CAAS ANNUAL REPORT




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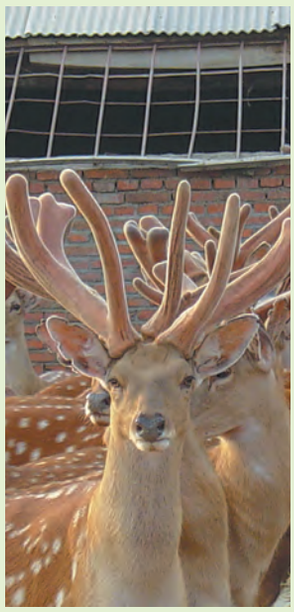


2015

2015 in numbers

1 publishing house

1 graduate school

34 subsidiary institutes

10 co-hosted institutes

7101 employees including 1598 managerial personnel, 5743 researchers, 1207 technicians and logistics workers

13 Academicians of the Chinese Academy of Sciences and the Chinese Academy of Engineering

112 new reviewed varieties, 428 registered software copyrights, 20 registration certificates for new veterinary drugs, agricultural pesticides and fertilizers. 12 patents won the National Awards for Outstanding Patents

1440 new patents including 614 invention patents

6.77 billion Chinese Yuan in annual revenue including 3.42 billion Chinese Yuan in government grant

1600 supervisors, 600 supervisors for Doctoral Programs, 550 teachers, 4415 students including 156 international students

Over 4500 papers published including 16 published in top international journals such as *Nature* and *Science*

228 S&T achievements, 143 awards including 6 national awards and 78 provincial-level awards

28 Memorandums of Understandings or agreements signed and 8 joint international cooperation platforms established with international agricultural research institutes

10 administrative departments

Message from the President

The year 2015 is a crucial year for deepening reform in China. It has witnessed the successful conclusion of China's 12th Five-Year Plan and is the scoping year for the upcoming 13th Five-Year Plan. In this important conjunction, Chinese Academy of Agricultural Sciences (CAAS) faithfully adhered to its "顶天立地" ("顶天立地" is a Chinese idiom which means to reach the heavens while keeping the feet on the ground) development strategy, and made significant progress in all-round way. Remarkable gains have been achieved in talent pool, international cooperation and infrastructure construction. Capacity in science and technology innovation, technology transfer, and research infrastructure has kept on improving. Building on the achievements in the past five years, CAAS has come up with its new targets and goals, and envisions greater excellence in the years to come.

In 2015, to fulfill the mission of national team for agricultural research, CAAS has rolled out the Agricultural Science and Technology Innovation Program (ASTIP) in a full-fledged way. It is delightful for us to harvest 228 research achievements, 6 of which were awarded by the State Council. The number of papers published in the top international journals such as *Nature* and *Science* was doubled over last year. CAAS has played a leading role in the construction of the National Agricultural Science and Technology Innovation Alliance and launched 3 collaborative innovation initiatives, namely the heavy metal pollution control in southern China, black soil protection in northeast China, water saving and grain production ensuring in north China. Nation-wide researches and demonstrations into the integrated technology-based green production modes for 9 major agricultural products have been conducted by CAAS. CAAS' role as think tank in agricultural sector has further strengthened. Our expertise and scientific inputs on major agricultural issues have been recognized by the society and have made great contribution to government policy-making. To expand the international partnerships, CAAS has signed 28 agreements and built 8 new international joint laboratories with top international research institutions. We also hosted or organized numbers of international academic conferences/workshops and undertook numerous international cooperation projects.

I would like to take this opportunity to extend my heartfelt gratitude to our peers both at home and overseas, who have always been caring and supportive to our endeavors. I sincerely welcome you to conduct exchange and cooperation with CAAS.

Jiayang Li

Professor Li Jiayang, Ph.D.
Vice-Minister of Agriculture
President of CAAS

Content

2015 Summary

In 2015, with the full-fledged implementation of Agricultural Science and Technology Innovation Program (ASTIP), CAAS has actively adjusted and optimized the disciplinary layout and built up a 3-tier subjects system to follow up the international agricultural research frontiers and meet the needs of agricultural development in China. Under this new system, former 1026 research groups were reorganized into 315 innovation research teams to better fit with the characteristics of agricultural research.

Over the past year, CAAS deliberately worked out its strategic plan for the 13th Five-Year Plan period (2016-2020). Great progress has been made in capability development in agricultural scientific innovation, technology transfer and infrastructure improvement.

Research achievements: in 2015, CAAS made 228 major S&T achievements, including 6 national awards and 78 ministerial or provincial-level awards.

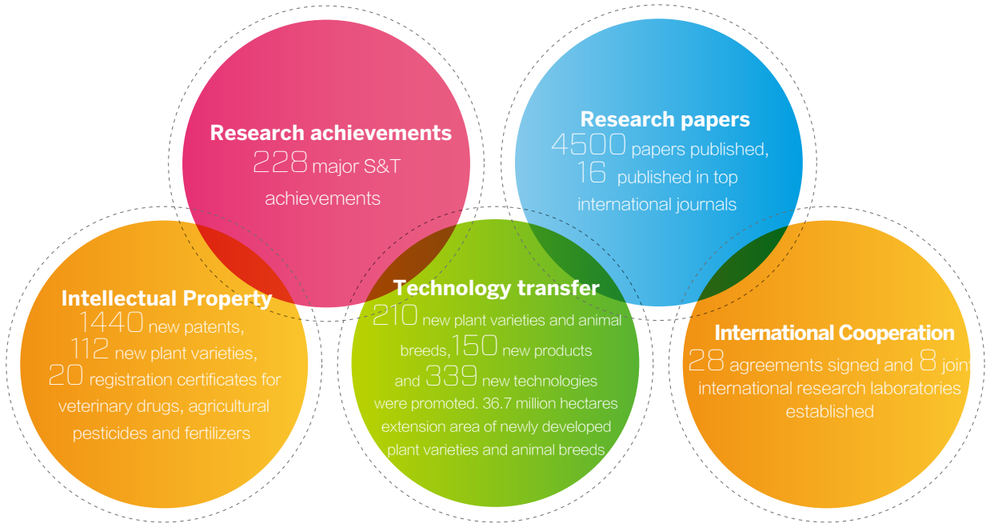
Research papers: CAAS scientists published a total of over 4500 papers as first or corresponding author in various academic journals. Among the published papers, 16 were published in top international journals such as *Nature* and *Science*, which was twice than that of last year.

International Cooperation: CAAS continued to strengthen its strategic cooperation with major international research institutions. It signed 28 agreements and established 8 joint international research laboratories to strengthen cooperation focusing on crop efficiency, plant protection, veterinary science, animal husbandry, and environmental-friendly technology development.

Intellectual Property: A total of 1440 patents were granted, and 614 of them were invention patents. 12 won the National Awards for Outstanding Patents. 112 new plant varieties were successfully released, 428 software copyrights were registered, 20 registration certifications for veterinary drugs, agricultural pesticides and fertilizers were issued.

Technology transfer: A total of 210 new plant varieties and animal breeds, 150 new products and 339 new technologies were promoted. Extension areas of newly developed plant varieties and animal breeds have reached to 36.7 million hectares and 210 million heads/birds, in which 31 new varieties/breeds and 49 new technologies were listed as the main dominant varieties/ breeds and main recommendation technologies of Ministry of Agriculture in 2015.

Major Breakthroughs in Agricultural Scientific Research



Key Events

January

• CAAS President Li Jiayang met with World Bank's Vice President Makhtar Diop, aiming to strengthen joint efforts to support Africa in crop production, animal husbandry and capacity building.

• "DNA Molecule for Expressing Hairpin RNA, the Constructing Method and the Use Thereof" a major discovery by the Biotechnology Research Institute of CAAS, was granted an invention patent by the European Patent Office.

• CAAS Annual Meeting 2015 was held during 26-27, January. CAAS President Li Jiayang delivered his keynote speech.

February

• The digital campus system and video conference system of CAAS have been successfully integrated and put into practice, which will enable remote education and video conference in CAAS.

• The Collaborative Innovation Center on Cotton Science and Technology of CAAS has been established, aiming to solve major problems in cotton industry development through an effective collaboration mechanism.

• CAAS further enhanced its efforts on intellectual property rights management by building up an integrated working system with a better interaction mechanism, and promoting the establishment of its national-level technology transfer platform.

March

• Chen Mengshan, Secretary of the Leading Party Group of CAAS, met with Christian Schmidt, Federal Minister of Food and Agriculture of Germany. Both sides exchanged opinions on the establishment of a Sino-German Agricultural Science and Technology Cooperation Platform.

• A triple live vaccine for swine transmissible gastroenteritis, porcine epidemic diarrhea and porcine rotavirus, invented by the Harbin Veterinary Research Institute of CAAS, and entered into production.

April

• Chinese Vice-Premier Liu Yandong visited CAAS and attended the Seminar on Agricultural Science and Technology Innovation.

• Institute of Cotton Research of CAAS led the research on the whole genome sequencing and mapping of *Gossypium hirsutum*, the most widely planted cotton species in the world. The research results were published in *Nature Biotechnology*.

• CAAS convened a workshop for its development strategy planning in the forthcoming 13th Five-Year Plan period.

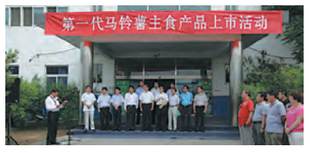
May

• CAAS President Li Jiayang was elected a 2015 Foreign Member of the Royal Society of London, UK.

• CAAS signed an agreement with the government of the Changji Hui Autonomous Prefecture and the Changji National Agricultural Sci-Tech Park of the Xinjiang Uygur Autonomous Region to jointly build the "Western Agricultural Research Center of CAAS".

June

• A new kind of steamed bun made of 30 percent potato flour, which was developed by Institute of Food Science and Technology of CAAS, came into the market in Beijing.



• The Fifth Meeting of the EU-China Task Force on Food, Agriculture and Biotechnology was held in CAAS.

• CAAS signed a cooperation agreement with the International Livestock Research Institute (ILRI) to establish a joint laboratory on the control and treatment of ruminants' diseases.

• CAAS officially issued the *Opinions on Strengthening the Basic Research in Agriculture*, further embodying the responsibility and mission of CAAS as the national driving force for agricultural science and technology innovation in China.

July

• The China National Rice Research Institute of CAAS found that copy number variant (CNV) at the GL7 locus contributes to grain size diversity and quality in rice, which is expected to help with the molecular design of grain shapes and breeding of high-yield and high-quality rice. This work has been published in *Nature Genetics*.

• The Harbin Veterinary Research Institute of CAAS found that the ER class I α-mannosidase interacts with HIV Env, initiates its degradation process, and inhibits HIV-1 Env expression in a dose-dependent manner. The discovery is expected to lead to a future cure for the disease. This work had been published in *Journal of Biological Chemistry*.

• Zhang Taolin, Vice Minister of Agriculture and Chen Mengshan, Secretary of the Leading Party Group of CAAS, jointly launched the National Service Center for Technology Transfer in Agriculture.

• CAAS held a video conference to review the progress made in implementing the Agricultural Science and Technology Innovation Program (ASTIP).

August

• The Lanzhou Veterinary Research Institute of CAAS decoded the mitochondrial (mt) genome of *Gnathostoma spinigerum*. The new data will help understand the evolution, population genetics and systematics of this medically important group of parasites. This work has been published in *Scientific Reports*.

• CAAS President Li Jiayang met with a delegation headed by Uri Ariel, Minister of Agriculture and Rural Development of Israel. Fruitful discussions were made on future collaboration in the field of water resources management and techniques of efficient utilization for agricultural resources.

