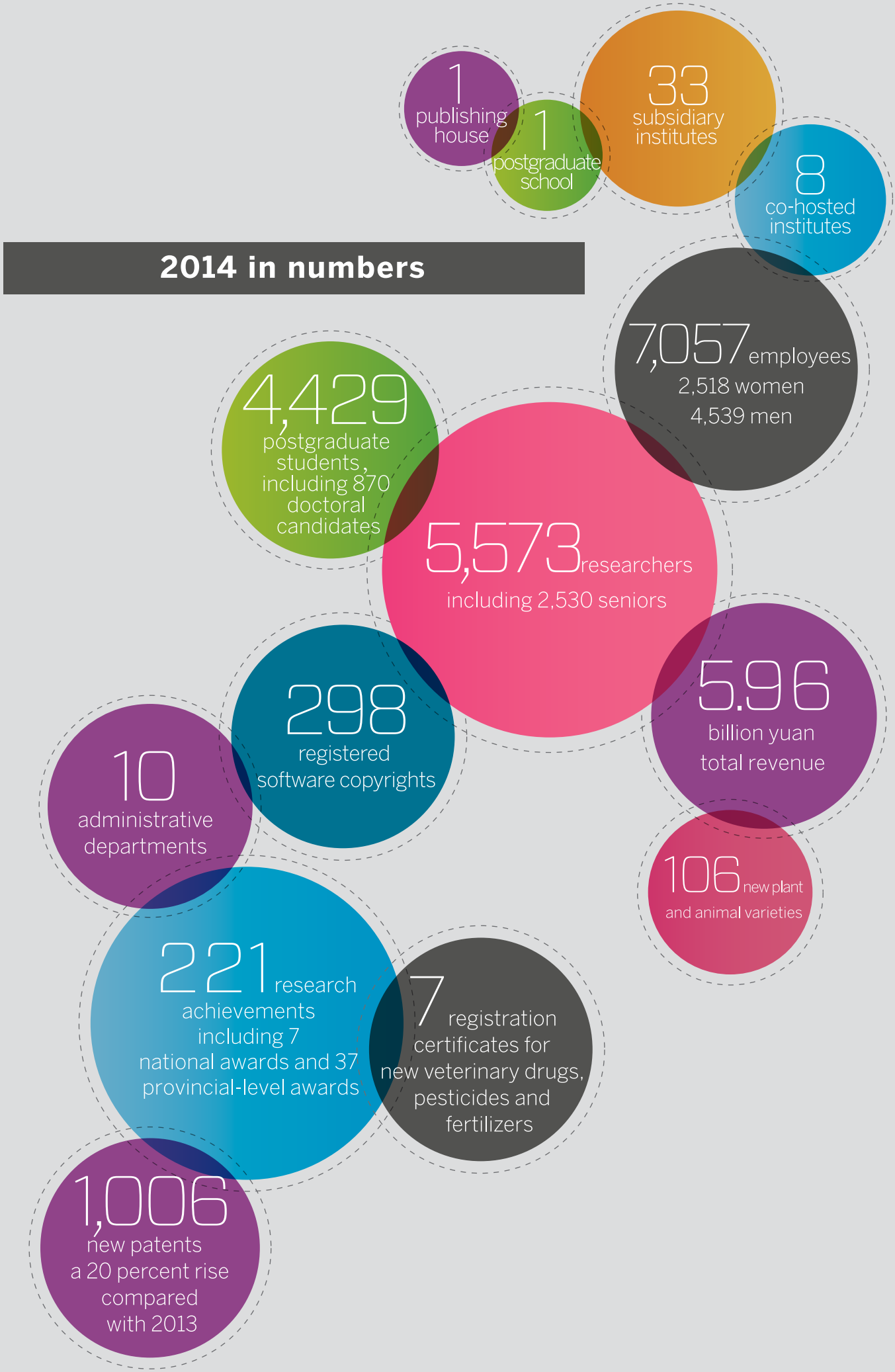
CAAS
ANNUAL REPORT

2014

2014 in numbers



Message from the President

2014 was a fruitful year for the Chinese Academy of Agricultural Sciences, with marked improvements in innovation, team building and its management system. The academy made great strides in the implementation of its Agricultural Science and Technology Innovation Program and achieved major breakthroughs in genomics research and innovative technology integration. With a growing number of research papers published in top international academic journals, new plant and animal varieties approved, invention patents granted and national technology awards presented, CAAS sharpened its edge in technology services and the industrialization of its research findings — this has enabled it to provide increasingly strong technological support for the country's food security and rural economic development.

Last year witnessed an increase in grain yield in China for the 11th consecutive year. The progress in agricultural technology contributed substantially to the growth, up to 56 percent and CAAS, as China's national team for agricultural research, played a key role in this, as it rolled out 221 research achievements, seven of which received national awards. The academy conducted research into an integrated technology-based production mode for crops, such as rice, corn, wheat, beans, cotton and oilseed rape, with nearly 2,000 researchers from 12 CAAS institutes and 210 of its partners involved. Through the new production mode they are exploring, six kinds of crops all saw a more than 10 percent growth in yearly yield — with the highest up 44.7 percent — and generated more 500 yuan ($81) per mu (0.07 hectares) than before. CAAS signed 34 key agreements on strategic partnerships with top international research institutes, hosted or organized 49 international academic conferences, built five new international joint labs and secured 245 various projects for international cooperation.

All in all, 2014 was a year in which CAAS made significant progress toward its goal of being a top world-class agricultural institution.

I would like to take this opportunity to extend my sincere gratitude to our peers both at home and overseas, who have always been caring and supportive of our endeavors. I am looking forward to more communication and cooperation as CAAS builds on its current partnerships and forges new ones.

