechanisms of *Magnaporthe oryzae* pathogenesis and rice resistance to blast disease

A group led by Dr. Ning Yuese and Dr. Liu Wende at the Institute of Plant Protection of CAAS revealed a direct correlation between plant nutrition and disease resistance, and analyzed the regulation mechanism of monocotyledon's receptor kinase SD-1 against rice blast fungus. These studies are of great significance for finding new disease control methods.

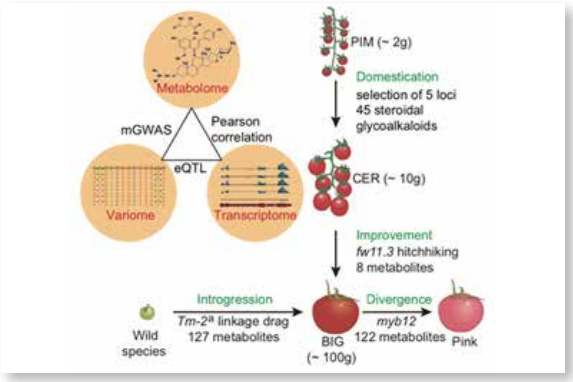
The *Magnaporthe oryzae* effector AvrPiz-t suppresses innate immunity by modulating the rice potassium channel OsAKT1

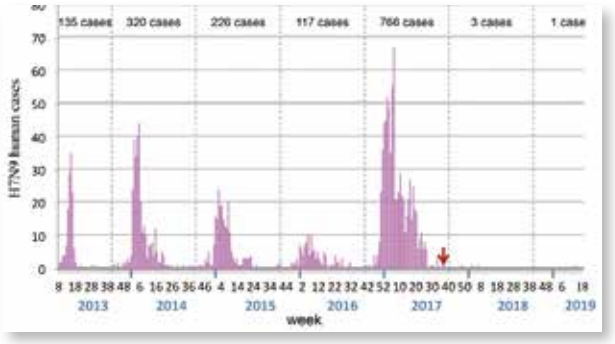


A multi-omics study revealed the history of tomato breeding

A team led by Prof. Huang Sanwen at the Shenzhen Agricultural Genomics Institute of CAAS applied a multi-omics approach to integrate the data of genome, transcriptome and metabolome from hundreds of tomato genotypes, and revealed changes of fruit metabolome in tomato breeding history. The result is a breakthrough in the study of plant metabolic biology.

A multi-omics view of tomato breeding





Poultry vaccines to block human infection with the H7N9 virus in China

Prof. Chen Hualan and her team at the Harbin Veterinary Research Institute of CAAS developed a H5/H7 bivalent avian influenza inactivated vaccine. The vaccine can effectively stop the spread of H7N9 avian influenza viruses in poultry and block the human infection with H7N9 virus in China. The successful prevention and control of H7N9 infection has become a model case of controlling zoonosis from animal sources in China.

Human infection with H7N9 viruses. The red arrow shows the application time of H5/H7 vaccine to poultry in China

Development and industrialization of ethanamizuril, a new anticoccidials for animals

Prof. Xue Feiqun's research group at the Shanghai Veterinary Research Institute of CAAS completed a series of studies on ethanamizuril, including the drug effect screening, preparation technology, pharmacological and pharmacokinetic research, toxicity and safety evaluation, clinical research and environmental assessment. The team has solved several technical difficulties related to the production process, absorption and metabolism, and residues of veterinary drugs, to realize the industrialization.

The ethanamizuril solution

Zhongxu grassland white feather duck breed

The certification of Zhongxu grassland white feather duck breed

Zhongxu grassland white feather duck breed passed the identification and registration of the National Farm Animal Genetics Resource Committee of China

Prof. Hou Shuisheng and his group at the Institute of Animal Science of CAAS cultivated a new duck breed called the Zhongxu grassland white feather duck, which earned the national farm animal new breed certification. The number of this breed for commercial sale has occupied 24 percent of the duck market nationwide. Hou's group also innovated a QR-code identification and data manage system, and selection techniques of duck breast muscle and fat skin rates.

Application of standardized and industrialized control technology for the Chinese chive gnat

A research team led by Prof. Zhang Youjun at the Institute of Vegetables and Flowers of CAAS improved a gnat control technology featuring regional cultivation characteristics and formulated related industrial standard in China. In 2018, the technology was applied at a total area of nearly 320,000 hectares in China.

Efficient transplant techniques for carpet-like rape seedlings

A research team led by Prof. Wu Chongyou at the Nanjing Research Institute for Agricultural Mechanization, which is affiliated to the Ministry of Agriculture and Rural Affairs of China, solved a key problem of transplanting rape seedlings with high efficiency and high density in paddy soil and rice straw returning fields. The problem was the last barrier of mechanized production of rape. The new technology has been widely promoted in main rape production areas nationwide.

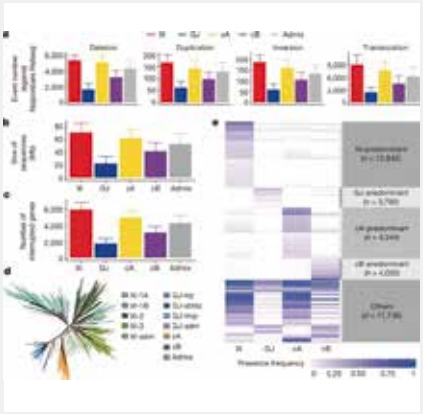
Rice seedling raising technology in overlaid tray

A research team led by Prof. Zhu Defeng and Prof. Chen Huizhe at the China National Rice Research Institute innovated a rice seedling raising mode in overlaid tray suitable for the rice transplanting machine. The team also developed related equipment for sowing and intelligent temperature and humidity control in greenhouses. Using technology leads to a neat and robust seedling emergence and increases the production and efficiency dramatically. The technology solves key transplanting problems of the rice machine like poor seedling emergence, irregular and dead seedlings, providing technical support for the development of rice production mechanization and socialized service.

A production mode to combine the high-quality cotton variety CCRI 641 and "wide-early-fine" planting pattern

A group led by Prof. Zhang Xiling at the Institute of Cotton Research of CAAS integrated the new high-quality cotton strain CCRI 641 and the new planting pattern of "wide-early-fine". The production mode was applied in Northwest China's Xinjiang Uygur autonomous region in 2018 and increased the yield by more than 20 percent. Significant breakthroughs were made in "good methods going together with elite cultivars" and in the "combination of agricultural machinery and agronomic practices".

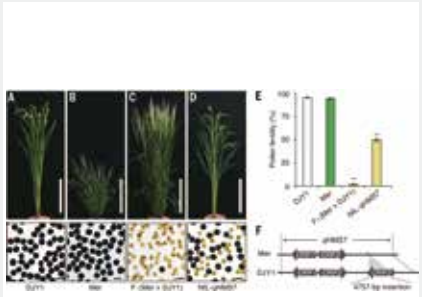
Frontier Scientific Breakthroughs in 2018



GENOME VARIATION OF 3,010 ASIAN CULTIVATED RICE SAMPLES

Prof. Li Zhikang at the Institute of Crop Sciences of CAAS and Prof. Ruan Jue at the Shenzhen Agricultural Genomics Institute of CAAS published a paper titled "Genome variation of 3,010 Asian cultivated rice samples" in *Nature*. The article explored the origin, gene, classification and evolution of rice, and revealed the rich structures and genetic diversity of rice species. The study will greatly promote global rice genome research and improve rice molecular design breeding capacity.

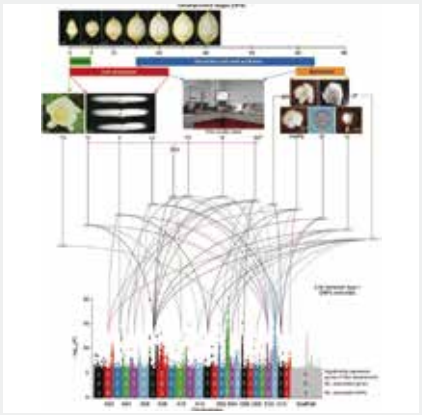
◀ Number and population differentiation of genomic structural variations



▲ Identification of the selfish genetic element encoded by qHMS7

A SELFISH GENETIC ELEMENT CONFERS ON RICE NON-MENDELIAN GENETICS

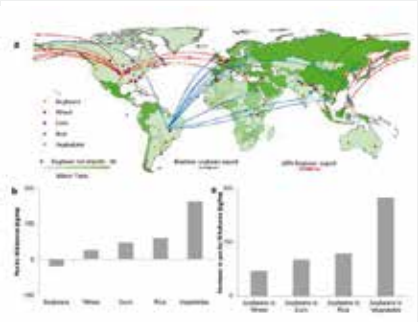
Prof. Wan Jianmin and his colleagues at the Institute of Crop Sciences of CAAS reported the mechanism on how a rice's selfish genetic element controls hybrid sterility. A related study named "A selfish genetic element confers on rice non-Mendelian genetics" was published in *Science*. The study proposed that the selfish genetic system promoted differentiation between wild and cultivated rice and played an important role in maintaining genome stability. This toxicity-antidote molecular mechanism may be a common phenomenon in the control of hybrid sterility in rice. The group's findings provide a reference for studying selective hybrid sterility mechanisms between the *indica* and *japonica* subspecies of cultivated rice.



RE-SEQUENCING THE UPLAND COTTON'S CORE COLLECTION IDENTIFIES GENOME VARIATION LOCI THAT INFLUENCE THE FIBER QUALITY AND YIELD

Prof. Du Xiongming at the Institute of Cotton Research of CAAS published a paper titled "Re-sequencing the upland cotton's core collection identifies genome variation loci that influence the fiber quality and yield" in *Nature Genetics*. The study found more than 3.66 million SNP markers in a core collection of 419 Chinese upland cotton samples for the first time. It also identified fiber-related elite loci, providing a basis of molecular selection and genetic operation for cotton improvement.