• The Institute of Crop Sciences of CAAS found that the SnRK2-APC/CTE regulatory module mediates the antagonistic action of gibberellic acid and abscisic acid pathways, thus influencing the growth and development of crops such as rice. This work has been published in *Nature Communications*.

September

• The China National Rice Research Institute of CAAS, in cooperation with relative research institutions, identified and cloned *GS2*, a key gene that can significantly increase the yield of rice, from *Baodali*, a local variety of rice in Zhejiang province. This work has been published in *Molecular Plant*.

• After 23 months of research on feeding piglets with high glucose and high fat diet, scientists from the Institute of Animal Sciences of CAAS found that the shift of energy supply source from glucose to ketone body is crucial to the development of non-alcoholic steatohepatitis. This work has been published in *Scientific Reports*.

• CAAS Vice President Wu Kongming was invited to deliver a keynote Lecture on Biotechnology Development in Agriculture to the Standing Committee of the Chinese People's Political Consultative Conference.

October

• Chen Hualan, scientist from Harbin Veterinary Research Institute of CAAS, won the 2016 L'Oréal-UNESCO Awards for Women in Science. She is one of the total 5 awardees and the only awardee from the Asian and Pacific Region.

• Scientists from the Institute of Crop Sciences of CAAS discovered that VILLIN2 (VLN2) can affect cell expansion, polar auxin transport and growth of the rice by modulating microfilament dynamics. Related research results were published in *The Plant Cell*.

• The China National Rice Research Institute of CAAS developed a CRISPR-Cas9 system for multiplex genome editing. The system in theory is easy to realize infinite numbers of assembly of gRNAs. The result has been published in *Journal of Genetics and Genomics*.

November

• The Center for International Agricultural Research of CAAS was launched, which will serve as an international agricultural scientific and technological cooperation platform.

• CAAS officially issued its strategic plan on science and technology development for the 13th Five-Year Plan period.

• Institute of Vegetables and Flowers of CAAS discovered the gene *TEN* for controlling cucumber tendrils development, revealing the homologous nature of cucumber tendrils and lateral branch which had confused Charles Darwin, owner of the theory of evolution. The result has been published in *Molecular Plant*.

• The Symposium on 20 Years of Strategic Collaboration between China and CABI was successfully held in Beijing.

December

• CAAS Vice President Tang Huajun and Vice President Wan Jianmin were elected as academicians of the Chinese Academy of Engineering.

• Sino-German Soil Science and Soil Conservation Seminar was held in CAAS. CAAS and its German counterpart signed the German-Sino Agricultural Science and Technology Cooperation Platform Agreement.

• A CAAS delegation led by President Li Jiangyang visited UK, Austria and Italy, reached consensus on a number of collaborative issues with 4 international organizations including FAO, and 6 agricultural research institutes including Rothamsted Research.

New Academicians

Tang Huajun, Professor
Vice President of CAAS

Tang Huajun has been working on better utilization of agricultural land resources, spatial distribution of crops and its dynamics. He has expanded the traditional study on cropland dynamics into the crop patterns inside croplands. To effectively and efficiently monitor crop conditions at the national level, an integrated crop monitoring system has been developed under his leadership, combining remote sensing, *in situ* observation stations, and wireless sensor networks. He has also developed a series of spatial models to analyze quantitatively the process and characteristics of changes in China's major crops over the past several decades, as well as to predict the changing trends of crop patterns during the coming decade and its possible impacts on China's food security. His research achievements have provided rapid and reliable information support to important policy decisions regarding the management of crops throughout China for a decade. His achievements have won the National Science and Technology Progress Award (Second Prize) twice and the Science and Technology Progress Award (both First Prize and Second Prize) five times by the Beijing municipal government. He has published 220 academic papers and 10 books. He was elected an overseas corresponding member of the Belgian Royal Academy in 2004 and was nominated to be the member of the High Level Panel of Experts on Food Security and Nutrition, the Food and Agriculture Organization of the United Nations in 2010.
He was elected to be an academician of the Chinese Academy of Engineering in 2015.

Wan Jianmin, Professor
Vice President of CAAS

Wan Jianmin has been working for decades on the cloning of trait genes and employing of molecular approaches to the improvement of rice. He has pioneered biotechnology-based rice breeding by molecular design in China. So far, he has cloned 27 trait genes and developed 10 Ningjing varieties, of which Ningjing 1, 3 and 4 are the main recommendation rice varieties by the Ministry of Agriculture.
He has published more than 150 papers as first or corresponding author in top international journals such as *Nature, Nature Biotechnology, Nature Communications, PNAS,* and *The Plant Cell*. He is the chief scientist of the national key S&T Special Project named New Crop Variety Development with Genetic Engineering Technology. He has been listed as the distinguished professor in the Cheung Kong Scholars Program. In 2012, he won the Ho Leung Ho Lee (HLHL) Science and Technology Innovation Award and was included in the National Ten Thousand Talents Program. He received the National Excellent Scientific and Technological Workers Award in 2014. He won the 2015 National Science and Technology Progress Award (First Prize), the National Technology Invention Award (Second Prize), and awards in provincial and ministerial level (two first prizes and three second prizes).
He was elected to be an academician of the Chinese Academy of Engineering in 2015.

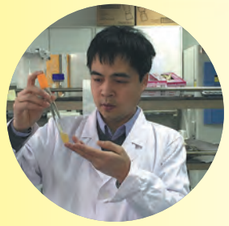
Honors and Awards

Wang Hong

Distinguished scientist of the National Thousand Talents Program
Wang Hong, member of the Agro-disaster Reduction and Prevention Research Team at the CAAS Institute of Agricultural Resources and Regional Planning, is a distinguished scientist of the National Thousand Talents Program. She has explored a new mechanism for agricultural disaster risk apportion and management, and has established a new policy framework for agricultural disaster insurance.

Zeng Zhanghua

Leading scientist of the National Thousand Young Talents Program
Zeng Zhanghua and his team at the CAAS Institute of Environment and Sustainable Development in Agriculture have conducted research into multi-functional nanomaterials and their application in agriculture. To increase the effective utilization of pesticides and veterinary drugs and achieve cost efficiency, Zeng's academic work mainly focuses on the fabrication of novel nano-pesticides with high affinity for crop foliar and the discovery of sustained-release veterinary nano-drugs with highly specific targeting.

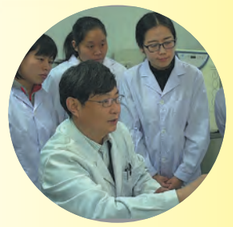


Qiao Yongli

Winner of National Excellent Young Scientists Fund
Qiao Yongli at the CAAS Institute of Crop Sciences focuses his research on the molecular mechanisms of plant pathogenic oomycete effectors. Qiao and his team have found that two RxLR effectors encode *Phytophthora* suppressors of RNA silencing (PSRs) from the oomycete plant pathogen *P. sojae*, and discovered a novel mechanism for small RNA mediated resistance in phytopathogenic oomycetes.

Li Peiwu

Oil Crops Research Institute
Li Peiwu and his team have conducted research on the development of aflatoxins-targeted ultra-sensitive antibodies and detection technologies for agro-foods safety. Their achievements won the 2015 National Technology Invention Award (Second Prize) by State Council.



Hu Zhichao

Nanjing Institute of Agricultural Mechanization
Hu Zhichao and his team won the 2015 National Technology Invention Award (Second Prize) by State Council for their research on the key technology and equipment for peanut harvest mechanization.

Honors and Awards

He Zhonghu

Institute of Crop Sciences

He Zhouhu and his team won the 2015 National Science and Technology Progress Award (Second Prize) by State Council for their research on the introduction and utilization of CIMMYT wheat germplasm in China.

Zhao Ming

Institute of Crop Sciences

Zhao Ming and his team won the 2015 National Science and Technology Progress Award (Second Prize) by State Council for their research and application of optimized management system for canopy and topsoil for high yield in maize.

Xu Minggang

Institute of Agricultural Resources and Regional Planning

Xu Minggang and his team won the 2015 National Science and Technology Progress Award (Second Prize) by State Council for their research and application of integrated technologies on soil organic matter evolution and promotion in the main grain production areas in China.

Li Shaokun

Institute of Crop Sciences

Li Shaokun and his team won the 2015 National Science and Technology Progress Award (Second Prize) by State Council for their development of maize planting handbooks and flip charts.

In addition, as participants in cooperative projects, CAAS institutes also shared several national awards with other domestic partners. The Institute of Biotechnology participated in research in the breeding and application of high yield cotton variety *LuMianYan 28*; the Oil Crops Research Institute took part in the research on the genetic mechanism of yellow-seed rape (*Brassica napus*) and new variety breeding; the Feed Research Institute took part in research on the protection and development of Rongchang pig germplasm; the Institute of Plant Protection and the Institute of Vegetables and Flowers participated in research on key technologies and applications for high efficiency utilization of pesticides; the Farmland Irrigation Research Institute took part in the R&D and application of key technologies and products for precision drip irrigation as well as research and application of key technologies for new types of low energy consumption and multi-functional water-saving equipment. Those joint efforts harvested 6 National Science and Technology Progress Awards (Second Prize) by State Council.

Strategic Programs

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

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

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

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

1. The Agricultural Science and Technology Innovation Program

In order to better fulfill its mission of meeting national demand and following international scientific trends and achieving its strategic goal of building a world-class agricultural research institution, CAAS has initiated the Agricultural Science and Technology Innovation Program (ASTIP) since 2013. Three years' implementation witnessed remarkable achievements of ASTIP on solving key scientific and technological issues related to China's development of modern agriculture through systematic reform and more dynamic science and technology innovation.

Mapping a blueprint for ASTIP during the 13th Five-Year Plan period (2016-2020) To foster China's agricultural scientific and technological innovation, better tackle crucial strategic scientific issues related to rural economic development and meet the requirements of modern agriculture development, ASTIP has built up a 3-tier subjects system and identified 18 key scientific tasks, and made a plan to strengthen its characteristic subjects, expand the novel cross-cutting subjects, improve the structure of its disciplines according to the development trends of agricultural S&T and industrial demands.

Increasing output of agricultural research Due to an improved structure of disciplines and more efforts in agricultural fundamental research, CAAS made a series of major scientific findings in 2015. Scientists at the academy published 16 papers in world-class academic journals, including *Nature* and *Science*, doubled the figure in 2014.

To meet the demand of national development strategy, CAAS conducted research and demonstration into the integrated technology-based green production. The technologies were widely adopted in crop and livestock sector, including rice, corn, wheat, soybean, rape, potato, cotton, dairy cattle and sheep. Twenty-five advanced production modes were developed for further extension in the above sectors, and fifty-four experimental demonstration bases were established in major grain-producing areas and typical ecological zones of 17 provinces. The program has demonstrated the role of CAAS as a national team for agricultural research to promote sustainable agricultural development in China.