Jiayang Li

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

Content

2014 Summary

In 2014, the Chinese Academy of Agricultural Sciences continued to advance the Agricultural Science and Technology Innovation Program, known as ASTIP, and enhanced its capacities in innovation, the industrialization of its research findings and technology services. Its endeavors in agricultural science and technology have been crucial for the country's food security and agricultural development.

In 2014, CAAS completed three recruitment drives for the pilot research teams included in ASTIP and constructed the system and structure of the program with 32 pilot institutes and 315 research teams founded. A new mechanism for research and management that is adapted to the characteristics and rules of China's agricultural research took basic shape at CAAS after the academy explored a new path of coordinated innovation.

2014 was a fruitful year for CAAS due to the major breakthroughs it achieved in applied and fundamental research, innovations in key technologies, the number of high-quality papers published in top international academic journals, the application and industrialization of its research results, and the increased international cooperation.

Applied fundamental research: Substantial progress was made in the genome studies of wheat, rice, soybean, cotton, cucumber and tobacco. CAAS has made new breakthroughs in high-yielding technologies for major grain crops. The China National Rice Research Institute has developed hybrid rice with a record high average yield of 955 kilograms per mu (0.07 hectares), and a team at the Institute of Crop Sciences developed a new variety of corn that can yield 1,227.6 kilograms per mu, a new record.

Research papers: CAAS researchers published a total of 4,646 papers as first or correspondence author in various academic journals. Among the published papers, 1,885 were collected in the Science Citation Index or Engineering Index, an increase of 21 percent from 2013 and 20 were published in top international journals such as Science and Nature.

Technology transfer: A total of 218 new varieties, 116 products and 372 technologies were promoted in 860 million mu (57.3 million hectares) areas and in 230 million livestock.

International cooperation: CAAS continued to strengthen its strategic cooperation with major international research institutions. It signed 34 technological cooperation agreements with universities, government departments and institutions, including the University of Western Australia, Ghent University in Belgium, Germany's Federal Ministry of Food and Agriculture, the French National Institute for Agricultural Research and the Argentinian National Institute of Agricultural Technology. It also established eight international platforms, including a new China-Australia joint lab for sustainable agricultural ecosystems to strengthen cooperation focusing on medicine and medical treatments, herding, animals and plant quarantine, fruit trees and vegetables.

Intellectual property: A total of 1,006 patents were granted, up 20 percent from the previous year. Of them, 497 were invention patents. Four won the national Awards for Outstanding Patents. The same year, 25 new plant varieties were developed and 106 varieties were successfully reviewed — eight of them by the State and 98 by the provincial authorities. Also, 276 books were published in 2014. Other achievements include 298 registered software copyrights and seven registration certificates for veterinary drugs, agricultural chemicals and fertilizers.

CAAS made 221 major achievements in science and technology last year, including nine winners of national awards, accounting for 39 percent of the country's total in the sphere of agriculture, and 37 provincial or ministerial-level awards.

Major breakthroughs in applied fundamental research

Key Events

January

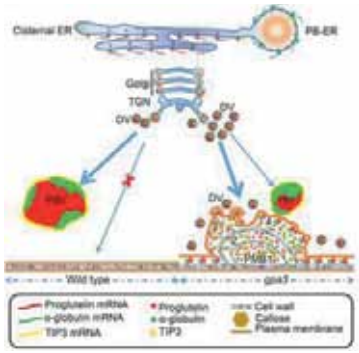
• The Key State Laboratory of Cotton Biology, co-hosted by the Institute of Cotton Research and Henan University, opened at the institute in Anyang, Henan.

• CAAS President Li Jiayang, met *Science* editor-in-chief Marcia McNutt, during her visit to the academy in Beijing.

February

• Construction on the CAAS National High-tech Agricultural Demonstration Park completed.

• Scientists at the Institute of Crop Sciences cloned the GPA3 gene, a key factor in determining rice grain quality.



March

• Scientists at the Oil Crops Research Institute led the revealing of the mechanism of oil accumulation in sesame seeds and the synthesis of sesamin which is a special antioxidant and anti-aging functional component.

• CAAS President Li Jiayang led a delegation to Australia, Indonesia and Singapore and attended the Life Science Symposium.

• Researchers at the Institute of Vegetables and Flowers and their collaborators from University of California, Berkeley, revealed the epigenetic mechanism that the methylated transposons mediate the evolution of polyploidy genomes and the differentiation of multi-copy paralogous genes.

• The CAAS-ICRAF Joint Laboratory on Agroforestry and Sustainable Animal Husbandry was unveiled.

April

• As a main partner of the International Peanut Genome Consortium, the Oil Crops Research Institute has contributed greatly to the whole genome sequencing of two wild diploid species that are thought to be the progenitors of the cultivated peanut. The sequenced genome of the two wild species are believed to cover 96 percent of the genes existing in the cultivated peanut.

• Scientists from CAAS and Zhejiang University revealed a distinct mechanism for βC1, the pathogenesis factor of geminivirus, for counteracting host RNA silencing defense by induction of an endogenous suppressor of RNA silencing.

May

• CAAS President Li Jiayang met Michael Scuse, Under Secretary of the US Department of Agriculture, during his visit to the academy in Beijing.

• Scientists at the Institute of Crop Sciences revealed the molecular basis of heterosis derived from the hybridization between species with different genome ploidy.

• The Institute of Cotton Research led genome sequencing of diploid cotton – Gossypium arboreum.