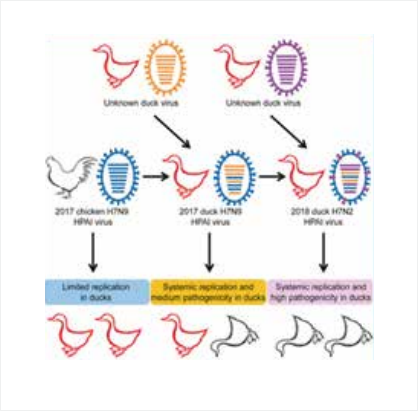
◀ Diagram between fiber traits and their associated loci intensity and chromosomal locations



International soybean trade (A) and meta-analysis on per hectare N balance of soybeans and four major crops (wheat, corn, rice, and vegetables) converted from soybeans (B and C)

IMPORTING FOOD DAMAGES DOMESTIC ENVIRONMENT: EVIDENCE FROM GLOBAL SOYBEAN TRADE

Prof. Sun Jing and his team at the Institute of Agricultural Resources and Regional Planning of CAAS recently published a paper titled "Importing food damages domestic environment: evidence from global soybean trade" in *Proceedings of the National Academy of Sciences*. Contrary to conventional wisdom that importing countries benefit from international food trade at the environmental cost of the exporting countries, the paper revealed a major environmental problem regarding soybean trade in the importing countries. Results suggested a need to re-evaluate environmental consequences of international trade of all major goods in all importing countries. China, for example, is the largest soybean importing country and has significant implications for the fundamental rethinking in global policy-making and debates on the environmental responsibilities among consumers, producers and traders across the world.



Evolution and virulence in ducks of H7N9 highly pathogenic influenza viruses

RAPID EVOLUTION OF H7N9 HIGHLY PATHOGENIC VIRUSES EMERGED IN 2017 IN CHINA

Prof. Chen Hualan and her team at the Harbin Veterinary Research Institute of CAAS found that the highly pathogenic viruses H7N9 evolved rapidly into multiple genotypes by deriving genes from other chicken and duck viruses, enabling certain strains to become highly lethal in mice and ducks. The application of an H5/H7 bivalent vaccine in poultry can successfully prevent the spread of the viruses in poultry and humans. The study titled "Rapid evolution of H7N9 highly pathogenic viruses emerged in 2017 in China" was published in *Cell Host & Microbe*.

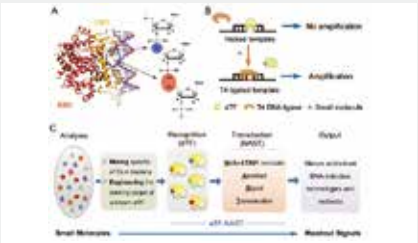
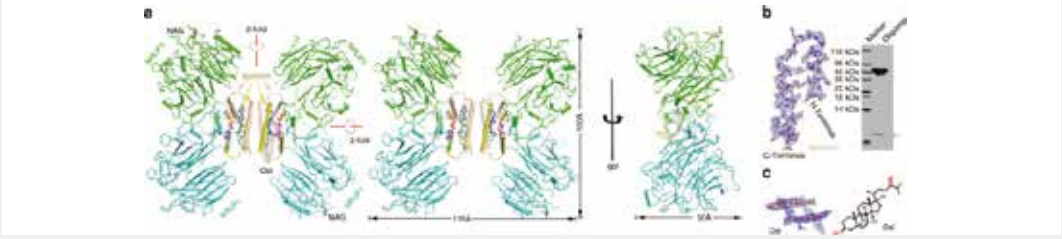


Illustration of the aTF-NAST based biosensors. A, schematic for the interaction between an aTF and its TFBS with a nick. Intact and broken phosphodiester bonds are highlighted in blue and orange circles, respectively. B, schematic of the aTF-NAST. C, workflow for the development of small-molecule biosensors using aTF-NAST.

SENSING DIVERSE SMALL MOLECULES IN VITRO WITH NEW BACTERIAL ALLOSTERIC TRANSCRIPTION FACTORS

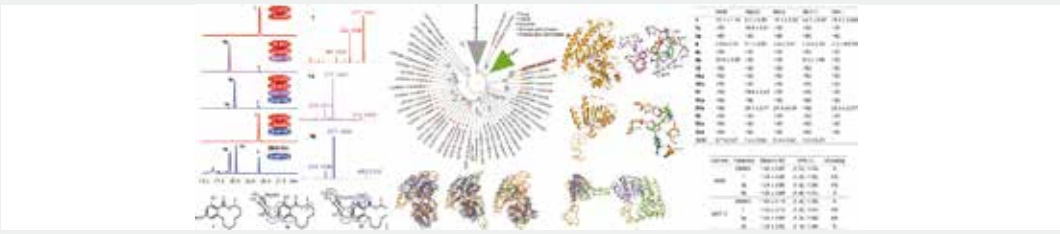
Prof. Li Shanshan and her team at the Institute of Plant Protection of CAAS published a research article titled "Sensing diverse small molecules in vitro with new bacterial allosteric transcription factors" in *Science Advances*. They found a new capacity of bacterial allosteric transcription factors (aTFs) - these factors could interact with nicked DNA binding sites. With this new finding, Li's team designed and implemented a novel aTF-based nicked DNA template-assisted signal transduction system (aTF-NAST). The system could reliably and modularly transduce the signal of small molecules recognized by aTFs to the ligated DNA signal, thus enabling the small molecules to be measured via various mature and robust DNA detection methods.



▲ Structure of the MRJP1 oligomer

ARCHITECTURE OF THE NATIVE MAJOR ROYAL JELLY PROTEIN 1 OLIGOMER

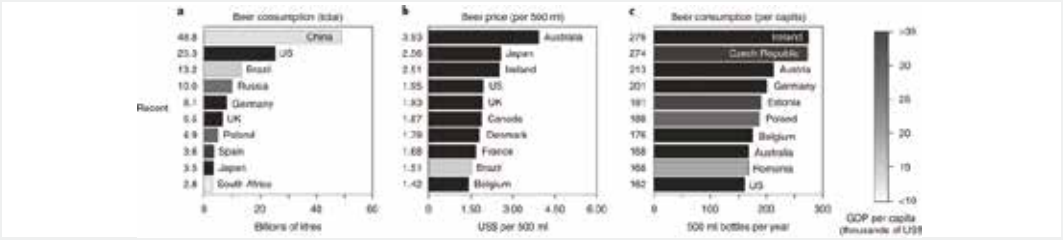
Prof. Tian Wenli at the Institute of Apicultural Research of CAAS published a paper titled "Architecture of the native major royal jelly protein 1 oligomer" in *Nature Communications*. The heterogeneous ternary complex structure of MRJP1 was determined by using its weak homologous protein structure. The result explains why MRJP1 oligomer in royal jelly is more stable than MRJP1 monomer and why royal jelly can lower cholesterol.



▲ Characterization of Beauveria bassiana glucosyltransferase-methyltransferase module and the bioactivities of methylglucosides

METHYLGLUCOSYLATION OF AROMATIC AMINO AND PHENOLIC MOIETIES OF DRUG-LIKE BIO-SYNTHONS VIA COMBINATORIAL BIOSYNTHESIS

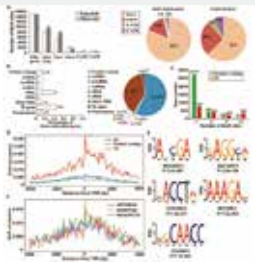
Prof. Xu Yuquan and his team at the Biotechnology Research Institute of CAAS published an article titled "Methylglucosylation of aromatic amino and phenolic moieties of drug-like bio-synthons via combinatorial biosynthesis" in *Proceedings of the National Academy of Sciences*. They identified previously undiscovered fungal glucosyltransferase and methyltransferase, and created a synthetic biology platform in which glucosyltransferase and methyltransferase could produce glycosylated polyketides not found in nature, some with increased stability and bioactivity.



▲ Consumption and price of beer in recent years

DECREASES IN GLOBAL BEER SUPPLY DUE TO EXTREME DROUGHT AND HEAT

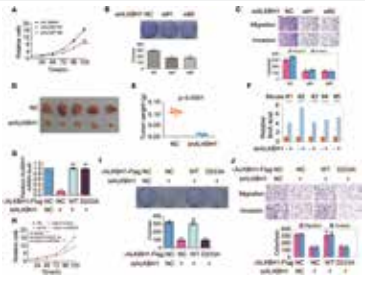
Prof. Lin Erda at the Institute of Environment and Sustainable Development in Agriculture of CAAS published an article titled "Decreases in global beer supply due to extreme drought and heat" in *Nature Plants*. The study showed that global climate changes, severe drought and extreme heat will lead to yield decrease of barley, which makes the beer more scarce and expensive.



▲ Distribution pattern of 6mA methylation in genomic DNA of 9-day-old Col plants

DNA N^6-ADENINE METHYLATION IN ARABIDOPSIS THALIANA

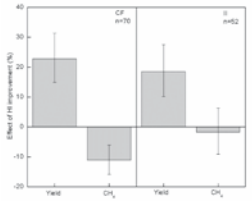
A team led by Prof. Gu Xiaofeng at the Biotechnology Research Institute of CAAS published a paper titled "DNA N^6-adenine methylation in Arabidopsis thaliana" in *Developmental Cell*. In the research, 6mA was found to be a potentially epigenetic mark in terrestrial plants. It was the first revealing of a genome-wide distribution and biological functions of 6mA methylation in plant. The study opens up a new area for comprehensively analyzing the mechanism of DNA methylation control of plant development and environmental adaptability.



▲ Increase of genomic 6mA modification level represses tumorigenesis

N^6-METHYLADENINE DNA MODIFICATION IN THE HUMAN GENOME

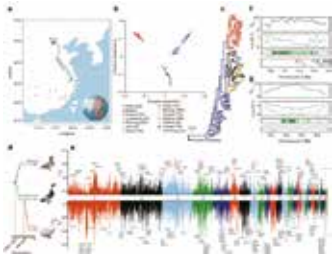
A team led by Prof. Gu Xiaofeng at the Biotechnology Research Institute of CAAS published an article titled "N^6-methyladenine DNA modification in the human genome" in *Molecular Cell*. The study confirmed that 6mA is extensively present in the human genome, and the decrease of 6mA level of genomic DNA is closely related to the malignant phenotype of tumor and the poor prognosis of tumor patients. It revealed that the decrease of 6mA level of human genomic DNA may promote development, invasion and metastasis of tumor, while the increase of 6mA level inhibits development, invasion and metastasis of tumor.



▲ Effects of rice harvest index (HI) improvement on grain yield and methane (CH_4) emissions from paddy fields under continuously flooded (CF) and intermittent irrigation (II) systems.