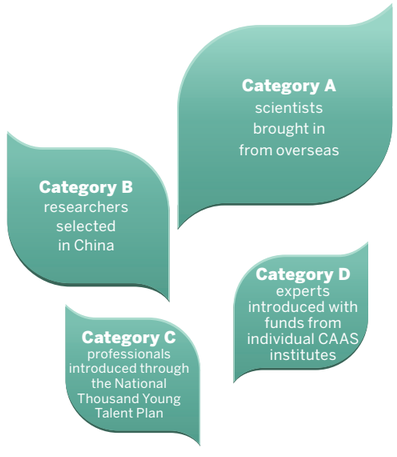
2. The Elite Young Scientists Program

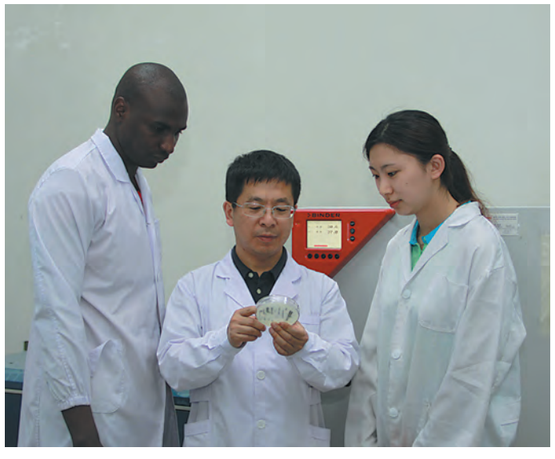
The Elite Young Scientists Program is an initiative launched by CAAS in 2013 to recruit scientists under the age of 40 with high quality and global vision. The program aims to improve the innovation capacity of the academy's research teams, to build a recruitment system that features international standards, to enhance the international competitiveness and academic research capacity, and to provide strong human resources to help realize its goal of becoming a world-class agricultural research institution and achieving "leapfrog development". The program is divided into four categories. Category A, B and C are funded by CAAS, of which Category A is for scientists from overseas, Category B is for those selected within China, Category C is for those introduced through the National Thousand Young Talents Program. Category D is for scientists introduced both from abroad and home, but using funds from individual CAAS institutes.

The program has strict procedures for recruitment. Young scientists need to pass reviews to become candidates and then pass another review after one year's work in their positions before to be finally selected.

The program was on the list of China's first 55 initiatives aimed at recruiting high-level talents overseas and has attracted attentions worldwide. CAAS has introduced 154 scientists through the program, including four winners of the National Science Fund for Distinguished Young Scholars, three winners of the National Excellent Young Scientists Fund, three scientists of the National Hundred, Thousand and Ten Thousand Talents Program, as well as four candidates of the National Thousand Young Talents Program. A total of 20 serve as chief scientists of CAAS' research teams of the ASTIP.

CAAS is striving to develop into a world-class agricultural institution and realize leapfrog development, and young talents are welcome to join it. For more information, please visit: http://www.caas.net.cn/kjcxgczl/zytz/237653.shtml





3. National Agricultural Science and Technology Innovation Alliance

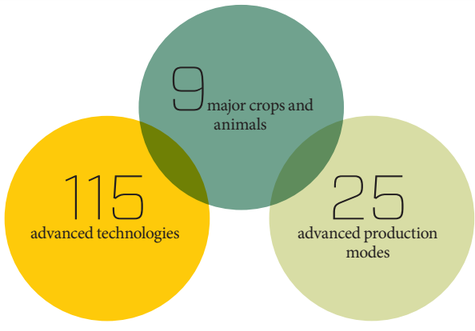
The National Agricultural Science and Technology Innovation Alliance (NASTIA) is a nationwide platform for scientific innovation and collaboration that brings together academies and universities of agricultural sciences, and enterprises at the national, provincial and city levels. NASTIA has become a major force for advancing China's agricultural scientific innovation and fulfilling the demand for deepening agricultural scientific reform.

Approved by the Ministry of Agriculture, as the leading institution of the NASTIA, CAAS has improved the management system of the alliance since it was founded at the end of 2014. It is now composed of a board council, an academic committee, an appraisal committee, a secretariat and an executive office. Focusing on key regional agricultural issues, NASTIA launched three collaborative innovation projects on heavy metal pollution control in southern China, black soil protection in northeast China, water saving and grain production ensuring in north China. It has also launched a research and demonstration program into integrated technology-based green production of nine agricultural products, such as wheat, rice among others, through environmental-friendly technologies. Bearing in mind the country's strategic demand for scientific technologies, NASTIA conducted a survey on key agricultural issues of four aspects, including fundamental cutting-edge technologies, core technologies, regional sustainable development and long-term fundamental scientific work, and put forward 16 proposals to the Ministry of Agriculture and the Ministry of Science and Technology. NASTIA has also promoted the development of cross-regional agricultural S&T innovation alliances in the provinces of Shandong, Jiangsu, Hubei, Guangdong and Jiangxi, as well as the development of S&T innovation alliances in aquaculture.

4. Research and Demonstration Program on Integrated Technology-based Green Production

The Ministry of Agriculture has set the goals of promoting green technologies, controlling water consumption in agriculture and reducing the use of fertilizers and pesticides. To address the key issues in regional development and agricultural industry in China, CAAS has adhered to the principles of prioritizing quantity, quality and efficiency, and has launched a research and demonstration program to increase productivity and efficiency for nine major crops and animals, including rice, corn, wheat, soybean, rape, potato, and cotton, as well as dairy cattle and sheep, through environmentally-friendly technologies. A total of 115 technologies were adopted for the production of the above -mentioned crops and animals. Twenty-five advanced productivity modes were also set up. The program has provided technical support for increasing agricultural productivity and efficiency in an environmentally-friendly manner and promoted more sustainable agricultural development in the period of the 13th Five-Year Plan (2016-2020).

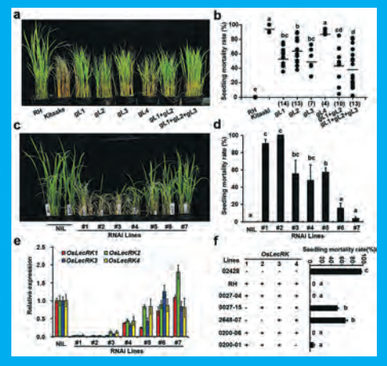
Through the technologies, the yield of pilot project's farmland with a rotation of wheat and maize has surpassed 1500 kilograms per 0.067 hectares. A mechanized farming system has been established for growing and transplanting rice seedlings. Through the new technology, soybean stalks are shattered and used as fertilizer, solving the problem of soybean residue burning. Through rotation of rape with grain crops, the farming system become more environmental-friendly, and the income of farmers are also raised. With regard to cotton production, a feasible technical package was set up to increase the yield. The yield and quality of milk are increased, and the technologies used to prevent and treat mastitis of dairy cattle have reached an internationally advanced level. Besides, a new sheep-fattening technology has raised the birth rate by 22 percent, the revenue generated by each sheep by 120 Chinese Yuan.



Research Progress

Crop Science

SIGNIFICANT PROGRESS IN THE STUDY OF BROWN PLANTHOPPER RESISTANCE IN RICE. Research team led by Wan Jianmin at the Institute of Crop Sciences has carried out systematic study on developing rice varieties with broad-spectrum and durable resistance to brown planthoppers and deciphering the mechanisms in the interaction between brown planthoppers and rice. They have identified a broad-spectrum and durable brown planthopper resistance gene, *Bph3*, through map-based cloning. The *Bph3* locus contains a cluster of three genes predicted to encode lectin receptor kinases (*OsLecRK*) acting additively to confer resistance to brown planthoppers. Introgression of one or two *OsLecRKs* into susceptible rice varieties can partially improve brown planthopper resistance, and co-expressing three *OsLecRKs* exhibited higher resistance. Introducing *Bph3* into a susceptible variety, Ningjing 3, through marker-assisted selection, significantly enhanced the resistance, both at seedling and mature stages. This study lays the foundation for breeding rice cultivars with broad-spectrum and durable insect resistance and understanding the molecular mechanisms of brown planthopper resistance.
This study has been published in ***Nature Biotechnology*** (2015,33(3): 301-307).



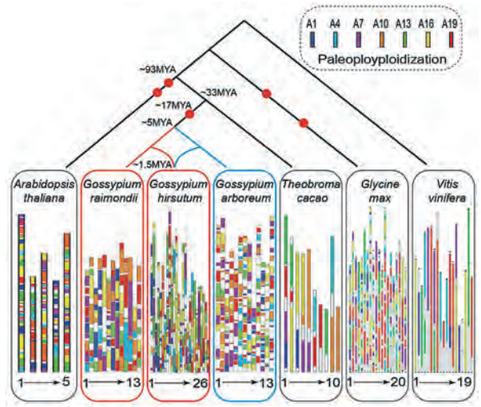
CIMMYT WHEAT INTRODUCTION AND UTILIZATION AWARDED BY THE STATE COUNCIL. The main achievements that He Zhonghu's research team at the Institute of Crop Sciences has made for this award include the introduction of 18165 wheat accessions stored in National Gene Bank from International Maize and Wheat Improvement Center (CIMMYT), and adaptation of CIMMYT accessions in China through multi-location trials and molecular markers; twenty-eight varieties derived from CIMMYT germplasm covered 14.7 million hectares. Most importantly, the multi-disease resistant breeding methodology based on adult plant resistance provided new strategy in breeding new varieties with durable resistance. CIMMYT and China started collaboration in the early 1970s and a shuttle breeding project on improving disease resistance was initiated in the mid-1980s. More than 20 Chinese institutes were involved in germplasm exchanges and training.
Their efforts won the 2015 National Science and Technology Progress Award (Second Prize).

RESEARCH AND APPLICATION OF OPTIMIZED MANAGEMENT SYSTEM FOR CANOPY AND TOPSOIL FOR HIGH YIELD IN MAIZE. To resolve the problems restricting further increase of yield in maize, especially for high planting-density population, the research team led by Zhao Ming from Institute of Crop Sciences in CAAS established a theoretical system of integrated optimized management system for canopy and topsoil in maize, and innovated the key techniques and technical patterns. The reasons of lodging and premature senility for high planting-density of maize were firstly ascertained, and then the theoretical system of canopy and topsoil optimization was presented. Guided by this theory, they developed new subsoiling management, new chemical control management and other key management for high planting-density maize population. By exerting the integrated effect, three new agronomic management combinations were innovated, i.e., subsoiling and increasing planting-density techniques, promoting plant root growth and controlling plant-type management, and improving soil productivity and promoting fertilizer efficiency. These combined agronomic techniques and management were extended in major maize producing areas in China, and applied widely in about 8.20 million hectares farmland in seven provinces from 2012 to 2015, thus increasing maize output by 8.34 million tons and economic benefits by 14.32 billion Chinese Yuan.
The findings won the 2015 National Science and Technology Progress Award (Second Prize).

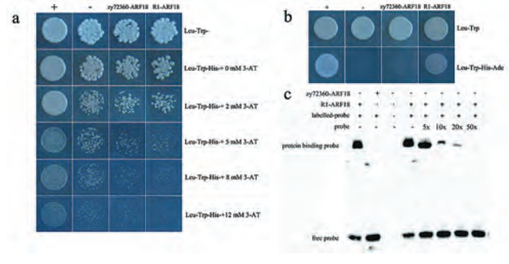
NEW HANDBOOKS AND FLIP CHARTS FOR MAIZE PLANTING. The research team, led by Li Shaokun, at the Institute of Crop Sciences, in collaborating with more than 500 maize experts from different production regions in China, complied six handbooks and 30 flip charts on maize planting, based on the natural characteristics of different regions. The work contains new ideas and new technologies for modern maize production. By the end of December 2014, the handbooks had been reprinted 21 times, with a total of 910,000 copies printed, and the flip charts had been reprinted 16 times, with a total of 1,654,000 copies printed. The handbooks and charts are also translated into other languages and published, including Mongolian, Uygur and Kazak. The *Handbook of Maize Planting in the Southwest* was also translated into English and used for agricultural exchanges and training in Southeast Asia and Africa. These handbooks and charts play a great role in all the maize production regions in China.
The research won the 2015 National Science and Technology Progress Award (Second Prize).