• With the completion of Brassica oleracea genome sequencing led by the Oil Crops Research Institute and the Institute of Vegetable and Flower, scientists found multi-layered intra- and inter-specific asymmetry of genome evolution.

June

• Scientists at the Tea Research Institute revealed the genetic differentiation rule of tea geometrid: Deep divergence existed in populations of tea geometrid.

• The Sino-African Training Program on Agricultural Technology opened at CAAS.

July

• In cooperation with the University of Arizona, Tucson, the Biotechnology Research Institute achieved significant breakthroughs in the research into diversity-oriented combinatorial biosynthesis of benzenediol lactone scaffolds by subunit shuffling of fungal polyketide synthases.

• CAAS signed a memorandum with the Tongzhou district government of Beijing for a CAAS branch in the district.

August

• A joint lab serving as a national agro-tech service platform backed by cloud-computing technologies was unveiled.

• A national trade center for seed-related technologies was inaugurated at CAAS.

•The International Consortium of Brassica napus Genome Sequencing, in which the Oil Crops Research Institute plays a major role as one of three leading institutes, decoded the tetraploid Brassica napus genome.

September

• Scientists at the Institute of Crop Sciences cloned the world's first stripe virus resistance gene STV11, and provided molecular insight into how the gene functions against the virus.

• Researchers at the Institute of Crop Sciences constructed the first plant pan-genome for annual wild soybean, the progenitor of cultivated soybean. The study comprehensively revealed inter-genomic variation between and within wild and cultivated soybeans on the whole-genome level.

• Scientists at the Harbin Veterinary Research Institute found a new pathway to inhibit the expression of the HIV-1 envelope protein.

October

• Two foreign experts at CAAS received the 2014 Friendship Award from the central government.

• CAAS launched a pilot project in its Agricultural Science and Technology Innovation Program for coordinated innovation.

• Researchers at the Institute of Vegetables and Flowers constructed the genome-wide variation map of the tomato.

November

• Researchers at the Institute of Vegetables and Flowers and the Agricultural Genome Institute revealed the molecular mechanisms of biosynthesis, regulation

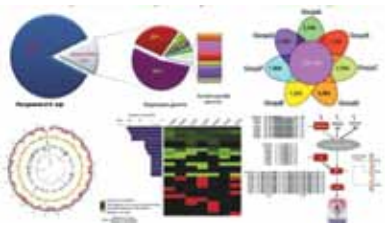
and domestication of bitterness in cucumbers.

• CAAS selected the third batch of pilot institutions for its Agricultural Science and Technology Innovation Program, which marked an end of the pilot team selection work.

December

• The National Science and Technology Innovation Association was founded, with CAAS President Li Jiayang elected as its chairman.

• Researchers at the Institute of Crop Sciences mapped and cloned the salt tolerant gene GmSALT3.



Honors and Awards

Yu Shuxun

Awarded the honorary title of being an outstanding national professional

Yu's team cultivated a range of short-season cotton and transgenic cotton varieties. Besides this, he also initiated the cotton genome sequencing projects of Gossypium raimondii, Gossypium arboretum, and Gossypium hirsutum, which already finished and will greatly promote the cotton basic research.

Qian Qian

Leading Talent of the Ten Thousand Talents Project

Qian, a researcher engaged in rice molecular breeding at the China National Rice Research Institute, has built a rice biological parent repository. His research team has cloned 73 genes with key agronomic characters, developed two new hybrid rice varieties, which are Indica rice of Japonica-quality.

Liu Wende

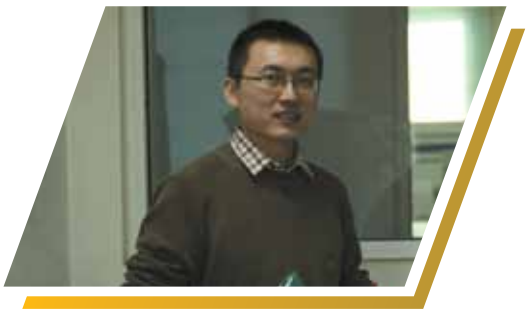
Beneficiary of the Excellent Young Scientists Fund

Liu and his research team at the Institute of Plant Protection have clarified the molecular mechanism of how rice blast fungus recognizes rice surface wax molecules, and revealed the mechanism of how protein post-translational modification, such as ubiquitylation, regulates disease resistance in rice.

Li Chengjun

Beneficiary of the Excellent Young Scientists Fund

Li and his research team at the Harbin Veterinary Research Institute revealed the mechanisms of influenza virus pathogenesis and variation, thus providing basis for risk assessment, and development and implementation of prevention and control strategies for avian influenza.



Liu Bin

Beneficiary of the Excellent Young Scientists Fund

As a principal investigator at the Institute of Crop Science, Liu identified the CRY-SPA mediated light signal transduction pathway in plants and revealed the molecular mechanism of how Cryptochromes regulate soybean leaf senescence in response to ambient light signals.

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

CAAS selected three groups of research institutions and teams for the Agricultural Science and Technology Innovation Program in 2014. The academy has devised a management system for ASTIP, one of three major national-level innovation projects, and has also been developing a collaborative mechanism for cross-institution and cross-discipline innovation.

According to the CAAS three-level disciplinary system, covering disciplinary clusters, fields and research interests, 32 pilot institutions were selected in batches to participate in ASTIP, with the original 1,026 task groups optimized and divided into 315 research teams. A group of excellent young researchers were given positions as chief experts. CAAS has been working on integrating all its resources and optimizing its research focuses, thus making its research more appealing to the market.