INCREASED HARVEST INDEX HAS A LIMITED POTENTIAL TO REDUCE METHANE EMISSIONS FROM RICE PADDIES

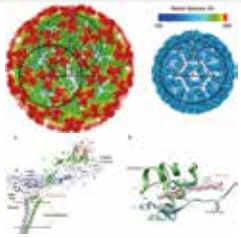
A group led by Prof. Zhang Weijian at the Institute of Crop Sciences of CAAS published an article titled "Increased harvest index has a limited potential to reduce methane emissions from rice paddies" in *Global Change Biology*. They found the improvement of rice harvest index (HI) could reduce methane (CH_4) emissions only under continuous flood irrigation and had inconspicuous effects under intermittent irrigation. Future rice breeding efforts aimed at HI improvement will have the CH_4 emission reduction potential of less than 4.4 percent. The findings can provide theoretical basis for paddy CH_4 emission assessment and rice planting innovation with low carbon emission.



▲ Sampling and genomic landscape of the divergence of ducks

A COLONY HYBRIDIZATION STUDY REVEALS THE DUCK SIZE AND COLOR-RELATED GENES

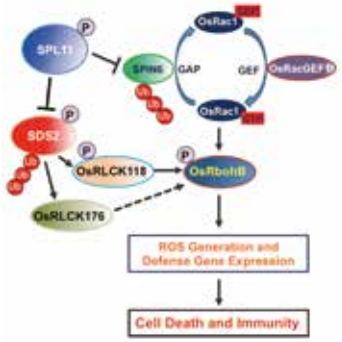
Prof. Hou Shuisheng and his colleagues at the Institute of Animal Science of CAAS published a paper titled "A colony hybridization study reveals the duck size and color-related genes" in *Nature Communications*. It illustrated the evolutionary process from mallard to Peking duck, identified a major gene *IGF2BP1* to control the body size of Peking duck. The findings provide both theoretical and technical foundation for high-yield molecular breeding of farm animals.



Overall cryo-EM structure of SINV Location of the newly-identified pocket factor (A) and the local enlarged view (B)

HIGH-RESOLUTION STRUCTURE ANALYSIS REVEALS THE INVASION AND ASSEMBLY PROCESS OF ALPHA VIRUSES TO HOST CELLS

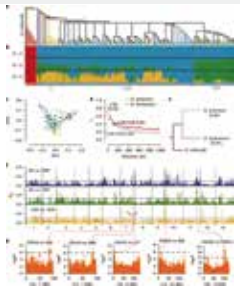
Prof. Wang Jingfei at the Harbin Veterinary Research Institute of CAAS published a research article titled "High-resolution structure analysis reveals the invasion and assembly process of alpha viruses to host cells" in *Nature Communications*. The study analyzed a 3.5 Å cryo-electron microscopy (cryo-EM) structure of a Sindbis virus strain, which is of great importance to characterizing the pH-driven conformational changes of virion and also provides structural insights into the design of drugs and vaccines for alpha viruses.



The U-box E3 ligase SPL11 targets the receptor-like kinase SDS2 to modulate cell death and immunity in rice

MONOCOTYLEDON'S RECEPTOR KINASE SDS2 CONTROLS CELL DEATH AND IMMUNITY IN RICE

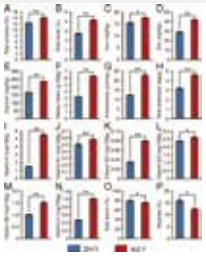
A research group of the Laboratory of Plant Disease Resistance at the Institute of Plant Protection of CAAS published a paper titled "Monocotyledon's receptor kinase SDS2 controls cell death and immunity in rice" in *Cell Host and Microbe*. The group found that SDS2 is a positive regulator of programmed cell death and immunity in rice. This study has established an important foundation for further understanding the rice's innate immune mechanisms.



Population structure and differentiation of diploid cotton

RE-SEQUENCING AN UPDATED A GENOME OF 243 DIPLOID COTTON VARIETIES IDENTIFIES THE GENETIC BASIS OF KEY AGRONOMIC TRAITS

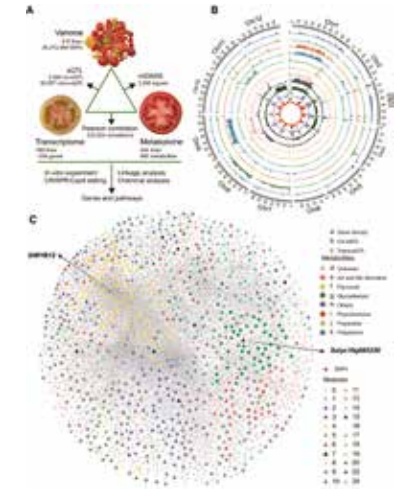
Prof. Li Fuguang at the Institute of Cotton Research of CAAS and Dr. Lin Tao at the Shenzhen Agricultural Genome Research Institute of CAAS published a paper titled "Re-sequencing an updated A genome of 243 diploid cotton varieties identifies the genetic basis of key agronomic traits" in *Nature Genetics*. The study elucidated the evolution, genetic diversity and population structure of Asiatic cotton for the first time. It also found that fusarium wilt disease resistance and fiber yield are strongly affected by geographical differentiation. It will lay a foundation for understanding of the A genome during the cotton evolution.



Mutation of the *OsROS1* gene led to a general improvement of nutritional profile in rice

MUTATIONS IN THE DNA DEMETHYLASE OsROS1 RESULT IN A THICKENED ALEURONE AND IMPROVED NUTRITIONAL VALUE IN RICE GRAINS

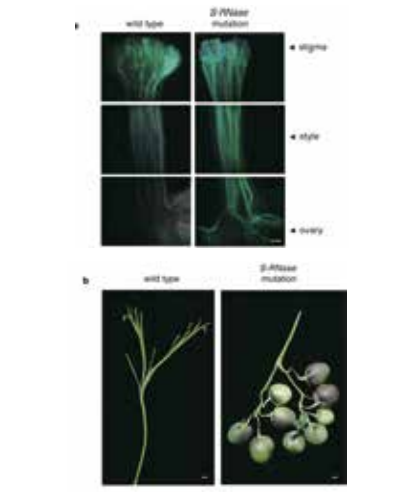
A team led by Prof. Liu Chunming at the Institute of Crop Sciences of CAAS published an article titled "Mutations in the DNA demethylase *OsROS1* result in a thickened aleurone and improved nutritional value in rice grains" in *Proceedings of the National Academy of Sciences*. This study discovered a novel way to improve the nutritional value of rice through identification of thick aleurone mutants, which provides genetic materials for developing nutrient-dense rice and possibly other cereals as well.



REWRITE THE FRUIT METABOLOME IN TOMATO BREEDING

A team led by Prof. Huang Sanwen at the Shenzhen Agricultural Genomics Institute of CAAS published an article titled "Rewrite the fruit metabolome in tomato breeding" in *Cell*. The metabolic changes of tomato fruits during the process of domestication, improvement, divergence and introgression were comprehensively revealed for the first time. Genetic loci controlling nutrients and flavor substances were identified, and new metabolic regulation methods were discovered. The study provides a hint to the genetic regulation of flavor and nutrients in tomatoes and to the whole-genome design breeding.

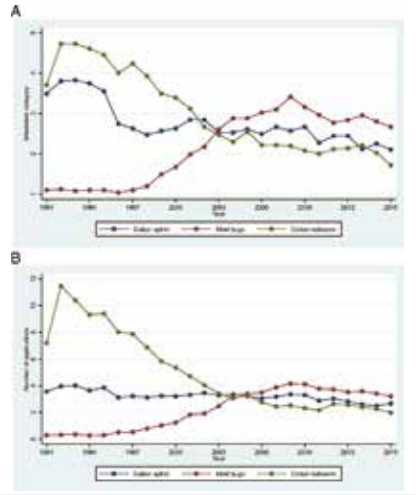
Generation and integration of multi-omics data. A, layout of the study. B, genomic distribution of mGWAS and eQTL. C, network built on correlation among metabolites, genes, and SNPs.



GENERATION OF SELF-COMPATIBLE DIPLOID POTATO BY KNOCKING OUT OF S-RNase

A team led by Prof. Huang Sanwen at the Shenzhen Agricultural Genomics Institute of CAAS published a paper titled "Generation of self-compatible diploid potato by knocking out of S-RNase" in *Nature Plants*. The research overcame the self-incompatibility of diploid potatoes by knocking out of S-RNase using the CRISPR/Cas9 system. This approach provides a new way to produce self-compatible diploid potato and is also helpful to other self-incompatibility crops. The new self-compatible diploid germplasm will accelerate the basis research and genetic improvement of potato.

Generation of self-compatible diploid potato by genome editing. A, the growth of pollen tubes in the wild type (left) and mutant (right) styles. B, the fruit-setting of wild type (left) and mutant (right) plants after self-pollination



A MULTIDECADAL AND COUNTY-LEVEL ANALYSIS ON THE EFFECTS OF LAND USE, *BT* COTTON PLANTING AND WEATHER ON COTTON PESTS IN CHINA

Prof. Lu Yanhui at the Institute of Plant Protection of CAAS and researchers from International Food Policy Research Institute published an article titled "A multidecadal and county-level analysis on the effects of land use, *Bt* cotton planting and weather on cotton pests in China" in *Proceedings of the National Academy of Sciences*. The result showed that *Bt*-based plant resistance is an effective way for integrated pest management and highlighted the potential for unexpected outcomes resulting from the agro-ecosystem feedbacks and the importance of climate. It provides important information for developing sustainable management approaches of cotton pests in China.

Cotton pest severity (A) and number of insecticide applications targeted at cotton aphids, mirid bugs, and cotton bollworm (B) across all counties in the sample, 1991-2015

Agricultural Science and Technology Achievements and Contributions

Implementing the 2030 Agenda for Sustainable Development: Action and Contribution

SUSTAINABLE DEVELOPMENT GOALS

The adoption of 2030 Agenda for Sustainable Development and the Sustainable Development Goals (SDGs) by the United Nations General Assembly in September 2015, marking a new era of sustainable development around the globe.

The establishment of sustainable agricultural and food systems is not only crucial for eradicating poverty and hunger — two overarching goals of the agenda — but has influence on targets related to environmental development, people's health and gender equality. CAAS has striven to boost science and technology innovation, tackle poverty with science and technology, and promote green development. It has combined the sustainable development goals of the new agenda with China's poverty alleviation and rural revitalization in a bid to realize the 2030 sustainable development goals earlier.

Focusing on major industrial demands and frontier agricultural sciences, CAAS has developed a new series of high-quality and high-yielding varieties like hybrid rice, transgenic insect-resistant cotton, rape and soybean. These new varieties have shown CAAS' leading position in the world in crop breeding and has made positive contributions to promoting agricultural development and food security.