MAPPING OF THE UPLAND COTTON GENOME (AD GROUP) COMPLETED. Li Fuguang's research team at the Institute of Cotton Research led the complete mapping of the upland cotton genome (Gossypium hirsutum), along with Peking University, BGI Tech, Wuhan University, Hebei Agricultural University and the Southern Plains Agricultural Research Center of the US Department of Agriculture. With the combination of different research methods, such as Shotgun sequencing and BAC-to-BAC, they have built a high-density genetic map for upland cotton, obtaining 26 pseudochromosomes and 76,943 protein-coding genes through the genome annotation. The research demonstrates that ethylene can bidirectional regulate the growth of fiber. It also confirmed the hypothesis of tetraploid cotton's evolutionary rule. The accomplishment of the map of the upland cotton genome is of significance for improving China's cotton research and promoting molecular mechanisms for the breeding of new cotton varieties with the important traits of high yield, good quality and resistance to biotic stress and abiotic stress.
At the same time, it has also laid the solid foundation for determining the origin, evolution, and the formation of tetraploid cotton and polyploidy species.

The research results were published in ***Nature Biotechnology*** (2015,5:524-532).



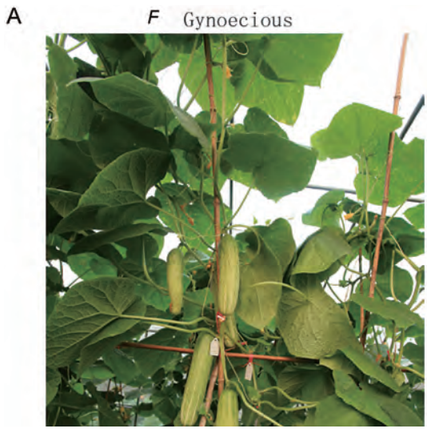
CLONING OF THE MAIN EFFECT QTL CONTROL GENE IN RAPESEED. Wang Hanzhong's research team at the Oil Crops Research Institute used the difference in grain weight of rapeseed cultivars zy72360 and R1 to construct a F_2 separation population and obtained a major effect of quantitative trait locus (QTL) on the A9 chromosome, in which the genes for grain weight and silique length are collocated. With the help of near-isogenic lines, associated groups, genome sequence comparison between the parents, and transgenic analysis, the team has identified that *ARF18* is the target gene regulating seed weight and silique length. Overexpression of this gene can cause a 15 percent variation in the grain weight, while the seed number per silique exhibits no change. This is the first polyploidy crop yield gene acquired by map-based cloning in the world and will provide a reference for yield gene cloning in other major polyploid crops such as wheat and cotton.
The results were published in *PNAS*(2015,112(37):5123–5132).

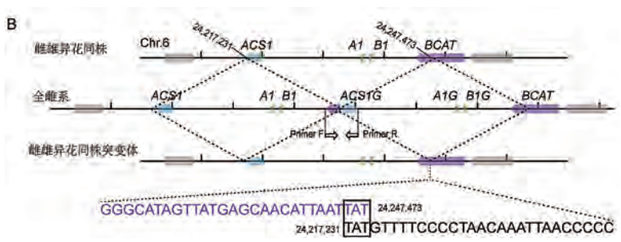


Horticulture Science

GENOME-WIDE MAPPING OF STRUCTURAL VARIATIONS REVEALS THE GENETIC BASIS OF GYNOECY IN CUCUMBER. Using multiple approaches such as genome wide association study and genome re-sequencing of cucumber mutants, Huang Sanwen's research team at the Institute of Vegetables and Flowers identified a recent copy number variation (CNV) of a particular 30 kb DNA segment in their research, which gave rise to gynoecious cucumbers bearing only female flowers. This CNV originated from the same cucumber (likely an Asian cultivar) due to the 3-bp microhomolog (TAT) and then radiated during cultivation to other parts of the world. This study will facilitate the dissection of the molecular basis of sex determination in cucumber and help in the development of cucumber cultivars with high-yield potential.

The related results have been published online in ***The Plant Cell*** (2015, 27: 1595-1604).





DEVELOPMENT AND EXTENSION OF WATERMELON VARIETIES WITH HIGH LYCOPENE, CITRULLINE AND VITAMIN C CONTENTS. Liu Wenge's research team at the Zhengzhou Fruit Research Institute carried out relevant research in functional watermelon varieties development. They developed the simple, quick determination methods of lycopene, citrulline and vitamin C, and revealed the mechanisms of changes of the content, genetic characteristics and molecular regulation mechanism of the three ingredients. Six watermelon varieties with high contents of the three functional ingredients were developed. The study indicated that watermelon quality breeding was improved significantly in China. In addition, functional watermelon varieties will have broad prospects of extension.

The results won the 2015 Science and Technology Progress Award of Henan Province (Second Prize).

THREE NEW FRUIT CULTIVARS WERE OFFCIALLY RELEASED BY THE SEED ADMINISTRATION BUREAU OF LIAONING PROVINCE. Two new pear cultivars 'Zhongaihongli' and 'Zhongjia No.1' and one new peach cultivar 'Cold-Resistant Peach Zhongnong No.1' were officially released by the Seed Administration Bureau of Liaoning Province. The two pear cultivars were developed by Jiang Shuling's research team, and the new peach cultivar was developed by the research team of Liu Fengzhi. Both of the two teams are affiliated with the Institute of Pomology of CAAS.

'Zhongaihongli' is a new pear cultivar derived from the hybrid progenies between 'Aixiang' and 'Hexincun'. This cultivar is highly resistant to pear scab, and moderate resistant to pear dry rot disease and cold. The fruit is approximately round and of middle to big size. Its average weight is 215.0 g and a big one can be up to 544.0 g. The fruit is aromatic and of good quality.

'Zhongjia No.1' is a new pear cultivar derived from 'CP10' seedling line (a superior seedling line of 'Jinxiang'). This cultivar is suitable for juice and canned pear-processing. This cultivar is moderate resistance to pear scab, pear dry rot disease and cold.

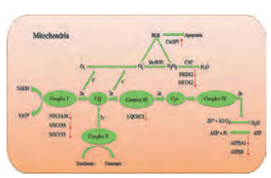
'Cold-Resistant Peach Zhongnong No.1' is a mid-early mature peach cultivar with cold resistance. It was derived from a 7-year-old natural seedling through grafted propagation, which grew in a farmer's courtyard in Shenyang.

Animal Science

ALPINE MERINO SHEEP APPROVED BY THE NATIONAL LIVESTOCK GENETIC RESOURCES COMMISSION AS A NEW NATIONAL BREED. The alpine Merino sheep is a new fine-wool breed adapted to high altitudes, cold and drought area, which was developed by Yang Bohui and his team at the Lanzhou Institute of Husbandry and Pharmaceutical Sciences. This achievement was made in cooperation with Gansu Sheep Breeding Technology Extension Station and five other institutions over 20 years. It is the first fine-wool Merino sheep bred in the high altitude area in China, and also the first of this kind in the world. It's a great breakthrough in the Chinese alpine fine-wool Merino sheep breeding program, which reaches an international leading level. It had been approved by the National Livestock Genetic Resources Commission as a new national breed on Dec. 21, 2015.

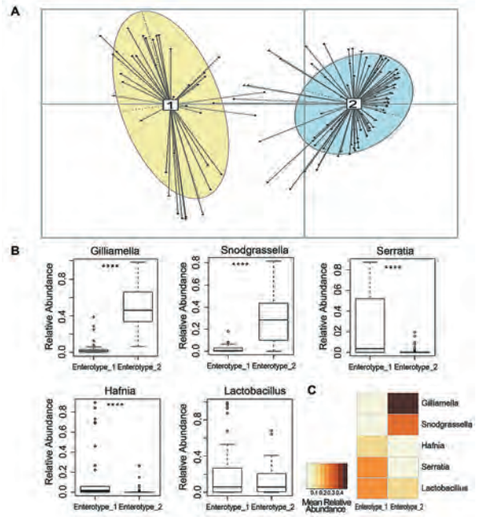
ANALYSIS OF THE MECHANISM OF ENVIRONMENTAL FACTORS ON THE HEALTH OF LIVESTOCK AND POULTRY. The research team led by Zhang Hongfu at the Institute of Animal Sciences investigated the effect of the heat stress and high ammonium on the growth and health of animals using artificial climate chambers and proteomics to solve the problems of environment impact on animal health. Up to date, this team has identified 257 differentially expressed proteins in broiler liver tissues after heat treatments using the high-throughput, label-free quantitative proteomics strategy of SWATH. The fecal metabonomics method to evaluate heat stress based on UPLC-QE MS has been developed and 10 potential biomarkers were obtained. Proteomics profiles were confirmed in pig's hypothalamus and liver against heat stress, which indicated the molecular regulation mechanism preliminarily. Key proteins related with chicken liver and intestine mucosal injury were screened, and the mechanisms of these injury and lipid metabolism were clarified. These study results described above lay the groundwork for the early warning in the environmental stress, evaluation of the degree of comfort, and development of strategies to ameliorate the negative impacts of environment on animal production and welfare.

Those findings have been published in ***Scientific Reports, PLoS One, Poultry Science*** and ***The Journal of Molecular Endocrinology.***



TWO GUT COMMUNITY ENTEROTYPES RECURRING IN DIVERSE *BUMBLEBEE* SPECIES FOUND. A study of hotspot issues concerning gut microbial communities was conducted by a joint team led by Li Jilian at the Institute of Apicultural Research in collaboration with the US National Academy of Sciences and the Chinese Academy of Sciences. They tested the gut microbial communities of 142 worker bees from 28 species of Chinese *bumblebees* using high-throughput 454 pyrosequencing of the V6-V8 region of bacterial 16S rRNA. It was shown that there are two conservative enterotypes in 28 species of *bumblebees*, which is in line with the findings in human beings and gorillas. The two gut community enterotypes observed in *bumblebees* were highly consistent with those in mammals, which may have potential effects on the health and population dynamics of *bumblebees*, and will provide a new perspective of gut microbial communities for future pollinating insect researches.

This result was published in ***Current Biology*** (2015,25:635–653).



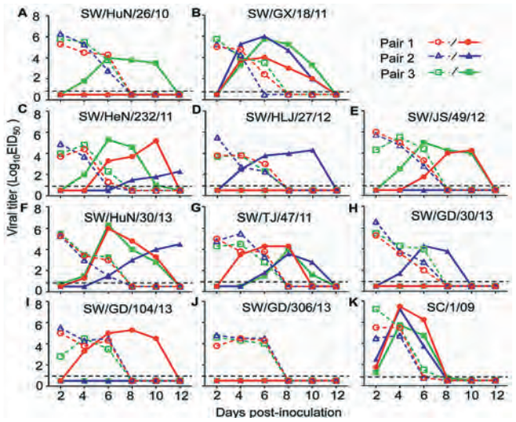
BREAKTHROUGHS IN EARLY WEANING AND FAST FATTENING OF LAMBS. Based on the nutritional physiology of lambs, Diao Qiyu's research team at the Feed Research Institute systematically studied the digestive physiology, immune and regulatory functions of nutrients, and formed new lamb cultivation technology system. Under this new system, the suckling period of lambs in the farming area was shortened to two weeks from 90 days, the average daily gain exceeded 200 g and survival rate increased by about 20%. The suckling period of lambs in the pasturing area was shortened to three to five weeks from three to four months, and the fattening period was shortened to five months from twelve months. Diao's lab won a patent for the first domestic lamb milk replacement in 2002 and Outstanding Patent Award of China in 2015. The team established the first professional production line, and formulated industry standard for the lamb milk replacements. The extension and application of the new lamb cultivation technology system decreased the mortality of lambs, increased the income of farmers, and achieved remarkable economic and social benefits.