CAAS has also constructed a range of systems, including funding control, performance appraisal and position management. It launched a yearly performance appraisal system driven by research capacity and innovation achievements, which involved the first group of 11 pilot institutes. CAAS has also released policies to deal with such issues as the mobile positions in ASTIP that have yet to be fully utilized, and the requirements for experts in these positions have been improved. The quotas for overseas work and the program budget have been clarified, and management of the funds for the program has been strictly carried out.

In response to what the nation and the industry need strategically, CAAS has integrated resources from different disciplines and institutions to devise a collaborative innovation system in fields such as protection of the black soil in Northeast China, underground water resources efficiency in North China and prevention of heavy metal contamination of rice in South China. The academy proposed and coordinated a series of nationwide cooperative innovation projects aimed at improving the yield of major crops and cash crops, as well as the development of animal husbandry. Its focuses for coordinated innovation include genome-designed seedlings, control of diseases shared between humans and livestock, and crop C3's biosynthetic pathway into crop C4 and high photosynthetic efficiency in breeding. Through such cooperative projects, the disciplinary clusters inside CAAS and research teams from outside CAAS and around the world have cooperated for progress in modern agricultural science and technology, and CAAS, as China's national team for agricultural research, is the domestic leader in the field.

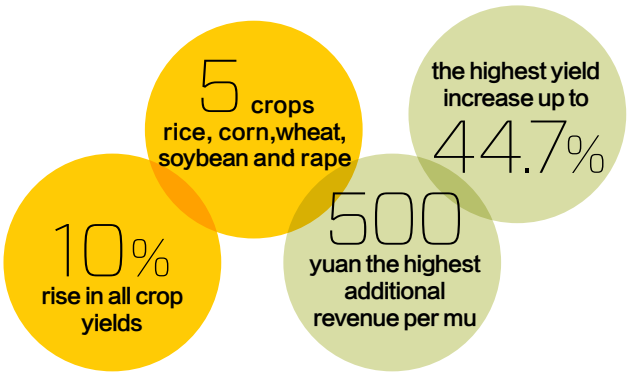
2. The Elite Youth Program

The Elite Youth Program is one of the important initiatives CAAS launched to recruit high-quality scientists with a global vision under the age of 40. The program aims to develop an innovative approach to recruit talent that is both a good fit for the academy and also globally. It also seeks to improve the innovation capacity of CAAS research teams, as well as their international competitiveness and academic research capacity, and it provides strong support in human resources to help CAAS realize its goal of becoming a world-class agricultural research institute and achieve "a quantum leap forward in development". The program is divided into four categories. Category A refers to scientists brought in from overseas, B refers to those selected in China, C refers to those introduced through the "Thousand Youths Talent Program" and D refers to those introduced with funds from CAAS institutes.

Based on scientific development and team building needs, the program has strict procedures for recruitment that focus on achievements and potential. Young scientists need to pass reviews to become candidates and then pass another review after a year's work in their position to be finally selected.

The program was listed as one of the nation's first 55 major overseas talent recruitment programs in 2014 and garnered a lot of attention both at home and abroad. Over the two years since it was launched, it has brought in 109 talents, including three "Nation's Outstanding Youths", one "Nation's Excellent Youth", two candidates from two of the nation's key talent programs and two from the "Thousand Youths Talent Program".

CAAS is now at a crucial stage in its development. Talents both around the country and abroad are welcome to join the academy. For more information, please visit: http://www.caas.net.cn/kjcxgczl/zytz/237653.shtml



3. Research program for the integrated production of grain, cotton, and oil crops

CAAS has conducted research into an integrated production mode to increase yields of crops including rice, corn, wheat, soybean and rape, in a bid to leverage its advantageous resources in technology, research findings, professionals and facilities, among others, to enhance technology support to agriculture. The objective of the program is to develop a new agricultural production system that helps increase efficiency and output, and increase quality and security. Some 2,000 researchers from 12 CAAS research institutes and 210 organizations outside CAAS, including local research institutes, colleges, technology promotion departments and companies, are participating in the program.

Through cooperation, they have achieved technological breakthroughs in increasing the yields of rice, wheat, corn, soybean and rape. They have developed several demonstration areas, founded research teams and established a cooperative system in which national research institutions, local governments and peer institutions have a role. The yield increases of these crops were all higher than 10 percent, with the highest up to 44.7 percent, and among them, the highest additional revenue per mu (0.07 hectares) was 500 yuan ($81).

Research Progress

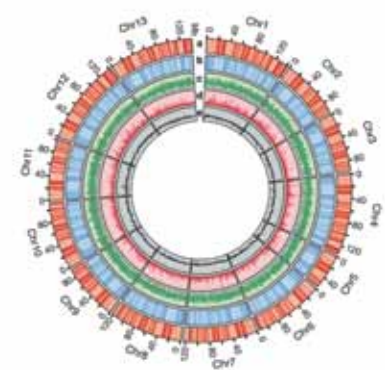
Crop Science

EVALUATION, INNOVATION AND UTILIZATION OF THE IMPORTANT TARGET BREEDING TRAITS IN WHEAT GERMPLASM UTILIZATION: Li Lihui and his research team at the Institute of Crop Sciences have developed new technologies and built novel approaches for simultaneous evaluation of multiple traits and genotypes within one growth season, including the prevention of pre-harvest sprouting, resistance to scab and resistance to wheat sharp eyespot, as well as protein composition and exogenous target genes. These technologies were built upon diverse germplasms and provided new approaches to broaden the genetic base in wheat breeding. Li's group also established technologies to explore and utilize superior germplasms, and new modes in which germplasm development works in concert with breeding. Thirty-four varieties have been developed using these elite wheat germplasms. Their plantation area has expanded up to 8.87 million hectares, and they generated 5.5 billion yuan ($880 million) in social and economic benefits. The above achievements have won the 2014 National Science and Technology Progress Award (Second Prize).