Technology for high oil content pyramiding breeding in rapeseed and its application

Exploitation and application of ID-type rice male sterile cytoplasm

Soybean: Zhonghuang 13

The academy established a remote sensing and monitoring system in agriculture, which has been promoted across the globe by the Group on Earth Observations. It also established China's first flood and drought remote sensing and monitoring system featuring high precision, large scale and short time period.

CAAS developed a number of new vaccines for the prevention and control of major livestock and poultry diseases. The vaccine, for example, which works against up to the H5 subtype of the bird flu virus, now occupies a market share of more than 95 percent in China. It has played a leading role in preventing diseases like avian flu and foot-and-mouth.

Other new varieties nurtured by CAAS include Datong yak, alpine fine wool sheep and Peking duck. They have filled the world's gap in yak's variety by artificial cultivation and related breeding system and technologies; realized the production of Australian merino sheep in China's high altitude and alpine cold and arid areas; and increased the income of farmers and herdsmen.

Research and application of key technologies for the remote sensing and monitoring of staple crops remote technologies

H5 Subtype of the bird flu virus

Inactivated vaccine for foot-and-mouth disease

Breeding technology and new breeds of Datong Yak

12 Responsible consumption and production

The China Agricultural Green Development Report 2018 released by CAAS shows that the comprehensive level of China's green development in agriculture has largely improved. The country has formed a batch of reproducible green agricultural development models and set a landmark of sustainability in the sector across the world.

CAAS continued to advance the 16 research and demonstration programs for more efficient production of crops such as rice, corn and rape. It has played a positive and effective role in optimizing the spatial distribution of agricultural production, restoration of agricultural resources, improving the environment of planting areas and the human living environment, promoting the construction of ecosystems and exploring green development models.

The academy led a national water research and demonstration program to prevent and control agricultural non-point source pollution in Erhai Lake funded by the National Water Pollution Control and Treatment Science and Technology Major Project. It put forward strategies to tackle non-point source pollution in the agricultural industry, and achieved a remarkable result under the guidance of "pollution control - green development - win-win cooperation" principles.

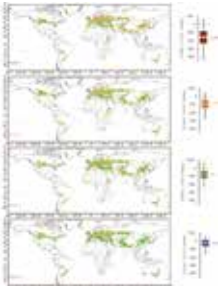
By testing the new findings in Erhai Lake, CAAS reduced agricultural non-point source pollution by 45 percent, improved the water quality of the demonstration area and developed a group of new industries including the use of edible fungus from agricultural waste. Economic benefits of the demonstration area increased by more than 20 percent, a good practice of the concept of "lucid waters and lush mountains are invaluable assets".

CAAS has always highlight climate change and its impact on grain crops and the supply of consumption goods. As the technical support unit of China on international climate change negotiations in agriculture, CAAS submitted position papers to the UN Framework Convention on Climate Change and other related international negotiations on issues including climate change adaptation and emission reduction in agriculture.

The academy also submitted negotiation documents and technique reports on dealing with climate change in agriculture to the Chinese government. This made great contributions in building a low-carbon development path for China's agriculture, safeguarding the rights and interests of the national development, and increasing the country's power in international negotiations of climate change in agriculture.

CAAS took part in the assessment and review of greenhouse gas emissions and the climate change mitigation program, in a bid to help the Intergovernmental Panel on Climate Change to complete a related report and to enhance China's international influence in agriculture.

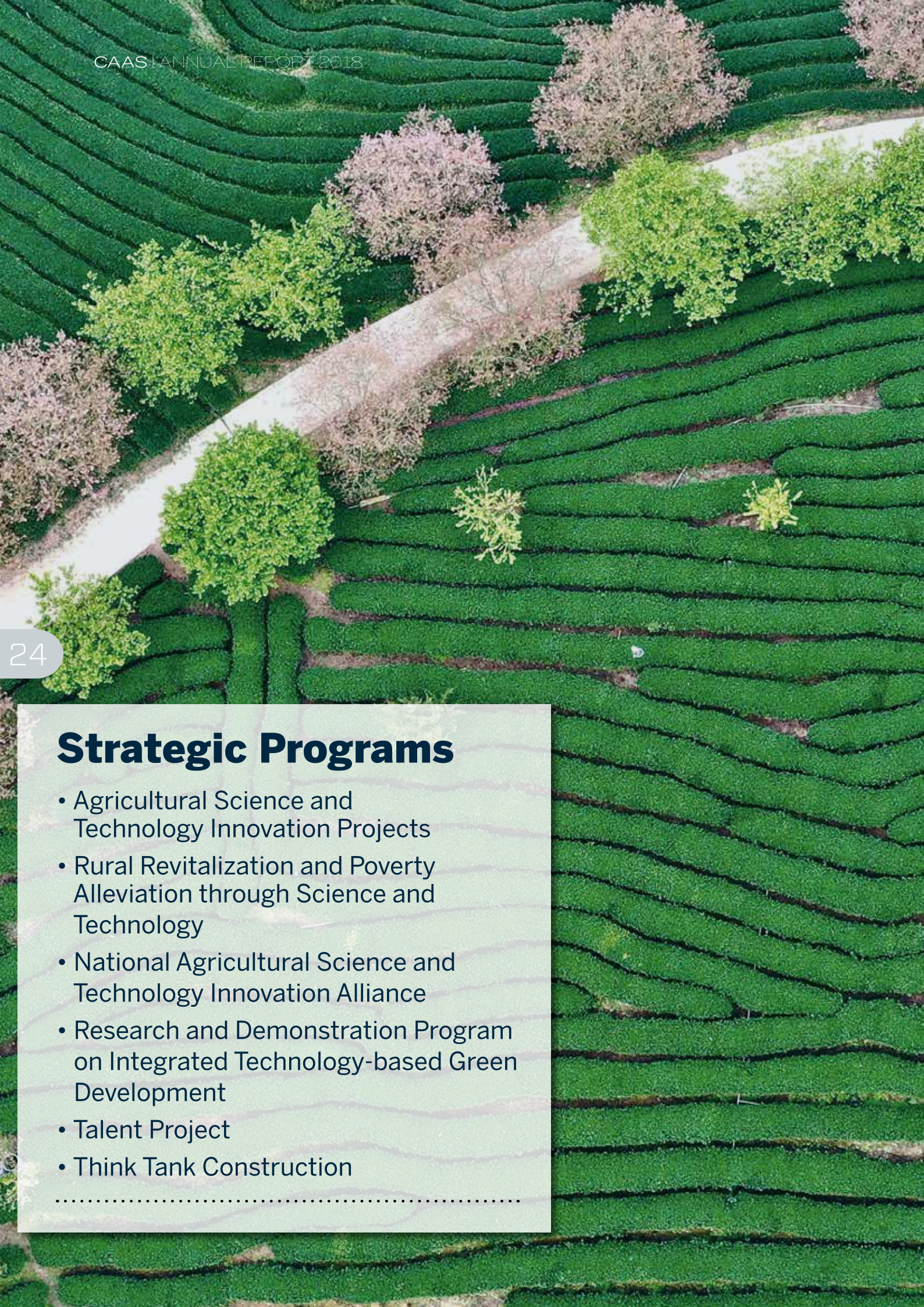
In 2018, CAAS' climate change team assessed, for the first time, the impact of climate change on global wheat production and the supply of beer. The report was published online as the cover story on *Nature Plants*. It was among the list of 100 papers attracting the most attention from the world's media in 2018.



CAAS has applied the Belt and Road Initiative and offered assistance to developing countries under the South-South cooperation framework. It has contributed much to supporting scientific and technological progress in developing countries' agriculture and rural areas, improving local people's livelihoods and ensuring regional food security.

As for bilateral cooperation, CAAS has established sound dialogue mechanism in agricultural science and technology and set up international cooperation platforms. High-level visits, signing of agreements, project cooperation, personnel exchanges and capability building are more frequent. So far, CAAS has signed strategic cooperative agreements with nearly 30 scientific research institutes and universities in countries and regions along the "Belt and Road".

For multilateral cooperation, CAAS has held a series of agricultural science and technology cooperation forums, to discuss innovation and development of modern agriculture under the Belt and Road Initiative, learn from each other and explore new modes of cooperation.



Strategic Programs

- Agricultural Science and Technology Innovation Projects
- Rural Revitalization and Poverty Alleviation through Science and Technology
- National Agricultural Science and Technology Innovation Alliance
- Research and Demonstration Program on Integrated Technology-based Green Development
- Talent Project
- Think Tank Construction

Agricultural Science and Technology Innovation Projects

Agricultural Science and Technology Innovation Project (2013-2025) divides into three phrases:

Pilot period (2013-2015)

Comprehensively carrying forward period (2016-2020)

Leapfrog development period (2021-2025)

CAAS has carried out a systematic examination for the first five-year program of Agricultural Science and Technology Innovation Project (ASTIP), and promoted the mid-term evaluation and assessment of collaborative innovation tasks, in a bid to further implement the spirit of the 19th National Congress of the Communist Party of China and the important instructions in President Xi Jinping's congratulatory letter for the 60th anniversary of the founding of CAAS.

It also aimed to sum up the experience and results of innovation projects, lead its development focusing more on "following the latest trends of international agricultural science, meeting the country's strategic demands and catering to the development of modern culture in China", and speed up developing world-leading disciplines and scientific institutes.

CAAS made evaluation plans and cleared the content, procedures and methods. Ten leaders of the academy each led a team and spent more than three months finishing the examination and assessment of 33 research institutes, 331 scientific research teams and 19 collaborative innovation tasks, together with more than 120 agricultural and management experts from outside of CAAS.

Expert assessments and the analysis of quantitative data showed that, along with the implementation of innovation projects, CAAS had a clearer development orientation, enhanced innovation capacity and increased innovation efficiency, with innovation results springing up continuously and its status and role as a front-runner of reform, an innovative national institute and a think tank becoming more prominent.

High-speed development and improved quality

Significant achievements are springing up

- CAAS has won 33 national awards in the agricultural science and technology innovation sector, accounting for about 20 percent of its total agricultural awards.
- CAAS won eight national awards in 2018, reaching its highest level since the reform of the National Awards in 2000.

Scientific papers are improved in both quantity and quality

- CAAS has published a total of 25,690 scientific papers, including 10,042 in SCI/EI journals.
- CAAS has published 12 papers in *Science, Nature* and *Cell journals*, making it a leader in China in the sector.