STUDY AND APPLICATION OF BIOLOGICAL CONTROL TECHNOLOGY ON THE MANAGEMENT OF POISONOUS AND HARMFUL WEEDS IN GRASSLAND. To meet the major strategic needs in grassland development and utilization, Liu Aiping's research team at the Institute of Grassland Research focused on their research and application of biological control technology to tackle with the bottlenecks in the prevention and control of poisonous and harmful weeds in the grassland of the Inner Mongolia Autonomous Region, including *Stipa grandis* burr, Canada thistle (*Cirsium arvense*), *Euphorbia esula*, etc. This study is of great significance to improve the prevention and control of poisonous and harmful weeds, boost the ecological and environmental health of the grasslands, and promote the sustainable development of the animal husbandry in the area of grassland.

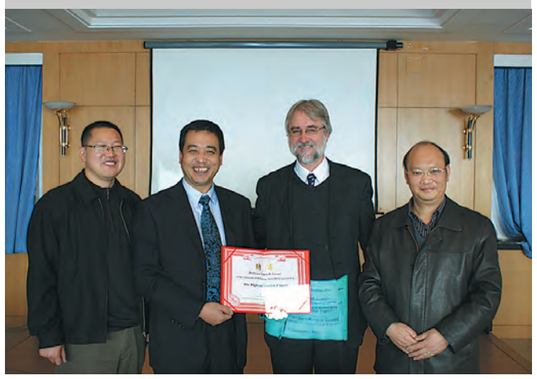
The team's achievement won the 2015 Science and Technology Progress Award of the Inner Mongolia Autonomous Region (Second Prize).

Veterinary Medicine

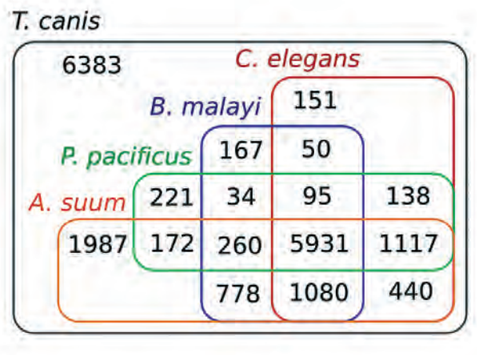
IMPORTANT RESEARCH FINDINGS ON ANIMAL INFLUENZA VIRUSES. Animal influenza viruses continue to challenge human health. Surveillance of these viruses and evaluation of their pandemic potential are important for future influenza pandemic preparedness. Pigs are important intermediate hosts for novel influenza generation and human infection. Two lineages of H1N1 swine influenza viruses (SIVs), classical H1N1 SIVs and Eurasian avian-like H1N1 (EAH1N1) SIVs, have been circulated in pigs since 1918 and 1979, respectively. The classical H1N1 SIVs emerged in humans as a reassortant and caused the 2009 H1N1 influenza pandemic. The research team at the Harbin Veterinary Research Institute led by Chen Hualan found that after long-term evolution in pigs, the EAH1N1 SIVs preferentially bind to human-type receptors and are able to be transmitted in ferrets by respiratory droplets, and that the preexisting immunity in the human population may not be able to prevent the spread of the EAH1N1 SIVs. The study shows the potential of EAH1N1 SIVs to transmit efficiently in humans and suggests that immediate action is needed to prevent the efficient transmission of EAH1N1 SIVs to humans.
This study was published in ***PNAS*** (Yang et al., PNAS, online on Dec. 28, 2015).

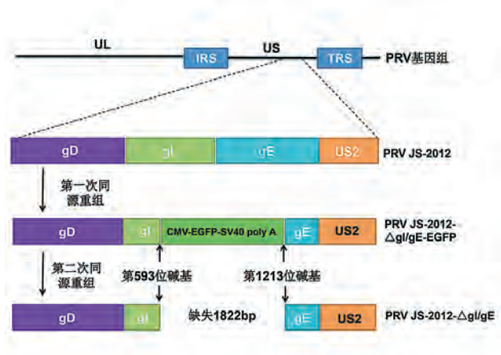


DRAFT GENOME AND TRANSCRIPTOME OF *TOXOCARA CANIS*. In collaboration with the University of Melbourne, Australia, BGI-Shenzhen and other institutions, the research team led by Zhu Xingquan at the Lanzhou Veterinary Research Institute, conducted research on the genome study and transcriptome analysis of *Toxocara canis*, a zoonotic parasite of major socioeconomic importance worldwide. This genome is 317 Mb in size, has a repeat content of 13.5% and encodes at least 18,596 protein-encoding genes. They have studied transcription in a larval, as well as adult female and male stages, characterized the parasite's gene-silencing machinery, explored molecules involved in development or host-parasite interactions and predicted intervention targets. The draft genome of *T. canis* is expected to provide useful resources for future molecular studies of this and other related parasites. This achievement was published in ***Nature Communications*** (2015,6: 6145).



PROGRESS IN ATTENUATED VACCINE FOR VARIANT STRAIN OF PSEUDORABIES VIRUS. A research team led by Tong Guangzhi at the Shanghai Veterinary Research Institute developed an attenuated vaccine for emerging Pseudorabies virus variant strain, designated as PRV JS2012-ΔgI/gE, which deleted *gI* and *gE* genes. The evaluation of transgenic safety and the environmental release trial for the vaccine were conducted for measuring the virus proliferation level, the distribution in tissues, and virus shedding in swine. The capability of horizontal and vertical transmission was also assessed. Combined with the results of the previous transgenic safety evaluation and the environmental release trial in 2015, it was indicated that JS-2012-ΔgI/gE vaccine was safe with good quality. Recently, Environmental Release and Production Experiments of Transgenic Biosafety for PRV JS-2012-ΔgI/gE vaccine have been approved by the Ministry of Agriculture of China. The approval is a key step for clinic trials and for this novel veterinary vaccine to be certificated. It holds the promising for prevention and control of emerging Pseudorabies virus infection in swine.

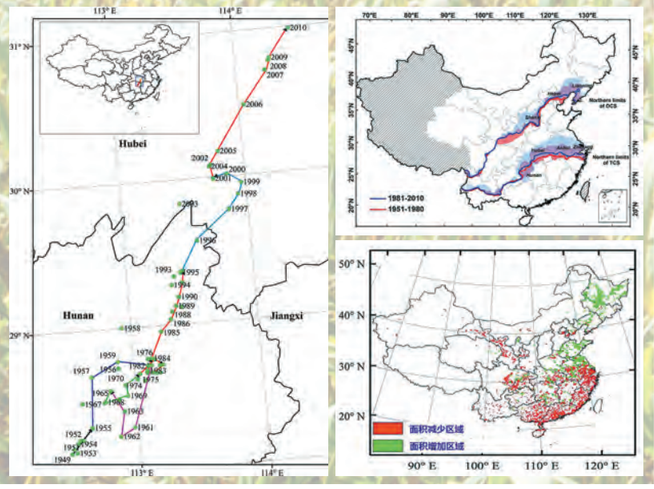




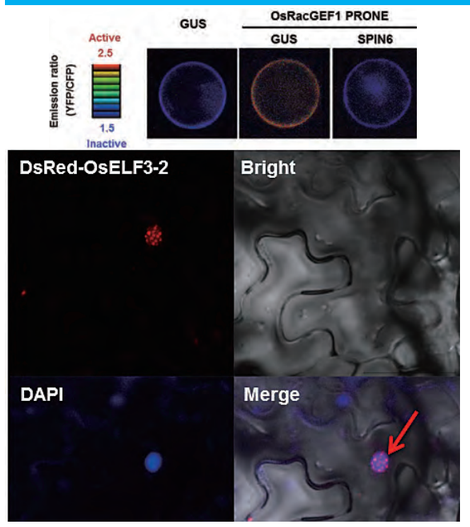
Agricultural Resources and Environment

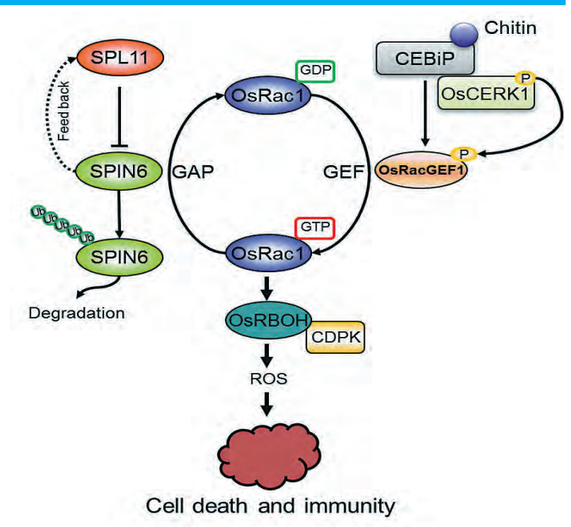
MAJOR RESEARCH PROGRESS IN CHANGES OF CHINA'S CROP DISTRIBUTION. By combining remotely sensed data, climatic data and agricultural census data, Tang Huajun and his team at the Institute of Agricultural Resources and Regional Planning developed a new entropy-based method to map the spatial distribution of China's major crops. Based on this, they constructed the first high-precision, long-term historical dataset for the spatial distribution of rice, maize and wheat crops in China at a grid level. This dataset was then used to scientifically disclose changes of China's crop distribution, investigate the northward shift of Chinese cropping systems, and explain the transition of Chinese grain production between grain-transporting from the south to the north (food shipped from Southern China to Northern China) to grain-transporting from the north to the south over the past three decades. Moreover, using a linear regression model, they examined the driving factors, in particular climate changes, behind such crop production movement. While the major driving forces have been social and economic factors as urbanization, irrigation investment, and agricultural or land use policy changes, climate has played a significant role as well. Understanding how the crop production system has historically responded to external forces, both natural and anthropogenic, will provide critical insights into how the system is likely to respond in the future.

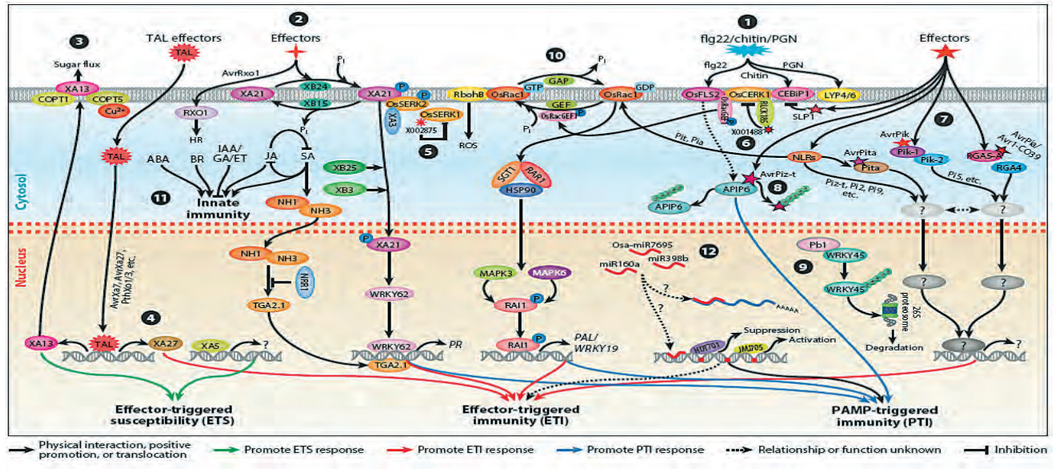
Their latest findings were published in ***Global Ecology and Biogeography, Environmental Science*** and ***Technology and Scientific Reports.***



DISSECTION OF NEW MECHNISMS OF THE UBIQUITIN-PROTEASOME PATHWAY IN RICE IMMUNITY. Wang Guoliang's research team at Institute of Plant Protection have published a research paper about E3 ligase SPL11 substrate protein SPIN6 in rice. They found that SPL11 ubiquitinates SPIN6 *in vitro* and degrades SPIN6 *in vivo* via the 26S proteasome-dependent pathway. Importantly, they found that SPIN6 is the RhoGAP of the small GTPase OsRac1, which is a key component in rice immunity. This study established the working model for SPIN6 and its interacting proteins SPL11 and OsRac1, and its function in the control of cell death and immunity in rice, which provides the theoretical basis for breeding broad-spectrum disease resistance rice varieties and a novel concept to develop new strategy for rice disease management. The results were published in ***PLoS Pathogens*** (2015 Feb; 11(2): e1004629).