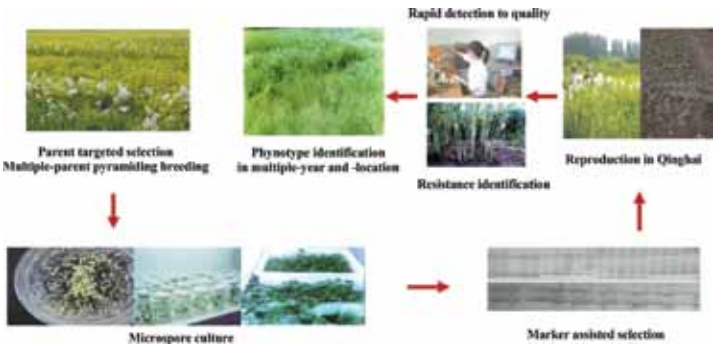
BREAKTHROUGHS IN THE RESEARCH ON RICE FUNCTIONAL GENOMICS: Wan Jianmin and his team at the Institute of Crop Sciences have made breakthroughs in understanding the molecular mechanisms involved in the rice heading date, stripe virus resistance and grain quality control. They cloned the heading date gene *DTH7*, which is also related to rice grain yield, and found that *DTH7* regulates expression of the florigen genes *Hd3a* and *RFT1* through *Ehd1* to control rice flowering. They cloned the rice stripe virus gene *STV11* and discovered that the two haplotypes of *STV11* differentiate stripe virus resistant – or susceptible, thus providing a key to develop resistant varieties through molecular breeding. They also cloned the gene *GPA3*, which controls transport of the rice storage proteins. This gene encodes a protein harboring the plant-specific Kelch-repeat, which forms a complex with *GPA1 / Rab5a and GPA2 / VPS9* (previously cloned by Wan's team) and coordinately regulates the directed transport of the storage proteins. These findings were published in *PNAS, Nature Commucations* and *the Plant Cell*, respectively.

MOLECULAR BREEDING PLATFORM FOR INSECT-RESISTANT THREE-LINE HYBRID COTTON: A research team led by Guo Sandui at the Biotechnology Research Institute established a molecular breeding platform for insect-resistant three-line hybrid cotton. The team has developed more than 300 germplasms, 40 sterile lines and 20 restorer lines, which have some excellent traits, such as high yields, disease and insect resistance, and early maturation. Over 20 elite combinations have been selected from more than 100 combinations, including five that are undergoing national or provincial trials. To date, four three-line hybrid varieties, including *Yinmian 2* and *Yinmian 8*, have been approved for commercialization by the State Committee, and the two varieties have generated 1.4 billion yuan ($230 million) in revenue. The three-line hybrid technologies help reduce the costs in seed production and improve the purity of the seeds. At the same time, growing these hybrids results in a 60 to 80 percent reduction in pesticide use compared with growing normal cotton varieties, so the environment is also protected. The technologies were awarded an Excellent Chinese Patent Award by the State Intellectual Property Office in 2014.

DECODED GENOME SEQUENCE OF DIPLOID COTTON – *GOSSYPIUM ARBOREUM*: A research team led by Li Fuguang at the Institute of Cotton Research completed the whole genome sequencing of diploid cotton – *Gossypium arboretum* (A subgenome). In this study, a highly homozygous cultivar of *G. arboreum, shixiya 1*, was sequenced. The assembly of *G. arboreum* genome is 1,694 million base pairs in total length. In all, 90.4 percent of the assembly was further anchored and oriented on 13 pseudochromosomes. Also, 41,330 protein-coding genes were predicted in *G. arboreum*. It was found that 68.5 percent of the genome was occupied by repetitive DNA sequences and long terminal repeat retrotransposons accounted for 95.12 percent of all repeat sequences. An article "Genome sequence of the cultivated cotton *Gossypium arboreum*" was published in *Nature Genetics* on May 18, 2014. This is another breakthrough in cotton genome research in China, following the completion of genome sequencing of diploid cotton *Gossypium raimondii* (D subgenome).



TECHNOLOGY FOR BREEDING HIGH OIL CONTENT RAPESEED AND ITS APPLICATION: A research team led by professor Wang Hanzhong has established the largest natural rapeseed group with the most widely genotypic variation in oil content. Through specific genetic experiments, the team is the first in the world to prove that seed oil content is mainly regulated by the maternal genotype. They also identified five pathways to regulate oil content in four high oil resources and six new functional genes with proprietary intellectual property. With the association population and segregation population, they clarified the correlations between oil content and yield component traits were not significant. They created five new varieties (hybrids) of double low rapeseed with high oil content, high yield, multiple resistance, and wide adaptability. Of the varieties, *Zhongshuang 11* boasts the world's high oil content — up to 49.04 percent, strong shattering resistance, high lodging, and anti-Sclerotinia. As the highest oil content of all winter rapeseed open-pollinated varieties in China, *Zhongshuang 11* overcomes the contradiction of double low rapeseed varieties between high oil content and high yield and multi-resistance. The study received a 2014 National Award for Technological Invention (Second Prize).