The number of new varieties and patents has significantly increased

- CAAS has approved 638 new crop varieties
- CAAS has gained 234 new agricultural plant varieties rights
- CAAS has developed 94 new pesticides, fertilizers and veterinary drugs
- CAAS has been granted 2,931 invention patents
- CAAS has 36 patents that won the China Patent Award, accounting for 68 percent of China's total in agricultural sector. The number of patents in biotechnology and pharmaceutical fields ranked first in the world.

CAAS has made commendable progress in various business and industry sectors in the past five years since implementing an agricultural science and technology innovation project plan.

CAAS made a breakthrough in system innovation and witnessed huge improvement in scientific innovation capacity and influence.

- It has discovered 10 major advanced scientific theories
- It has made 10 core technological breakthroughs to meet China's significant demand
- It has innovated 10 important products for rural areas
- It has accelerated the development of 10 projects in line with the future trends

Performance of the plan's comprehensive carrying forward period (2016-2020)

- **36 percent** of the quantitative index has been finished or over-fulfilled
- **89 percent** of the performance indicators have been completed or exceeded the schedule
- As of 2020, all targets are expected to be over-fulfilled

Rural Revitalization and Poverty Alleviation through Science and Technology

Activities of rural revitalization and sci-tech poverty alleviation were off to a good start. By investigating and surveying several highlighted regions, CAAS has chosen 38 counties including Lankao in Henan province and Wuyuan in Jiangxi province as the demonstration of Rural Revitalization and Sci-tech Poverty Alleviation.

The academy launched construction in four demonstration counties - Donghai in Jiangsu province, Lankao in Henan province, Wuyuan in Jiangxi province and Qionglai in Sichuan province. Focusing on a key target of prospering local industries, CAAS organized academies of agricultural sciences from involved provinces and cities to participate in the construction, carried out demonstration of key integrated technologies in agricultural and rural modernization, ecological circulation and rural energy resources, and promoted sci-tech development modes across the county.

CAAS promoted the research and demonstration program on integrated technology-based green development for more efficient production. As a result, expenditure in the farming sector was lowered by 6,720 yuan ($976) per hectare on average via cost saving and increased efficiency. The average expenditure reduced in the animal breeding sector was up to 32 percent.

The academy has sent more than 60 cadres to work in poverty-stricken counties for poverty alleviation and dispatched more than 3,300 experts to provide science and technology services in poor areas. They have made positive contributions to helping the poor steadily increase their incomes and to wining the battle against poverty, by carrying out sci-tech projects and promoting industrial development.

CAAS promoted targeted poverty alleviation through science and technology in an all-around way and launched more than 150 science and technology projects of different types. It developed sci-tech poverty alleviation modes of Ankang, a city in Shaanxi, and Fuping, a county in Hebei.

In Xinjiang Uygur autonomous region and the Tibet autonomous region, CAAS conducted science innovation and technology results commercialization projects in fields of cotton, corn, vegetables, fruit trees and agricultural information, making new achievements. It organized training courses to attract more than 55,000 visits from agricultural technicians, farmers and herdsmen, and promoted 36 new varieties and more than 50 new technologies.

CAAS teased out major problems in regional development and tackled key technical problems such as citrus greening disease, rotational tillage in winter, the improvement of quality and production efficiency of sheep industry, and comprehensive treatment and utilization of pig manure, , through which CAAS promoted the regional development.

National Agricultural Science and Technology Innovation Alliance

In 2018, the National Agricultural Science and Technology Innovation Alliance continued to focus on agricultural supply-side structural reform, the improvement of product quality and production efficiency in agriculture, and green development. It organized more than 1,000 units and collected funds of 1.88 billion yuan ($273.54 million) to carry out 463 collaborative innovation tasks covering technological integration, project demonstration, application, promotion, technical service and consultation.

They also innovated 974 sets of integrated technologies, held 955 meetings and built collaborative platforms and mechanisms featuring the close combination of industry, research and commercial application, and a close link among the upstream, midstream and downstream of industries.

The alliance made new breakthroughs in science and technology innovation, new highlights in operating mechanisms and new achievements in leading industrial development. Its 20 model innovation alliances set up 117 demonstration centers and organized training courses that attracted more than 4,000 visits. Innovation alliances of dairy, cotton and high-quality bee products established their own industrial standards and labels, in exploring the "alliance mode" for high-quality agricultural development.

Making a key layout centering on rural revitalization, promoting quality-oriented and green development-oriented agriculture

The alliance carried out technical research and projects of demonstration, promotion and application in the improvement of rice quality and production efficiency, high-quality cotton, high-quality dairy products and smart agriculture, to promote the shift from yield-oriented agriculture to quality-oriented agriculture.

It conducted collaborative research on major regional tasks including the cyclic use of livestock and poultry waste and the utilization of straws, in a bid to provide comprehensive solutions for a batch of important regional and eco-environmental problems, and to promote comprehensive treatment on prominent eco-environmental issues in agriculture and rural areas.

Also, industrial alliances were set up in industries of special economic animals, yaks, high-quality bee products, irrigation agriculture and rural environmental management, to boost the development of the national agricultural alliance.

Actively exploring collaborative mechanisms, forming special operation mode of the national alliance

The national agricultural alliance has developed several operation modes featuring substantiation, integration, co-construction and sharing.

Alliances of rice commercial molecu-

lar breeding, agricultural waste and fishing equipment implemented the substantiation operation mode, which stimulated the enthusiasm of scientific researchers in serving industries. Alliances of dairy, cotton and sea fishery implemented the integration operation mode, which exerted their advantages of multi-discipline and coordinated operation. Alliances of agricultural big data and crop germplasm resources formed an operation mode of co-construction and sharing, which continuously strengthened the integration of resources against the backdrop of sharing economy.

Promoting basic and long-term agricultural science and technology work, completing construction of data platforms in agricultural sciences

The national agricultural alliance issued the first batch of 36 pilot experimental stations, established and used a working data collection and delivering system that is in line with the characteristics of multi-discipline and various types of data. It provided training to observers and monitoring staff, offering a guarantee for systematic and normative management.

Research and Demonstration Program on Integrated Technology-based Green Development

CAAS continued to advance the existing 16 research and demonstration programs for more efficient production of products such as rice, corn and rape. It integrated 184 advanced and applicable technologies from home and abroad, and formed 53 sets of comprehensive technology modes for different ecological conditions.

It also set up 160 demonstration bases in 27 provinces, cities and districts, covering an area of nearly 30,000 hectares. The bases also influenced the production on 1.93 million hectares of land, with a total of more than 27 million livestock and poultry for demonstration. They have achieved good results in increasing production, improving efficiency and promoting green ecology. In the farming sector, output increased by an average of 26 percent, the consumption of water, fertilizers and pesticides reduced by 38 percent, 22 percent and 35 percent respectively, and expenditure was lowered by 6,720 yuan ($976) per hectare on average via cost saving and increased efficiency. The average expenditure reduced in the animal breeding sector was up to 32 percent.

Due to its meat duck research and demonstration program, CAAS has bred a new variety of lean-fleshed Peking duck - Zhongxu grassland white feather duck - and got the national approval for new breeds of livestock and poultry. The new duck variety has broken the monopoly of foreign lean-fleshed meat ducks in Chinese markets and was reported by many national and local media including Xinhua News Agency and People's Daily. Their reports received positive feedback from the public.

The 16 programs helped CAAS to further improve its collaborative research networks, with 26 institutes, 56 teams and 503 scientists and technicians from CAAS taking part in the research. The programs also attracted participation from 260 units and 2,800 individuals from outside the academy.

CAAS has organized 44 demonstrations in various forms with different scale and 189 technical training courses, attracting more than 16,000 visits from experts, agricultural technology extension workers and large farming and breeding households.

Talent Project

Young Talent Project Plan (2017-2030)

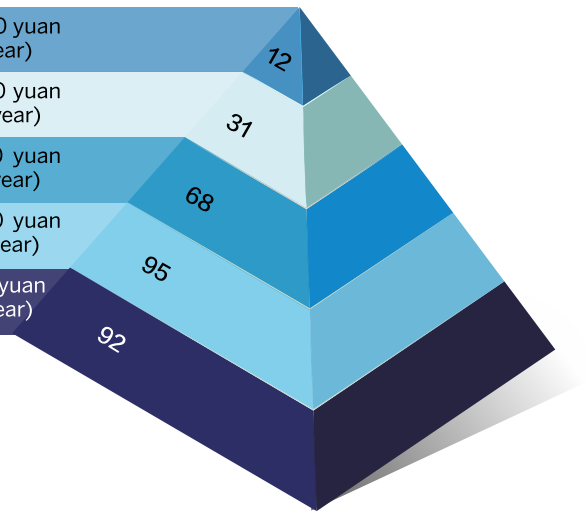
The "Young Talent Project Plan" (2017-2030) is an important, forward-thinking project that CAAS initiated in 2017 to strengthen its core competitiveness and realize leapfrog development. CAAS will construct an all-round talent system and build an innovative, transformative and supportive talent team 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 build a young talent team featuring full-function and optimized structure with capacity of innovation, transformation and support. The team will be 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.

Special support policies for outstanding agricultural talents

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 ($294,854) (per person a year), and they receive an annual subsidy of 500,000 yuan ($73,713) (per person a year).

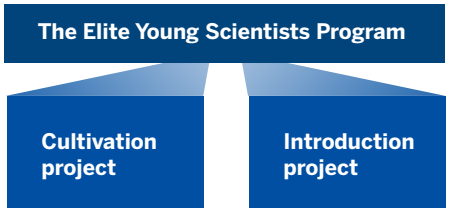
Top talents	Research funds :2 million yuan ($294,854) (per person a year)	Annual subsidy : 500,000 yuan ($73,713) (per person a year)
Leading talents in Class A	Research funds : 1.5 million yuan ($221,141) (per person a year)	Annual subsidy : 300,000 yuan ($44,228) (per person a year)
Leading talents in Class B	Research funds :1 million yuan ($147,427) (per person a year)	Annual subsidy: 250,000 yuan ($36,856) (per person a year)
Leading talents in Class C	Research funds : 800,000 yuan ($117,941) (per person a year)	Annual subsidy: 200,000 yuan ($29,485) (per person a year)
Young talents	Research funds :600,000 yuan ($88,456) (per person a year)	Annual subsidy :100,000 yuan ($14,742) (per person a year)



The research funds for leading talents in Class A are 1.5 million yuan ($221,141) (per person a year), and their annual subsidy is 300,000 yuan ($44,228) (per person a year). The research funds for leading talents in Class B are 1 million yuan ($147,427) (per person a year), and their annual subsidy is 250,000 yuan ($36,856) (per person a year). The research funds for leading talents in Class C are 800,000 yuan ($117,941) (per person a year), and their annual subsidy is 200,000 yuan ($29,485) (per person a year). The research funds for the young talents are 600,000 yuan ($88,456) (per person a year), and their annual subsidy is 100,000 yuan ($14,742) (per person a year).
By the end of 2018, CAAS had 298 outstanding agricultural talents, including 12 top talents, 194 leading talents and 92 young talents, making its talent pool bigger and stronger.