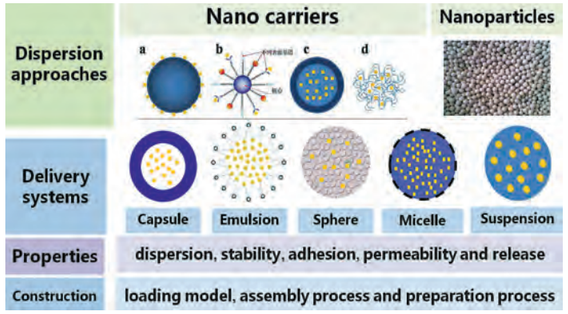






COMPREHENSIVE TECHNOLOGY AND ITS APPLICATION OF SOIL ORGANIC MATTER EVOLUTION AND PROMOTION IN THE MAIN GRAIN PRODUCING AREAS IN CHINA. A research team led by Xu Minggang at the Institute of Agricultural Resources and Regional Planning conducted a research network to explore the limiting factors and unclear technical approaches in soil organic matter promotion in different areas in China with intensive cultivation and excessive use of chemical fertilizers. The research was based on 42 long-term field trials and 362 long-term monitoring stations of typical local farms in five major grain-producing areas in the country — Northeast China, North China, Northwest China, uplands in South China and paddy fields in the Yangtze River region. The research revealed the evolution and influencing factors of soil organic matter evolution in different areas of croplands in China in nearly 30 years, and developed a key technology for soil organic matter promotion. Meanwhile, the comprehensive technology for soil organic matter promotion in different regions was also integrated and innovated, and 13 key technology patterns of organic matter promotion with regional uniqueness were put forward to enhance soil organic matter by increasing the application of organic manure and straw returning as well as the reduction of limiting factors. This research provided a technical template to enhance soil organic matter in croplands, and had remarkable effects on their promotion in a large number of areas in China. The technology has brought significant ecological and environmental benefits, promoted the use efficiency of organic resources, including straw and manure, and significantly improved cropland quality with accumulated areas of 7.15 million hectares involved over the past three years.
This work won the 2015 National Science and Technology Progress Award (Second Prize).

MAJOR PROGRESS IN NANOPESTICIDE RESEARCH. To increase effective utilization rate of pesticide and reduce agricultural residues and environment pollution, nano-agricultural science and technology innovation team led by Cui Haixin at the Institute of Environment and Sustainable Development in Agriculture made important research progress in improving the efficacy and safety of pesticides through the use of nanomaterials and nanotechnology. In their research, they constructed and developed efficient and safe pattern and processing technology to make new green nanopesticide formulations through molecular assembly and interface polymerization technology, including nanoemulsions, nanocrystals, nanocapsules, nanospheres, nanomicelle and solid dispersion. Their study illustrated the mechanism of nano-pesticide on improving efficient deposition, adhesion and controlled release properties on leaf surface, leading to new paths for enhancing the efficacy of pesticides and decreasing residual pollution through reducing pesticide loss and decomposition. It also clarified the environmental behavior, toxicological effects and biological safety of typical nanopesticide, and its influence on the quality and safety of agricultural products, which provides a scientific basis for the promotion and application of new nanopesticide products.
The research has been supported by the Major National Science Research Program of China.



Agricultural Mechanization and Engineering

THE KEY TECHNOLOGY AND EQUIPMENT FOR PEANUT HARVEST MECHANIZATION. The research team led by Hu Zhichao at the Nanjing Research Institute for Agricultural Mechanization has made significant breakthroughs in solving the technical bottlenecks that have been long existing in picking peanuts, pulling up the plant and selecting and cleaning peanuts. A variety of peanut combine harvest machines were developed with high efficiency, adaptability and cost efficiency. The machines are on the list of major dissemination technologies promoted by the Ministry of Agriculture and have become leading products in the domestic peanut harvest equipment market, with about 30 percent of market share. Some of the products have been exported to India, Vietnam and other countries. The achievements play a significant role in meeting the peanut production urgent demand, leading industrial technological innovation and ensuring domestic oilseed supply.
Their achievements won the 2015 National Technology Invention Award (Second Prize).

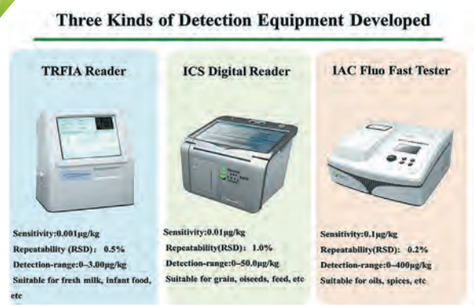
A SELF-PROPELLED MAIZE COMBINE HARVESTER WITH MULTI-FUNCTIONS. The research team led by Zhu Dewen at the Nanjing Research Institute for Agricultural Mechanization conducted research on maize combine harvester with multi-functions for maize cob harvesting, peeling off and packing, stalk collecting, chopping and baling to solve the problems of traditional practices in northern China, such as the outdated method of collecting maize stalks, complicated operation process, low mechanization level, long circulation cycle and high production costs. The self-propelled maize combine harvester with multi-functions was tested in Shandong Province. It solved the technical bottlenecks of maize stalk collection, reduced costs and the harvesting time, thereby realizing the goal of high-efficiency collection and comprehensive utilization of maize stalks.

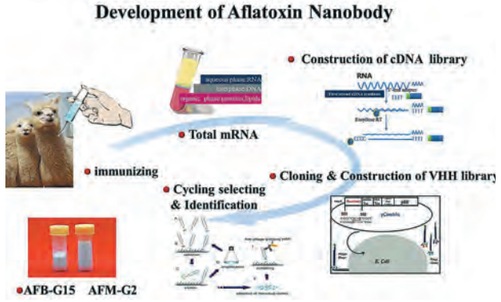
DEVELOPMENT OF WATER RESOURCES REGULATION AND EFFICIENT UTILIZATION TECHNIQUE MODE IN COMBINED WELL AND CANAL IRRIGATION AREAS IN NORTH CHINA. Through years of research, Qi Xuebin's research team at the Farmland Irrigation Research Institute developed rainwater-collecting and economical irrigation technique mode and invented an automatic farmland irrigation and drainage system based on limited exploitation of groundwater. They put forward groundwater recharge technology by flood accumulation in the wet season in order to harmonise water resources utilization and protection in irrigation area. In order to optimize and efficiently use water resources in those irrigation areas characterized with small scale and scattered water sources, complex terrain, poor irrigation conditions, single and small source of water supply and difficulties in water supply, they introduced an integrated networking system for surface water and underground engineering, and developed an optimal regulation technology for surface water and groundwater, an automatic irrigation technology for multi-stage distribution at constant pressure, and a constant pressure sprinkler irrigation technology for sloping land. Moreover, based on the new water saving technologies of irrigation engineering, agricultural practice and management , they developed an integrated technology system of water resources and highly efficient utilization of water resources in combined well and canal irrigation areas. The mode and the technology had been disseminated and used in Shanxi, Henan, Hebei and Shandong provinces, and achieved remarkable economic, social and ecological benefits, indicating potential wider application in the combined well and canal irrigation areas in North China. Their achievements won the 2015 Science and Technology Progress Award of Henan Province (Second Prize).

Agro-product Quality, Safety and Processing

DEVELOPMENT OF AFLATOXINS-TARGETED ULTRA-SENSITIVE ANTIBODIES AND DETECTION TECHNOLOGIES FOR AGRO-FOODS SAFETY. Aflatoxin is an extremely toxic and carcinogenic chemical, which is harmful to human health. Since aflatoxin has been found to have a tendency to contaminate many crops, highly sensitive and rapid detection techniques are crucial for agro-food production and safe consumption. To make breakthroughs in solving this major international problem, an innovation group led by Li Peiwu at the Oil Crops Research Institute invented a series of ultra-sensitive and specific targeting antibodies against aflatoxins and established high-sensitivity detection technologies through unremitting efforts over 15 years. The high-effect one-step hybridoma screening method was developed to select and breed well-qualified hybridoma cell lines by adopting a semisolid medium culture. Then, the immune active sites of hapten and potential mechanism of high sensitivity for the antibody were uncovered by investigating the antibodies-AFB1 interaction with the help of AA sequence comparison, homology modeling, molecular docking and mutant validation to overcome the challenge of hybridoma apoptosis and loss during sub-cloning and screening. The group selected a series of ultra-sensitive and specific anti-aflatoxin monoclonal hybridoma cell lines including 1C11, 2C9, 10G4, etc., and recombinant antibodies and nanobodies. The highest sensitivity and specificity of the antibodies were over 10 times higher than reported. Based on the antibodies, three analytical methods were firstly set up and standardized for onsite point-of-care detection of aflatoxins, including Europium nanospheres-based time-resolved fluorescence immunochromatographic assay, gold labelled immunochromatograghic strip assay and immunoaffinitiy column fluorescence enhancing assay. Moreover, a total of 17 test kits for aflatoxin determination and three pieces of detection equipment were invented. The determination methods show superior performance in comparison with current methods, including a false/positive rate of below 5 percent, a 10 to 50-fold increase of sensitivity, 75 percent reduction in costs, and the analysis time shortened by 80 percent. These technologies have been widely used in the field of aflatoxin detection in agricultural products including peanuts and rice, edible vegetable oils such as peanut oil and corn oil, spices such as peanut butter and soy sauce, dairy products including fresh milk, and animal feeds, which achieved remarkable economic and social benefits for agro-food quality and safety control.

Their achievements won the 2015 National Technology Invention Award (Second Prize).





R&D BREAKTHROUGH IN POTATO AS A STAPLE FOOD. To meet the national needs, the Institute of Food Science and Technology has grasped the historic opportunity of the Chinese government's promotion of potato as a staple food to improve people's nutrition and health. The research team led by Mu Taihua and Zhang Hong has screened 10 potato varieties suitable for processing and optimized the process parameters for potato flour for steamed bread, bread, noodles and rice noodles, of which potato flour accounts for more than 55 percent. Now, the first generation products such as potato steamed bread, potato bread and potato noodles with 30 percent potato granules, and potato rice noodles and potato nutrition fortified rice with 55 percent potato granules have been introduced to the market. Six series and hundreds of potato-based food-staple products have been produced, including composite flour, composite rice, cakes, potato-oat noodles, meal sets specified for microwave heating without unpacking, instant soup, etc. To satisfy the different needs for industrialization, chain catering and large canteens, and households, the research team has created an integrated bionic machine for fresh potato noodles and potato rice noodles, a one-step forming machine for potato rice noodles, and a small household machine for potato noodles and potato rice noodles.