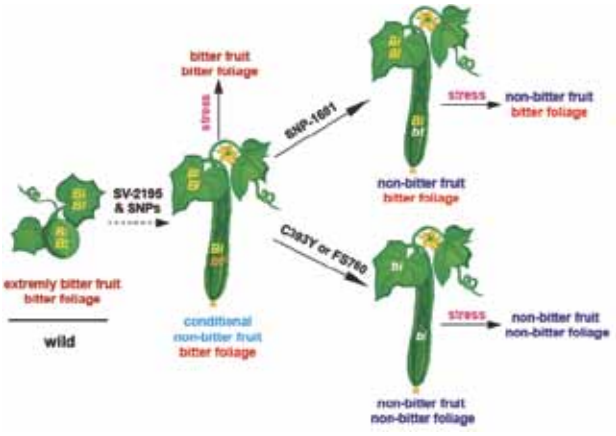


KEY CULTIVATION TECHNIQUES FOR SUPER RICE AND THE REGIONALIZED INTEGRATED USE FOR HIGH YIELDS: Research, led by Professor Zhu Defeng at the China National Rice Research Institute, revealed the high-yielding growth characteristics of super rice varieties and elucidated the common mechanism for its high yield formation, through which practical diagnostic indicators of the high-yielding plant population were established and key cultivation techniques have been developed to increase the yields of super rice. The super rice cultivation techniques were used in more than 1.19 million hectares, and rice yields increased by 6.4 million tons, creating economic benefits of nearly 14 billion yuan ($2.26 billion) from 2011 to 2013. The achievements have yielded enormous economic, social and ecological benefits, making great contributions to grain production and food security for China. The research results were granted the 2014 National Science and Technology Progress Award (Second Prize).

***DE NOVO* SEQUENCING AND ASSEMBLY OF WILD SOYBEAN FOR PAN-GENOME ANALYSIS OF DIVERSITY AND AGRONOMIC TRAITS:** A team led by Qiu Lijuan at the Institute of Crop Sciences constructed the first plant pan-genome for annual wild soybean, the progenitor of cultivated soybean, through sequencing and de novo assembly of seven representative accessions. The genome size of pan-genome is 986.3 million base pairs. Among the 59,080 annotated gene families, nearly half (48.6 percent) are conserved across all seven G. soja genomes as core genomic units, which were enriched in biological processes such as growth and immune system processes reflecting the biological characteristics of wild soybean species. Approximately half of the gene families (51.4 percent) were present in more than one, but not all seven G. soja genomes, and represent the dispensable genome, perhaps reflecting a role in adaptation to various abiotic and biotic stresses. The study revealed inter-genomic variations such as lineage-specific genes and genes with copy number variation or large-effect mutations and indicated a set of genes that may contribute to variation of agronomic traits. G. soja contained more R (Resistant)-gene domain architectures than G. max possibly reflecting adaptation to varied biotic stresses. This work illustrates the value of de novo assemblies in building and characterizing large eukaryotic pan-genomes and provides domestication related candidate genes. It will facilitate the harnessing of untapped genetic diversity from wild soybean for enhancement of elite cultivars. The team's findings were published online in *Nature Biotechnology* on Sept 14, 2014.

Horticulture Science

CUCUMBER, POTATO, CHINESE CABBAGE GENOME RESEARCH: The teams led by Wang Xiaowu and Huang Sanwen at the Institute of Vegetables and Flowers made a significant breakthrough in genome research on vegetable crops. They *de novo* or re-sequenced the genomes of important vegetables such as the cucumber, potato, tomato and cabbage, and investigated their genome structures, evolution and genetic variations to reveal the genetic basis for domestication, improvement, divergence and introgression during vegetable breeding. Especially, in combination with comparative genomics and metabolomics in the cucumber population, they are the first to have reported a nine-gene cluster that is a directly participant in the secondary metabolites biosynthesis of bitterness in cucumber, revealing the molecular basis of biosynthesis, regulation and domestication of bitterness in cucumbers. The innovation teams from the IVF provided a good example of the integration of big data, such as genomics, variation map, transcriptome, with metabolomics and molecular tools to solve a breeding problem in vegetable crops. Their findings were published online in the world's top journals including *Science*, *Nature*, *Nature Genetics* and *PNAS* in 2014.



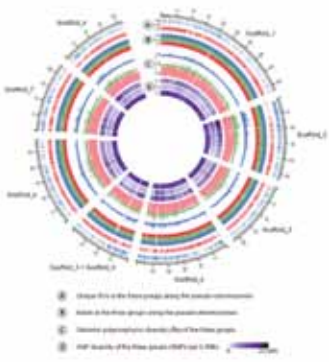
ESTABLISHMENT OF A MALE STERILE BREEDING SYSTEM FOR CABBAGE AND THE DEVELOPMENT OF NEW VARIETY: Fang Zhiyuan's team at the Institute of Vegetables and Flowers are the first to identify the cabbage dominant genic male sterile material and set up the breeding system with male sterile lines. They created the backcross breeding techniques with the self compatible lines to get the fine CMSR3 cytoplasmic male sterile lines. The team developed a batch of excellent core inbred lines and six cabbage new varieties with breakthroughs. The new varieties were extended up to 666,666.7 hectares in 25 provinces in China and generated 3 billion yuan ($480 million) in newly increased economic benefits. The team also initiated a new approach of hybrid seed production in cabbage and enriched the theory and practice for genetic breeding with male sterility in vegetables. Their research plays an important role in enhancing the breeding level, ensuring an adequate vegetable supply, and reducing the impact of vegetable varieties from abroad. The achievement was granted the 2014 National Science and Technology Progress Award (Second Prize).