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 meet the new development requirements, 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 2018, 14 young talents were introduced at the academy-level through the introduction project, and 22 people were introduced at the institute-level through the introduction project.

Introduction of High-level Talents with Flexible Policies

In 2018, CAAS issued Interim Measures for the Management of High-level Talents Introduction with Flexible Policies, providing support to such talents in terms of staffing, project application and research condition. It aims to further widen the talent introduction channels and implement more positive, open and effective talent introduction policies, so as to attract and gather more high-level Chinese and foreign agricultural elites to serve the development of modern agriculture. Last year, CAAS introduced 115 high-level talents enjoying flexible policies.

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, agricultural resources and environment, biology, horticulture, agrostology and agricultural engineering. In total, 1,607 post-doctoral researchers have been enrolled, including 135 Chinese graduating from foreign universities and 56 foreigners. In 2018, CAAS enrolled 140 post-doctoral researchers, and there are currently 495 post-doctoral researchers in the centers for post-doctoral studies of CAAS, including eight foreigners.

Think Tank Construction

Establishing a regular mechanism for strategic studies; Creating a high-end agricultural science and technology think tank brand; Accelerating the construction of the agricultural science and technology think tank

To improve CAAS' capacity in supporting decision-making as a national agricultural think tank and develop a stable strategic research team, the academy has carried out strategic research projects centering on the major agricultural and rural development problems and key mechanisms of innovation for building of world-class academic disciplines and scientific research institutes.

CAAS has also formed a regular mechanism to release and promote achievements of agriculture and the strategic research of science and technology development. It developed a group of systemic, leading, policy-oriented, forward-looking and open agricultural strategic research achievement, which provided decision-making references to CAAS' building of world-class disciplines and scientific institutes and to the implementation of the rural revitalization strategy.

Hosting the 2018 China Agricultural and Rural Science and Technology Development Summit

CAAS and its partners jointly held the first China Agricultural and Rural Science and Technology Development Summit on Sept 20 in Beijing. Several reports including the *China Agricultural and Rural Science and Technology Development Report (2012-2017)*; the *2017 Leading Studies on Global Agriculture*; the *2017 Major Advances in China Agricultural Science*; the *2017 New Technologies, Products and Equipment in China's Agriculture and Rural Areas*; and the *Analysis on the Competitiveness of Global Scientific Papers and Patents(2017)* were released.

The summit reviewed China's agricultural and rural science and technology progress and achievements in the past five years; analyzed China's new agricultural tasks and challenges under a new situation and in the new era; proposed the development strategy and focuses of China's agricultural and rural science and technology in the new era; and also created a high-end platform for issuing the agricultural science and technology results and for facilitating dialogue and communication in the sector.

The event was of great significance to further reaching consensus, implementing the innovation-driven development and rural revitalization strategies, and promoting green agriculture and high-quality development.

2018 China Agricultural and Rural Science and Technology Development Summit

Releasing the *China Agricultural Industrial Development Report* for the first time

CAAS and the International Food Policy Research Institute released the *China Agricultural Industrial Development Report* and the *2018 Global Food Policy Report* on June 26 in Beijing. The reports assessed the impact of agricultural policy changes and external shocks on China's agricultural development. They also focused on analyzing the development trends of 17 agricultural products in 2020 and 2035, and had in-depth discussions on China's major agricultural development progress. The world's food and nutrition security, and future opportunities and challenges in the sector were also discussed.

The *China Agricultural Industrial Development Report*, unveiled for the first time by CAAS, is a positive attempt to research China's agricultural industry. Serving as an important result of the China agricultural development prediction system, the report will play a key role in pushing the implementation of the rural revitalization strategy and in deepening agricultural supply-side structural reform.

Hosting the 2018 China Agricultural Outlook Conference

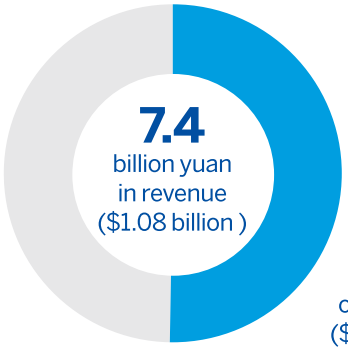
The Agricultural Information Institute of CAAS organized the 2018 China Agricultural Outlook Conference on April 20, during which the *China Agricultural Outlook Report (2018-2027)* was released. The conference forecasted the market supply and demand trends of China's main agricultural products for the next 10 years, announced the trends of 18 crops/product in the next decade, and had high-level expert seminars on topics like rural revitalization, international trade and agricultural big data, monitoring and early-warning.

Since 2014, China has held the conference annually and released an outlook report for the next 10 years, which have become an major reference for Chinese and overseas market entities and related units to adjust their market expectations on agricultural products.

Support Capability

- Annual Budget
- Staff
- Domestic Cooperation
- International Cooperation
- Regional Strategic Development
- Research Facilities
- Field Stations
- Intellectual Property Achievements
- Graduate Education

Annual Budget



3.8
billion yuan
of state funding
($552.46 million)

The academy last year initiated 16 new infrastructure projects with government grants exceeding 350 million yuan ($51.63 million) and completed State-funded projects worth 221 million yuan ($32.59 million). The amount of unused and carry-over funds reached 259 million yuan ($38.21 million).

It also finished acceptance of 21 projects, built scientific research and supporting facilities that covered an area of 52,000 square meters, and added about 186 hectares of land for scientific research.

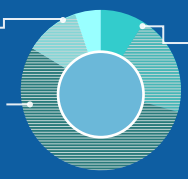
Staff

CAAS had 10,821 members of staff by the end of 2018 - 6,920 permanent employees and 3,901 contract workers.

Among 6,920 permanent employees:

875 technicians and logistics workers, **12.64%**

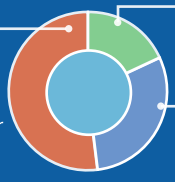
5,921 researchers (including **1,453** people who also hold managerial posts), **85.56%**



1,577 managerial staff, **22.79%**

5,921 researchers

3,071 hold research assistant title or below, accounting for **51.87%**



Of all the researchers at CAAS, **1,083** are professors, accounting for **18.29%**

1,767 are associate professors, accounting for **29.84%**

Postgraduate Degrees holders 75.83%

Researchers Doctorate Degrees Holders **2,824**

Researchers Master's Degrees Holders **1,666**

Managerial Staff
(Postgraduate degree holders 58.97 %)

Doctorates Degrees: **521**

Master's Degrees: **409**

683 managerial staff members are 45 years old or younger, accounting for **43.31%**

Technicians and Logistics Workers

Special Government Allowances from the State Council: **3**

First-class Technical Posts: **15**

Second-class Technical Posts: **187**

Academicians of the Chinese Academy of Sciences and the Chinese Academy of Engineering — **13** people

National Ten Thousand Talents Program — **52** people

National Young and Middle-aged Expert with Outstanding Contributions to China — **29** ppeople

Special Government Allowances from the State Council — **134** people

National Hundred, Thousand and Ten Thousand Talents Program — **66** people

Innovative Talents Growth Program initiated by the Ministry of Science and Technology — **43** people

Innovation teams in key areas — **10** teams

China Agricultural Elite Award presented by the Ministry of Agriculture and Rural Affairs — **14** people

Outstanding Talents for Agricultural Scientific Research. — **82** people

Domestic Cooperation

Focusing on modern agriculture, CAAS has enhanced its cooperation with local governments and figured out their major technical requirements for regional development. It has signed strategic cooperative agreements with provinces of Shandong, Gansu and Heilongjiang, and with 8 cities including Ningbo in Zhejiang province and Hulunbuir in Inner Mongolia autonomous region, to carry out in-depth cooperation.

CAAS has set up more than 10 rape demonstration sites and conducted technology research on returning straw to the field and reducing the use of fertilizers and pesticides in Hubei, Henan and Shaanxi provinces.

The academy has also promoted new poultry varieties and supported breeding techniques in Shandong, Guangxi Zhuang autonomous region and Ningxia Hui autonomous region, involving 130 million chickens and ducks. The move has created economic and social benefits in those areas.

International Cooperation

In 2018, CAAS positively implemented the Belt and Road Initiative, achieved good results in international cooperation and significantly enhanced its international reputation and influence.

Serving national diplomacy, telling good stories about Chinese agricultural science and technology

CAAS received 6 heads of states: British Prime Minister Theresa May; Kim Jong-un, Chairman of the Workers' Party of Korea and Chairman of the State Affairs Commission of the DPRK; Kyrgyz President Sooronbay Jeenbekov; Malaysian Prime Minister Mahathir Mohamad; Somali President Mohamed Abdullahi Mohamed; and President Salvador Sanchez Ceren of El Salvador.

It also received 2 country-level officials and more than 30 ministerial-level officials from different countries, making positive contributions to China's diplomacy.

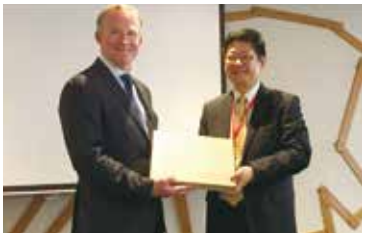
Expanding bilateral and multilateral cooperation mechanisms, building a global cooperation system for science and technology innovation

CAAS signed and renewed 16 cooperative agreements and memorandums, organized more than 30 important international academic conferences and created 25 new international cooperation platforms based on the ongoing 134 ones. These initiatives gave a big boost to expanding channels and improving the level of CAAS' international cooperation.

The academy cooperates with countries leading agricultural science and technology. It hosted the first China-Australia Sustainable Agricultural Technology Forum and the first China-France Agricultural Scientists Summit. It also established a regular bilateral top scientists' meeting between China, France, the United Kingdom, Norway, Germany and the United States.