Agricultural Information and Economics

KEY TECHNOLOGY AND EQUIPMENT ON AGRICULTURAL MARKET INFORMATION COLLECTION.
The research team led by Xu Shiwei at the Agricultural Information Institute has carried out research on key technologies for the collection of agricultural market information and the development of the necessary equipment, in a bid to meet the needs of agricultural market information acquisition. The team has developed a standardized agricultural market information collection technology and classification system, and made breakthroughs in the real time location technology for agricultural information collection. They also generated a specialized agricultural information collection device, characterized by state-of-the-art techniques, user friendly and high adaptability. Furthermore, the team has developed a novel data processing technology for agricultural information collection. These achievements have been progressively applied in multi-agricultural market information collection, providing significant technical support for the decision-making of national agricultural macro-management.
The achievement was granted a 2015 China Agricultural Science and Technology Award (First Prize) by the Ministry of Agriculture.

RESEARCH ON THE NATIONAL FOOD SECURITY FROM THE PERSPECTIVE OF REFORM.
The research team led by Jiang Heping at the Institute of Agricultural Economics and Development has carried out the research on the national food security from the perspective of reform and made important overall progress in the last year in the following areas. Firstly, the research team analysed the reasons why the per capita financial income and the per capita farmers' income from grain-producing counties are lower than those at the national and provincial levels, and then they designed a policy mechanism to reduce those gaps. Secondly, they analysed the current situation of grain security in China from the perspective of the grain self-sufficiency rate. Thirdly, considering relatively high costs of grain produced domestically, increased grain imports, large domestic grain stocks and benefits of high grain self-sufficiency rates of the foreign countries for China's import, they proposed that China should reduce domestic grain production proportionally, and thereby solve the gap between domestic grain production and consumption through international trade. Finally, it is suggested that the government should establish a grain production evaluation and accountability system in main grain consumption areas to ensure grain security; establish main-functional regions for grain production driven by mechanisms innovation and technology innovation; foster new grain producers to develop appropriate scale operation and improve grain production efficiency; and build a comprehensive compensation mechanism.
The research has been supported by the Major Program of National Social Science Foundation of China.

Domestic Cooperation

CAAS has conducted cooperation with local governments in major grain producing areas, typical ecological zones, special functional regions, as well as remote and undeveloped regions. The cooperation, in the forms of joint technical projects and pilot bases, personnel exchanges, technical services, consulting and training, has set up a platform for the academy's technology transfer and promoted regional agricultural development. Substantial progress was made with the local governments, such as Dezhou in Shandong province, Daxing district in Beijing, Xinxiang in Henan province, Jingmen in Hubei province and Shiyan in Hubei province. Significant technology supports were made in the under-development areas like Fuping in Hebei province, Enshi in Hubei province and Xiangxi in Hunan province, and in the autonomous regions such as Xinjiang Uygur Autonomous Region and Tibet Autonomous Region.

International Cooperation

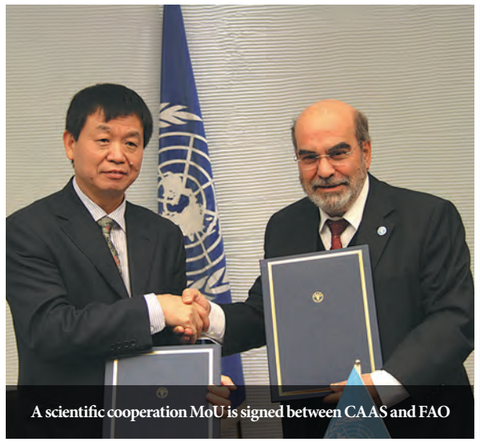
• Establishing the Center for International Agricultural Research (CIAR), CAAS

In order to fasten the step of agricultural technologies "going out" and serve the Belt and Road Initiative, CAAS established a Center for International Agricultural Research (CIAR) and developed the relative action plan. CIAR will be an important platform in providing information services for agricultural S&T innovation, international cooperation and agriculture "going out", as well as acting as a think tank for decision-making.

Launching ceremony of CIAR of CAAS

• Expanding strategic cooperation partnerships

CAAS has signed or renewed 28 memorandums of understandings or agreements with top class agricultural research institutions worldwide, including the Food and Agriculture Organization of the United Nations (FAO), the John Innes Centre of the United Kingdom, Murdoch University of Australia, the Institute for Plant and Food Research of New Zealand, University of Liege of the Belgium, the Rural Development Administration of South Korea, and Bayer CropScience.



A scientific cooperation MoU is signed between CAAS and FAO

Surachai Liengboonlertchai, the first Vice-President of the Thailand National Legislative Assembly visits CAAS

• Setting up international cooperation platforms

In 2015, 8 international cooperation platforms were set up in CAAS with foreign research institutions and universities, including the Sino-German Platform on Agricultural S&T Cooperation, the Sino-Kazakhstan Joint Laboratory on Agricultural Sciences, the Sino-Cuban Cooperation Center on Sericulture, the Sino-Australian Joint Center on the Prevention and Control of Invasive Alien Species, the Sino-New Zealand Joint Laboratory on Soil Molecular Ecology, the Sino-UK Joint Centre for the Sustainable Intensification of Agriculture, the Sino-Korean Joint Lab on Agricultural Sciences, and the CAAS-ILRI Joint Laboratory on Control and Treatment of Ruminant Epidemic Diseases.

Cao Jianlin, former Vice-Minister of Science and Technology, unveils the nameplate of the Sino-Kazakhstan Joint Laboratory on Agricultural Sciences

Zhang Taolin, Vice-Minister of Agriculture, unveils the nameplate of the Sino-German Platform on Agricultural S&T Cooperation

The Sino-Australian Joint Center on the Prevention and Control of Invasive Alien Species is launched

CAAS-ILRI Joint Laboratory on Control and Treatment of Ruminant Epidemic Diseases is launched

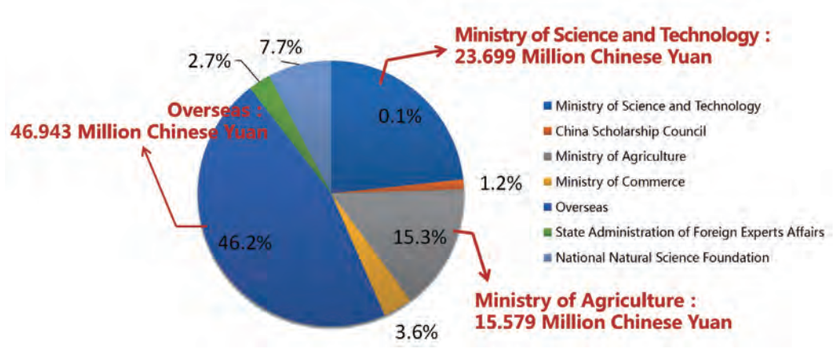
• Promoting the agricultural technologies "going out" strategy

CAAS has actively promoted its advanced technologies and products to foreign countries. Micro-potato seeds were donated to Cuba, integrated pest management (IPM) technologies focusing on biological control such as *Trichogramma evanescens* on rice and corn were transferred to Myanmar and Laos. Moreover, the academy conducted cooperation with Russia in research on migration insect pest and microbes which can be used as biocontrol microorganism. CAAS promoted its high-quality cotton varieties and cultivation technologies in Kyrgyzstan, and exported its avian influenza vaccines to Egypt.

• Boosting international cooperation projects

CAAS has attached great importance to applying international cooperation projects granted by domestic ministries. In 2015, 469 international cooperation projects were approved by the Ministry of Science and Technology, the Ministry of Agriculture and the State Administration of Foreign Experts Affairs, with a total fund of 140 million Chinese Yuan.

At the same time, CAAS has also applied the projects launched by the Horizon 2020 project from the European Union, Asia-Pacific Economic Cooperation, and the International Atomic Energy Agency.



• Organizing important international academic activities

In 2015, CAAS organized the 2nd International Conference on Agricultural Genomics, the High-level Seminar on 20 Years of Strategic Collaboration between China and CABI, the 19th Annual Meeting of the Agricultural Technical Cooperation Working Group of APEC, the 5th China-EU Food, Agriculture and Bio-technology Task Force Meeting, the 20th Meeting of the China-ROK Agricultural Science and Technology Working Group, the Sino-British Seminar on Soil and Water Resources Environmental Protection and Utilization, and the Sino-British Seminar on Application of Remote Sensing Technology in Agriculture. These activities greatly promoted the latest academic exchanges among experts, expanded CAAS' cooperation with international agricultural research institutions and widely promoted the impacts of the academy in the world.

The 2nd International Conference on Agricultural Genomics

Seminar on the 20 Years of Strategic Collaboration between China and CABI held in Beijing

The 19th Annual Meeting of the Agricultural Technical Cooperation Working Group of APEC held in the Philippines

• Enhancing capacity building

In 2015, CAAS sent 91 young and middle-aged scientists for overseas study or training through programs funded by the China Scholarship Council and the State Administration of Foreign Experts Affairs, and other international cooperation projects. Meanwhile, CAAS invited 800 foreign experts for academic exchanges in China. Frédéric Francis, from the University of Liege, Belgium, and Ryosuke Shibasaki, professor from the University of Tokyo, Japan, won the 2015 Friendship Awards from the Chinese Government, which is the top honor for foreigners who have made significant contributions to China. Moreover, the academy organized a range of training activities to improve its capacities, including the Workshop on National Network of Agricultural S&T International Cooperation involving agricultural research academies in China, and a training session for CAAS staffs who take part in the work related to international cooperation.

Winner of 2015 Friendship Award (Ryosuke Shibasaki)

Winner of 2015 Friendship Award (Frédéric Francis)

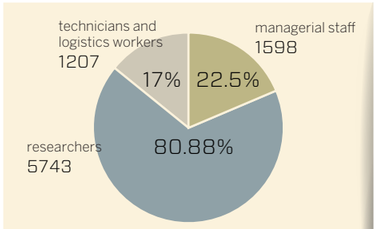
CAAS Training Workshop for Liaison Officer of International Cooperation

Workshop on National Network of Agricultural S&T International Cooperation

Staff

01

7101 members of staff by the end of 2015



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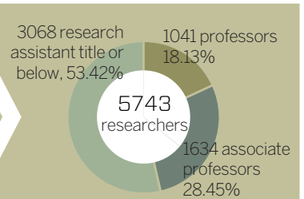


Researchers

Doctorate Degrees Holders 2373

Master's Degrees Holders 1706

03

The number of managerial staff members with doctorate degrees is 477, and that with master's degrees is 387, together accounting for 47.81 % of the total managerial staff. Among the technicians and logistics workers, 3 received special government allowances from the State Council, 16 are in the first-class technical posts and 206 in second-class technical posts. 220 technicians have college degrees, accounting for 18.22 % of the total number of this group.

At present, 13 academicians of the Chinese Academy of Sciences and the Chinese Academy of Engineering are working in CAAS. 15 CAAS scientists have been listed in the National Ten Thousand Talents Program; 21 scientists have been granted the honor of national young and middle-aged scientists in science, technology and management with outstanding contributions to China; 123 scientists have received special government allowances from the State Council; 61 scientists have been listed in the National Hundred, Thousand and Ten Thousand Talents Program; 14 scientists and 5 research teams have been ranked in the Innovative Talents Growth Program initiated by the Ministry of Science and Technology; 11 scientists have been conferred the honorary title of the Chinese Agricultural Talents by Ministry of Agriculture, and 82 scientists have been awarded Outstanding Talents for Agricultural Scientific Research.

Graduate Education

CAAS is one of the earliest institutions approved by the State Council to confer master's degrees and doctorates, and is the only doctorate conferral scientific research institution in the area of agricultural sciences. Its education program is carried out by the Graduate School of the Chinese Academy of Agricultural Sciences, known as GSCAAS.