ESTABLISHMENT OF A MARKER-ASSISTED SELECTION SYSTEM AND BREEDING CUCUMBER CULTIVARS WITH HIGH FRUIT QUALITY AND MULTIPLE DISEASE RESISTANCE: A research team led by Gu Xingfang at the Institute of Vegetables and Flowers accomplished chromosomal genetic mapping for 13 quality traits and resistance to four diseases for the first time in cucumbers after 20 years of collaborative study. And 32 simple sequence repeat and Indel markers were developed. Based on molecular marker-assisted and gene pyramiding technologies, eight new inbred lines carrying five to six high quality traits and seven to eight disease resistances were generated. Also six cucumber commercial varieties were bred which accomplished the updating for cucumber varieties. The six new varieties were spread more than 377,000 hectares in 27 provinces. The cumulative increased economic benefits reached 7.69 billion yuan ($1.24 billion). The spread area of the six cultivars run up to 14,500 hectares and accounted for more than 50 percent of total cucumber cultivation areas in Beijing. This study won the 2014 Beijing Municipal Science and Technology Award (First Prize).

BREEDING OF DWARF PEAR GERMPLASM AND ROOTSTOCKS: A pear breeding research team led by Jiang Shuling at the Institute of Pomology has taken the lead in breeding dwarf pear germplasm and stocks with proprietary intellectual property in China. To date, the research team has bred 40 new varieties of dwarf pears with high fruit quality and five dwarf pear rootstocks that have high compatibility with both Eastern and Western pears. Their efforts have greatly enriched the dwarf pear resources of China. Also, the team proposed matching cultivation techniques, conducted dwarf and compact cultivation by combining the new dwarf rootstocks and new pear varieties. The new cultivation system has achieved a breakthrough in the cultivation and has important significance in adjusting the structure of pear varieties, increasing farmers' incomes and ensuring the pear industry's sustainable development in China. The new dwarf pear rootstocks and new varieties including "Jinxiang", "Aixiang", "Xianghongmi" and "Zaojinxiang" can help save pruning costs by 38 percent and pest control costs by 50 percent, increase harvest efficiency by one to three times, and reduce environmental pollution in the orchard and the surrounding areas, compared with vigorous rootstocks. So far, more than 30 demonstration pear orchards have been established with these varieties and rootstocks, the total popularized area has reached 6,067 hectares, and the added benefits reached 1.01 billion yuan ($160 million). The team's achievement won the 2014 Annual Sinoref Horticulture Technology Award.

COMPARATIVE POPULATION GENOMICS REVEALS THE DOMESTICATION HISTORY OF THE PEACH (*PRUNUS PERSICA*) AND HUMAN INFLUENCES ON PERENNIAL FRUIT CROPS: A research team headed by Wang Lirong at the Zhengzhou Fruit Research Institute has made marked progress with its research on peach resequencing in cooperation with the company BGI. Through large-scale resequencing of 84 peach varieties, the evolution route from *P. mira* to *P. persica* was drawn, based on the whole genome level. Meanwhile, hundreds of genes under human selection were identified. This study showed that the most primitive progenitor of *P. Persica* is *P. mira*, which evolved into *P. davidiana*, and then *P. kansuensis* — the latter having a relatively close relationship with *P. Persica*. *P. ferganensis* is indistinguishable from the cultivated varieties of peach and can only be separated in geographical terms. Although the ratio between single nucleotide polymorphisms in wild related species and those in cultivated peaches is low, only 62 percent, the ratio of specific SNPs to total SNPs within cultivated peaches is higher than the team expected. The results could give a good explanation for the contradiction between low polymorphism in genome and more phenotypic variation in cultivated peaches.

CONTINUOUS AUTOMATIC PRODUCTION LINE FOR FLAT-SHAPE GREEN TEA: Lin Zhi and his research team at the Tea Research Institute carried out a systematic study of a continuous automatic production line of flat-shape green tea and made significant progress. The team has identified the processing parameters and the quality formation mechanism of Longjing Tea. They innovated a new mechanical processing technology for producing flat-shape green tea and developed four key equipment, including a numerical control stir-fried machine, a continuous tea flattening machine and a continuous tea straightening machine. Thus the first continuous automatic production line of flat-shape green tea in China was successfully developed. Since 2009, the technology has been demonstrated and expanded in the five main tea-producing provinces — Zhejiang, Jiangsu, Guizhou, Hubei, and Shandong — and in the past three years, the technology has generated some 260 million yuan ($41.83 million) in total economic benefits, including 53.735 million yuan in direct economic benefits and 206.735 million yuan in indirect economic benefits.

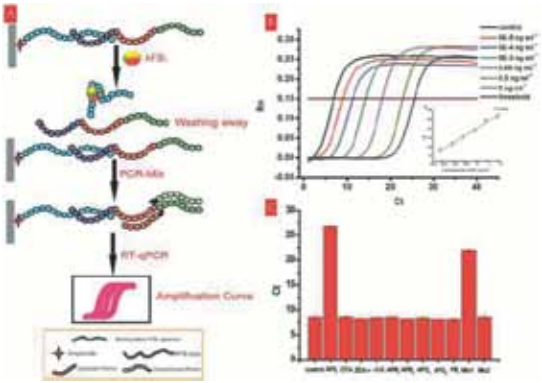


Animal Science

INNOVATION OF THE FEED ENZYME TECHNOLOGY SYSTEM AND DEVELOPMENT OF KEY FEED ENZYME PRODUCTS: A research team led by Yao Bin at the Feed Research Institute constructed an efficient technology system for mining new enzymes and genetic resources, revealed the enzyme structure-function relationship and high-level expression mechanism, and achieved large-scale production of feed enzymes with yields up to 10-50 g/L. The team has developed several feed enzymes, which helped yield farming production outputs three-fold higher than other technologies. Currently, the enzyme products are distributed nationwide, accounting for over 80 percent of the market, and they have been exported to more than 20 countries. As a result, 60 million tons of feedstuff resources have been saved and more than 10 million tons of pollutants have been reduced. The achievements won the second prize of 2014 National Science and Technology Progress Award.