CAAS increased agricultural science and technology cooperation with countries and regions involved in the Belt and Road Initiative. It has promoted in-depth cooperation with countries in Southeast Asia, South Asia and Central Asia

in rice, cotton, plant protection, animal epidemics prevention and control, and personnel training. It also enhanced science and technology cooperation with Latin American countries in soybean and biotechnology, and put forward the China-Africa Agricultural Research Institutes 10+10 Cooperation Mechanism.



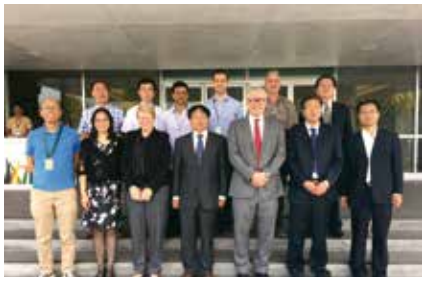
Playing leading roles, strengthening joint collaborative innovation mechanisms at home and abroad

CAAS took part in agricultural science and technology cooperation in the context of multilateral mechanisms such as CGIAR, G20 and APEC. It played a leading and coordinating role in the global arena. The academy led the work of the China-Europe Food Agricultural and Biotechnology Task Force, co-sponsored consultations among CABI member states of the Asia-Pacific region, and supported construction of the Belt and Road agricultural science and technology. CAAS also held seminars on international agricultural big science plans, becoming a role model in initiating and exploring international big science projects.

Pushing forward the "going global" of agricultural science and technology, sharing China's achievements and experience in the sector

CAAS initiated the innovation task of international cooperation. It did this by promoting collaborative innovation and integrated demonstration research for agricultural science and technology to go global. It took the lead in establishing a national alliance on the "going global" of agricultural science and technology, to gather multiple resources and make integrated "going global" efforts.

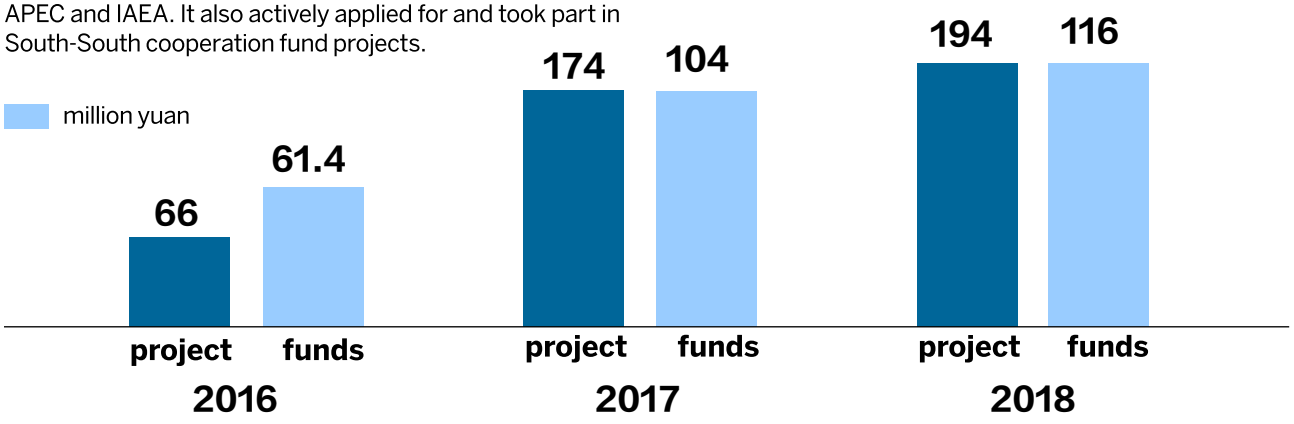
The CAAS Center for International Agricultural Research positively promoted the application of overseas agricultural information and data mining. The center monitored 19 key varieties, completed national study reports of 65 countries, provided training to more than 110 foreign agricultural talents, served more than 40 "going-global" companies with overseas agricultural information services and promoted the construction of a high-level overseas agricultural think tank.



Promoting organization and management of key international cooperation projects, helping enhance the innovation capability of agricultural science and technology

CAAS hosted and participated in bilateral and multilateral international cooperation projects. These were initiated by the Ministry of Science and Technology of China, the Ministry of Agriculture and Rural Affairs of China, National Natural Science Foundation of China, the European Union, APEC and IAEA. It also actively applied for and took part in South-South cooperation fund projects.

In 2018, CAAS' institutes participated in 252 international cooperation projects, with total funds reaching 259 million yuan ($37.68 million), of which 194 were newly added projects and total funds reached 116 million yuan ($16.88 million).



Enhancing talent training, strengthening the construction of international talent pool

In 2018, CAAS applied for a series of State-funded academic exchange programs for senior researchers, visiting scholars and post-doctors. 45 people were approved. It also had 40 postgraduates approved for a State-funded exchange project and one doctoral supervisor for short-term overseas exchange project.

CAAS was approved to introduce foreign experts under the National Thousand Talents Plan applied by its Biotechnology Research Institute. It was the first unit in the system of the Ministry of Agriculture and Rural Affairs to conduct such a project. In 2018, the academy introduced four projects of overseas technology and management talents and conducted two demonstration and promotion projects. The academy also hosted 34 foreign-aid training classes, offering special technical training to 1,778 students from 47 countries.

Regional Strategic Development

National (Chengdu) Agricultural Science and Technology Center

The National (Chengdu) Agricultural Science and Technology Center, which focuses on China's modern agricultural sector, was built to create a "Silicon Valley" of agricultural science and technology with global influence and a national demonstration base for modern agriculture. It also aims to solve the basic, directional, general and key issues that restricts the sustainable development of agriculture and rural areas in Southwest China and the whole country.

The first phase of the center includes laboratories covering an area of 100,000 square meters and 200 hectares of land designated for experimental planting, with a total investment of 292 million yuan ($43.12 million). It started to be constructed in June 2018 and is due to be operational in December 2019.

Western China Agricultural Research Center

The Western China Agricultural Research Center serves as a new agricultural science and technology innovation and service platform. It is based in the Xinjiang Uygur autonomous region and provides services to West China and Central Asia. In 2018, it gained periodical success in science and technology service and infrastructural construction to support agricultural development and rural revitalization of the Xinjiang Uygur autonomous region.

Last year, the center received 28 innovation teams from 15 CAAS institutes to carry out scientific research tasks. More than 20 crops, including corn, cotton and rape, were involved in the experimental planting, with a total growing area of about 33 hectares. Construction of the center's comprehensive service outlet, which the project bid opened in December 2018, is expected to kick off in April 2019.

North China Rice Research Center

The North China Rice Research Center is a major construction project approved by the National Development and Reform Commission. It aims to support the construction of Northeast China as the country's big breadbasket, with a gross floor area of 7,028 square meters and a total investment of 88.94 million yuan ($13.13 million). Construction of the center will start in 2019.

Research Facilities

Major Science and Technology Facilities
CAAS has 2 major national key scientific facilities; 1 national high-level biosafety laboratory for prevention and control of epidemics of animal diseases, 6 state key laboratories, 1 state key laboratory jointly built with provincial governments, 22 comprehensive key laboratories under the Ministry of Agriculture and Rural Affairs, 40 special key laboratories under the Ministry of Agriculture and Rural Affairs, 30 agro-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 has 5 national engineering technology research centers, 5 national engineering laboratories, 2 national engineering research centers, 22 national centers (sub-centers) for the improvement of varieties, 18 national agricultural industry technology research and development centers, and 32 academy-level engineering technology research centers.

Major supporting platforms
CAAS has 4 national science and technology foundation platforms, 12 national quality crop seed resource banks, 13 national nurseries for quality crop seed resources. The academy boasts 500,000 accessions of crop germplasm resources under long-term preservation, which ranks second in the world. It also has 5 national field stations for scientific observation and experiment, 3 national product quality supervision and inspection centers, 32 ministerial-level quality supervision and inspection test centers, 5 national agricultural testing reference laboratories, 7 national reference and professional laboratories, 2 FAO reference centers and 7 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 118 field stations in 27 provinces, municipalities and autonomous regions except for Chongqing, Guizhou, Shaanxi and Ningxia. The stations cover a total area of 6,793 hectares, including 2,940 hectares of land owned by CAAS and 310 hectares of land used for construction. A total of 1,304 staff members work at the field stations, of whom 554 work full time and part time, and 580 have signed long-term employment contracts.

In 2018, CAAS spent 243 million yuan ($35.87 million) and launched 46 projects for the construction, maintenance and purchase at the field stations. The area of newly added buildings reached 53,300 square meters. The academy also improved 249 hectares of experimental fields and purchased 88 pieces of agricultural implements, 157 sets of instruments and equipment. It carried out 1,702 scientific research projects with a total expenditure of 559 million yuan ($82.51 million).

The academy held 712 on-the-spot meetings and demonstrations and 508 opening days in its field stations, attracting 68,000 visits in total. It also organized 682 training classes, which attracted 54,000 visits from farmers and agricultural technicians. It promoted 529 new varieties and planted them in an area of 5.18 million hectares. It promoted 163 new agricultural techniques and adopted them on 4.44 million hectares of land and applied them to 116,000 livestock and poultry. It also promoted 66 new products which were planted on 3.55 million hectares of land.

Intellectual Property Achievements

In 2018, CAAS had 53 patents that won the China Patent Award (3 gold medals, 1 silver medal and 49 excellent prizes). It promoted the use of cloud patent management platform software and Innography, a patent and information analysis software, among its affiliated institutes, in a bid to increase the patent analysis capacity and work efficiency of frontline researchers. The academy also launched six circuit training activities themed on "Intellectual Property Serves Frontline Scientific Research". It designed an elective course of agricultural intellectual property introduction and practice for CAAS Graduate School, and provided patent agent, analysis and layout services to six institutes including the Institute of Crop Sciences, the Biotechnology Research Institute and the Oil Cops Research Institute, to further improved the IP management capacity of CAAS.

The 2018 Oil Cops Research Institute Intellectual Property Training Class

INTELLECTUAL PROPERTY ACHIEVEMENTS

53 CHINA PATENT AWARD

3 GOLD MEDALS

1 SILVER MEDAL

49 EXCELLENT PRIZES

Graduate Education

In 2018, the Graduate School of the Chinese Academy of Agricultural Sciences (GSCAAS) witnessed an overall improvement in the number of enrollment, quality of training and management level. New academic degrees were authorized including a first-level doctoral degree in agricultural engineering discipline, 2 first-level master's degrees in atmospheric sciences and aquaculture disciplines, a Master of Engineering degree and a Master of Library and Information Studies degree.