GSCAAS, ranking the top education force among schools for agricultural science education in China, has the task of training and fostering the high-level innovative talents. With the high-level scientific research capabilities and education resources support from the CAAS institutes, GSCAAS has established a multi-layer and multi-type education system that covers master's degrees, doctorates, foreign students, specialized postgraduates and continuing education, including 65 for master's degree disciplines, 53 for Ph.D degree disciplines and 2 specialized master's degrees in agriculture and animal medicine.

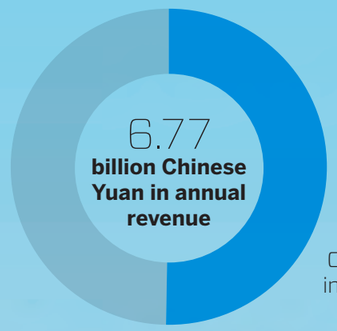
In 2015, the reform of postgraduate education was pushed forward smoothly, with an increased number of enrolled students, improved education quality, and the steady development of international education. At present, GSCAAS has 1600 supervisors, including 600 supervisors for Doctoral Programs and 550 teachers. A total of 4415 students are studying at the school. In 2015, GSCAAS enrolled 1305 students (269 for doctorates, 715 for masters, 255 for specialized masters, 47 foreign students, and 19 for doctorates under international cooperation programs). 1108 students graduated from GSCAAS. Among them were 200 PhD holders (including 27 foreigners), and 908 master's degree holders (including seven foreigners).

GSCAAS offers international students the Chinese Government Scholarship, Beijing Government Scholarship and the GSCAAS Scholarship. The study of doctorate and master's programs generally lasts three years, and the teaching language is mostly English or bilingual languages — Chinese and English. Currently, 156 foreign students are studying at GSCAAS, coming from 46 countries, covering 35 disciplines and involve in 25 institutes of CAAS.

Approved by the Ministry of Education, GSCAAS has carried out joint PhD programs with the University of Liège in Belgium and Wageningen University in the Netherlands, and it currently has 58 PhD candidates under the program. GSCAAS has continuously enhanced international cooperation and exchanges with new progress in the cooperation with world-renowned universities including the University of Sydney in Australia, Lincoln University in New Zealand, and Georg-August University of Göttingen in Germany.

Budget

The annual revenue of CAAS is 6.77 billion Chinese Yuan, up 13.57 percent on the year before. It includes government grant of 3.42 billion Chinese Yuan, up 22.36 percent from 2014. Both are the highest in the academy's history.



3.42 billion Chinese Yuan in government grant

Annual revenue

13.57% growth

Government grants

22.36% growth

Research Facilities

Major facilities for science and technology innovation: CAAS has 6 state key laboratories, 1 key laboratory co-founded by the Ministry of Agriculture (MOA) and Jilin Province, 19 comprehensive key laboratories of MOA, 23 specialized key laboratories of MOA and 19 observation and experimental stations of MOA. Also, the academy has established 22 national centers (sub-centers) for plant, and animal improvement, 5 national engineering research centers of Ministry of Science and Technology, 25 agro-products quality and safety risk assessment laboratories of MOA and 52 key laboratories of CAAS.

Major facilities for science and technology support: CAAS has established 2 major national facilities, including the National Key Facility for Crop Gene Resources and Genetic Improvement and the National Center for Agricultural Biosafety Sciences. CAAS has 11 national gene banks and 12 national germplasm nurseries, long-term preservation of 420,000 accessions in crop germplasm ranking the second largest in the world. The academy has 5 national observation and experiments field stations, 5 national engineering laboratories and 2 national engineering research centers of National Development and Reform Committee.

Major facilities for science and technology services: CAAS has established 4 national science and technology infrastructures, 3 national agro-product quality supervision and inspection centers, 26 agro-product quality supervision and inspection centers of MOA, 8 supervision and inspection centers for environmental safety of genetically modified plants of MOA. The academy also has 3 national reference laboratories, 2 FAO reference centers, and 7 OIE reference laboratories. In addition, the academy operates the National Agricultural Library, in which the collection of agricultural books and journals ranking the first in Asia and the third in the world.

Major experimental field bases for research: CAAS has 3 comprehensive experimental field bases at academic level and 103 comprehensive or specialized experimental field bases at CAAS institute level, which cover a total area of 6,459 hectare, locate in major agricultural production areas, typical agricultural ecological zones, special ecological zones, as well as major remote and undeveloped areas in 27 provinces.

Organizational Structure

President | **Secretary of Leading Party Group**

Vice-Presidents

Administrative departments
General Office
Department of Research Management
Department of Personnel
Department of Finance
Department of Infrastructure
Department of International Cooperation
Department of Agricultural Technology Transfer
CAAS Party Committee
Department of Supervision and Auditing

Logistics Service Center

Graduate School of CAAS

INSTITUTES IN BEIJING

- Institute of Crop Sciences
- Institute of Plant Protection
- Institute of Vegetables and Flowers
- Institute of Environment and Sustainable Development in Agriculture
- Institute of Animal Sciences
- Institute of Apicultural Research
- Feed Research Institute
- Institute of Food Science and Technology
- Biotechnology Research Institute
- Institute of Agricultural Economics and Development
- Institute of Agricultural Resources and Regional Planning
- Agricultural Information Institute
- Institute of Quality Standards and Testing Technology for Agro-Products
- Institute of Food and Nutrition Development of MOA

China Agricultural Science and Technology Press

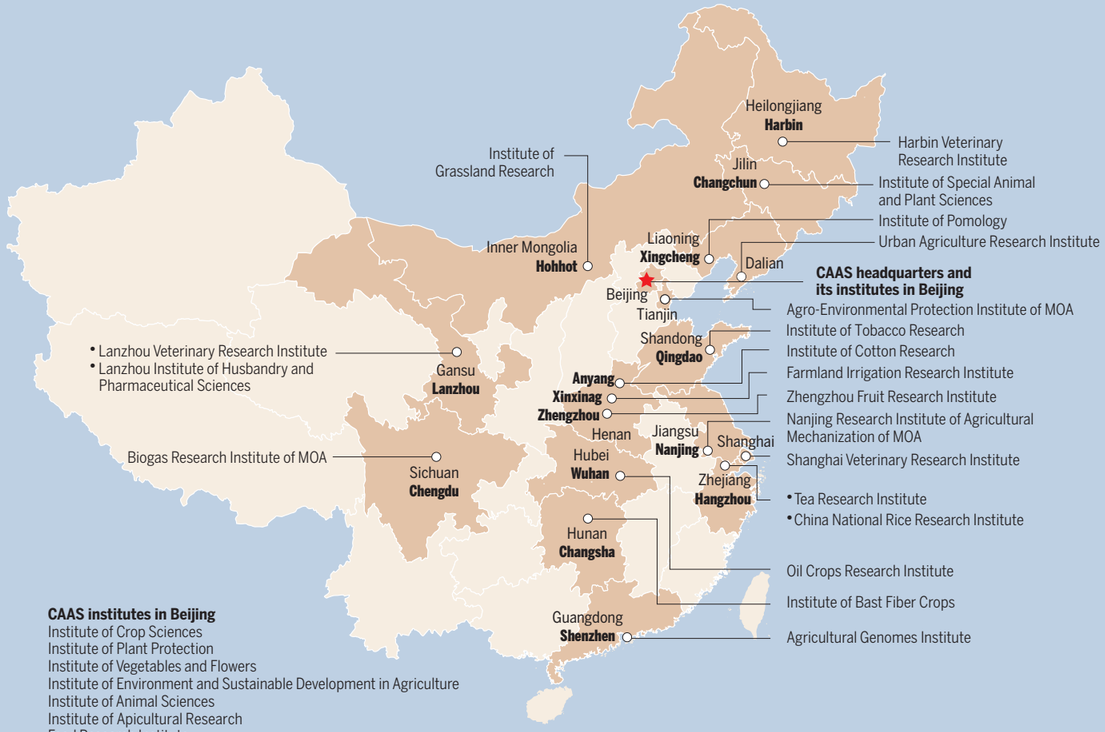
INSTITUTES OUTSIDE BEIJING

- Farmland Irrigation Research Institute
- China National Rice Research Institute
- Institute of Cotton Research
- Oil Crops Research Institute
- Institute of Bast Fiber Crops
- Institute of Pomology
- Zhengzhou Fruit Research Institute
- Tea Research Institute
- Harbin Veterinary Research Institute
- Lanzhou Veterinary Research Institute
- Lanzhou Institute of Husbandry and Pharmaceutical Sciences
- Shanghai Veterinary Research Institute
- Institute of Grassland Research
- Institute of Special Animal and Plant Sciences
- Agro-Environmental Protection Institute of MOA
- Biogas Institute of MOA
- Nanjing Research Institute of Agricultural Mechanization of MOA
- Institute of Tobacco Research
- Agricultural Genomes Institute
- Urban Agriculture Research Institute

CO-HOSTED INSTITUTES

- Citrus Research Institute
- Institute of Sugar Beet
- Sericultural Research Institute
- Institute of Chinese Agricultural Heritage Research
- Buffalo Research Institute
- Grassland Ecological Research Institute
- Poultry Institute
- Sweet Potato Research Institute
- Changchun Veterinary Research Institute
- Shenzhen Institute of Breeding and Innovation

Research Institutes Distribution



CAAS institutes in Beijing
Institute of Crop Sciences
Institute of Plant Protection
Institute of Vegetables and Flowers
Institute of Environment and Sustainable Development in Agriculture
Institute of Animal Sciences
Institute of Apicultural Research
Feed Research Institute
Institute of Agro-Products Processing Science and Technology
Biotechnology Research Institute
Institute of Agricultural Economics and Development
Institute of Agricultural Resources and Regional Planning
Agricultural Information Institute
Institute of Quality Standards and Testing Technology for Agro-Products
Institute of Food and Nutrition Development of MOA
Graduate School
China Agricultural Science and Technology Press

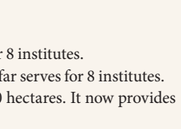
Field Stations

- The Nankou Pilot Base in Beijing, established in 1992, covers an area of 54 hectares and so far hosts pilot experiments for 8 institutes.
- The High-tech Industrial Park in Langfang, Hebei Province, established in 2003, covers an area of 133.3 hectares and so far serves for 8 institutes.
- The Comprehensive Experimental Base in Xinxiang, Henan Province has been expanded since 2009 to an area of 280 hectares. It now provides experiment sites and facilities to 6 institutes.

CAAS boasts **103** **research field stations at institute's level** | **27** **provinces, autonomous regions and municipalities** | **6459** **hectares** | Consolidating CAAS' strength for organizing the integrated research and conducting the synergic innovation.

The Nankou Pilot Base in Beijing

The High-tech Industrial Park in Langfang, Hebei Province



The Comprehensive Experimental Base in Xinxiang, Henan Province

Key Laboratories and Centers

1 Major national facilities

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

2 Key national laboratories

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

3 International reference laboratories

No	Facilities	Research	Institutes
1	FAO Reference Center of Animal Influenza	The Laboratory is in charge of the confirmative diagnosis of highly pathogenic avian influenza, animal influenza surveillance, development and update of vaccines and diagnostic reagents.	Harbin Veterinary Research Institute
2	FAO Reference Center of Biogas Technology Research and Training	Policy study and technology research in biogas-related sectors.	Biogas Institute of the MOA
3	OIE Reference Laboratory for Equine Infectious Anemia	Research focused on epidemiology and immunology of Equine 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

CAAS ANNUAL REPORT

2015

Chinese Academy of Agricultural Sciences

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