At present, the Graduate School has 1,984 supervisors, including 13 academicians of the Chinese Academy of Sciences and the Chinese Academy of Engineering. Of the total, 704 supervisors take charge of doctoral programs and 526 teachers work full time and part time. A total of 5,318 students are currently studying at the school - 1,883 students in doctoral programs and 3,435 in postgraduate programs.

In 2018, the Graduate School enrolled 1,713 students (569 for doctorates and 1,144 for master' s degrees), and a total of 1,095 students, which consist of 223 PhD holders and 872 master' s degree holders, graduated. The overall employment rate of the school's graduates was 97.1 percent. It also enrolled 191 international students (158 for doctorates, 27 for master's degrees and six for advanced study) last year. Of them, 108 were awarded Chinese Government Scholarships, and 61.3 percent were from countries and regions involved in the Belt and Road Initiative.

The Graduate School currently has a total of 523 international students - 470 doctorate candidates, 47 master candidates and 6 visiting students. They are studying in 41 disciplines among 31 CAAS institutes. They come from 57 countries of Asia, Africa, Europe, America and Oceania, including 19 BRI countries and regions. The number of international students from the BRI countries and regions accounts for 71.5 percent of the total.

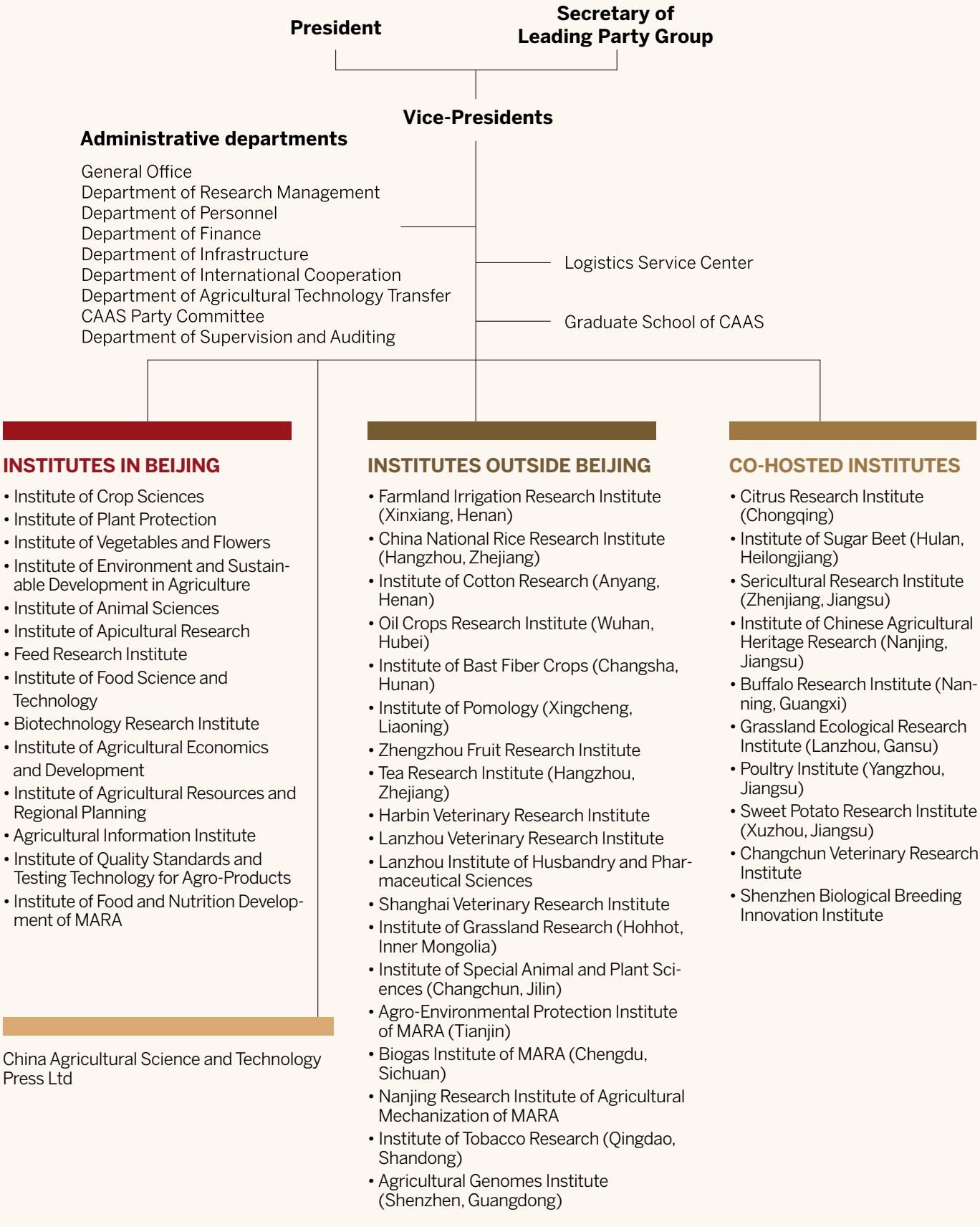
In 2018, 43 international students (36 PhD holders and 7 master' s degree holders) graduated from the Graduate School, of whom an overseas doctorate candidate received Chinese Government Scholarships for Excellent Overseas Students in 2018, and a visiting student won the 2018 John Crystal Award granted by the World Food Prize Foundation. The school had 143 students registered for joint doctorate under international cooperation programs. They studied in 32 disciplines among 25 CAAS institutes.

The Graduate School last year signed cooperation agreements on doctoral education with Canada's University of Alberta and Ireland's University College Dublin. It also signed nine memorandum of understandings with several foreign universities and scientific research institutes to promote graduate education cooperation.

Appendix

- Organizational Structure of CAAS
- Key Laboratories and Centers
- Honors and Awards

Organizational Structure of CAAS



Key Laboratories and Centers

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

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

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 MARA
3	OIE Reference Laboratory for Equine Infectious Anemia	Research focused on epidemiology and immunology of Equine Infection 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 interspecies pathogen transmission, molecular mechanism of pathogenesis and immune mechanism.	Harbin Veterinary Research Institute

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

Honors and Awards

Leading Scientists listed in the National Ten Thousand Talents Program

Liu Bin, a researcher at the Institute of Crop Sciences

Li Wenxue, a researcher at the Institute of Crop Sciences

Song Fuping, a researcher at the Institute of Plant Protection

Zhou Zhongshi, a researcher at the Institute of Plant Protection

Wu Liming, a researcher at the Institute of Apicultural Research

Yao Bin, a researcher at the Feed Research Institute

Luo Huiying, a researcher at the Feed Research Institute

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

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

Xin Xiaoping, a researcher at the Institute of Agricultural Resources and Regional Planning

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

Zhou Wei, a researcher at the Institute of Agricultural Resources and Regional Planning

Hua Wei, a researcher at the Oil Crops Research Institute

Huang Fenghong, a researcher at the Oil Crops Research Institute

Li Chengjun, a researcher at the Harbin Veterinary Research Institute

Zheng Haixue, a researcher at the Lanzhou Veterinary Research Institute

Guo Huichen, a researcher at the Lanzhou Veterinary Research Institute

Li Zejun, a researcher at the Shanghai Veterinary Research Institute

Cheng Guofeng, a researcher at the Shanghai Veterinary Research Institute

Li Shengben, a researcher at the Shenzhen Agricultural Genomics Institute

Outstanding Young Scientists listed in the National Ten Thousand Talents Program

Jia Guanqing, a researcher at the Institute of Crop Sciences

Gao Li, a researcher at the Institute of Plant Protection

Cheng Feng, a researcher at the Institute of Vegetables and Flowers

Zheng Mingming, a researcher at the Oil Crops Research Institute

Winners of the China Agricultural Elite Award initiated by the Ministry of Agriculture and Rural Affairs

Wen Jie, a researcher at the Institute of Animal Sciences

Zhou Xueping, a researcher at the Institute of Plant Protection

Li Peiwu, a researcher at the Oil Crops Research Institute

Leading Young and Middle-aged Scientists in the Innovators Talent Promoting Program initiated by the Ministry of Science and Technology

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

Li Yunhe, a researcher at the Institute of Plant Protection

Gao Yulong, a researcher at the Harbin Veterinary Research Institute

Zhang Zhonghua, a researcher at the Institute of Vegetables and Flowers

Zeng Dali, a researcher at th e Rice Research Institute

Deng Qianchun, a researcher at the Oil Crops Research Institute

Chief Scientist of an Innovation Team in the Innovators Talent Promoting Program initiated by the Ministry of Science and Technology

Zhao Guiping, a researcher at the Institute of Animal Sciences

Winners of the 15th Young Science and Technology Award of China

Lin Qibing, a researcher at the Institute of Crop Sciences

Cheng Feng, a researcher at the Institute of Vegetables and Flowers

Winners of the Outstanding Youth Science Fund

Ning Yuese, a researcher at the Institute of Plant Protection

Ruan Jue, a researcher at the Shenzhen Agricultural Genomics Institute

Winner of the Prize for Scientific and Technological Progress initiated by Ho Leung Ho Lee Foundation

Huang Sanwen, a researcher at the Shenzhen Agricultural Genomics Institute

Outstanding Young Agricultural Scientists selected by the Ministry of Agriculture and Rural Affairs

Ning Yuese, a researcher at the Institute of Plant Protection

Zheng Mingming, a researcher at the Oil Crops Research Institute

Wang Kejian, a researcher at the Rice Research Institute

Zhao Shengguo, a researcher at the Institute of Animal Sciences

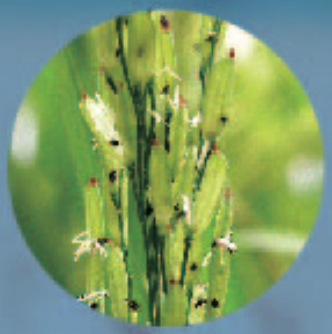
Zhu Zixiang, a researcher at the Lanzhou Veterinary Research Institute

Ruan Jue, a researcher at the Shenzhen Agricultural Genomics Institute

Zhang Ximei, a researcher at the Institute of Environment and Sustainable Development in Agriculture

CAAS ANNUAL REPORT

2018



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