AN ULTRASENSITIVE APTASENSOR FOR THE DETECTION OF AFLATOXIN B1 IN BABY FOOD: A research team led by Zheng Nan at the Institute of Animal Science has made major progress in the research on key technologies for testing the safety of baby food. An ultrasensitive aptasensor for the detection of aflatoxin B1 in baby food was developed for food safety. A corresponding research paper entitled "Development of an ultrasensitive aptasensor for the detection of aflatoxin B_1 " was published in the sixth issue of Biosensors and Bioelectronics in 2014.

Contamination of feed and food by aflatoxin B1 (AFB1), one of the most toxic of the mycotoxins, is a global concern. To prevent food safety scares and avoid subsequent economic losses due to the recall of contaminated items, methods for the rapid, sensitive and specific detection of AFB1 at trace levels are much in demand. Due to the complexity of food matrices, in order to improve the detection of mycotoxins in food, an ultrasensitive aptasensor was described for the detection of AFB1. An AFB1 aptamer was used as a molecular recognition probe, while its complementary DNA played a role as a signal generator for amplification by real-time quantitative polymerase chain reaction (Figure A). Under optimal conditions, a limit of detection (LOD) of 2.5×10−8 mg/kg was achieved, which is the most sensitive method for AFB1 up to now (Figure B). In addition, the proposed aptasensor exhibited excellent specificity for AFB1 compared with eight other mycotoxins, with no obvious Ct value change (Figure C).



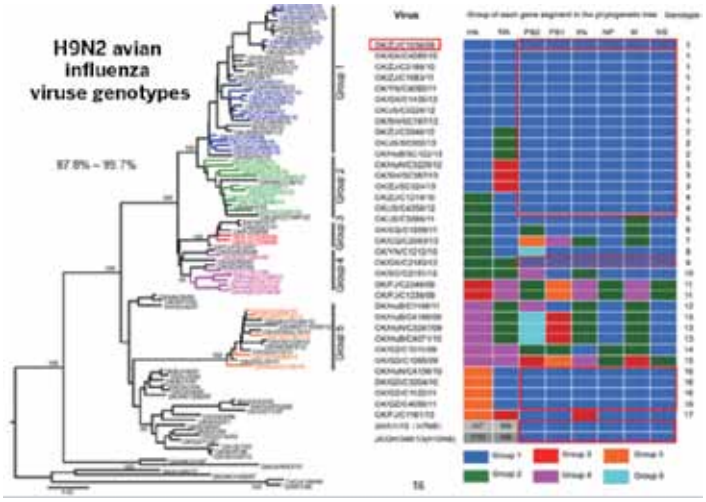
STUDY INTO THE MECHANISM OF HONEYBEE EMBRYOGENESIS: Li Jianke and his research team at the Bee Research Institute used liquid chromatography combined with mass spectrometry and bioinformatics to investigate the key biological pathways and the mechanism for honeybee embryogenesis. The in-depth characterization of the proteome changes during the honey bee embryogenesis provides a greater understanding of the molecular mechanism that underlies the process of embryogenesis in honey bee workers, and offers new insights into the embryology of other social insects. The research paper was published in the top-class international journal of proteome research, *Molecular and Cellular Proteomics*, in September 2014.

CONSTRUCTION AND UTILIZATION OF A GENETIC RESOURCES SHARING PLATFORM FOR SPECIAL ECONOMIC ANIMALS IN CHINA: Yang Fuhe and his team at the Institute of Special Economic Animal and Plant Sciences have constructed the biggest special economic animal germplasm resource library in the world, containing sika deer, wapiti, mink, blue fox, silver fox and pheasant et al., and established a technical system for germplasm resource preservation. They have formulated more than 60 technical regulations, involving investigation, integration, evaluation, preservation and sharing of genetic resources, among others. The team researched and evaluated 48 selected fine varieties thoroughly at the phenotypic and molecular levels, and established a complete germplasm resources database and information retrieval system for special economic animals. They share the information via a special economic animal germplasm resources website www.spanimal.cn. The team also developed six new varieties — Qingyuan wapiti, Siping sika deer, Minghua black mink, Jilin white racoon dog, Zuojia pheasant and Changbaishan sika deer, and provided breeding materials for breeding18 new varieties.

Veterinary Medicine

DEVELOPMENT AND APPLICATION OF FOOT AND MOUTH DISEASE (FMD) VIRUS SEROTYPE O BURMA'S 98 (MYA98) VACCINE: Liu Xiangtao and his research team at the Lanzhou Veterinary Research Institute have developed the world's first effective vaccine against O/MYA98. The vaccine is an important tool for rapid response to outbreaks of FMD. Temporary and formal permission for production has been authorized by the Ministry of Agriculture, and a new veterinary drug registration certificate has also been accredited. In all this innovative team has published 21 papers. They have established platforms for screening a vaccine seed virus and evaluation of vaccine efficacy based on molecular epidemiological technology and optimized the technique for vaccine quality control. By December 2013, 1.59 billion milliliters of vaccine products had been sold in 31 provinces, which generated 878 million yuan ($141.25 million) in sales, $268,000 in exports and 81.9 million yuan in taxes. The vaccine is the dominant product for FMD control in the domestic market at present. It is estimated that it has generated 3.67 billion yuan in annual average economic benefits. The related scientific outcomes have been granted the 2014 Gansu Provincial Science and Technology Progress Award (First Prize).

GENETICS, RECEPTOR BINDING PROPERTY, AND TRANSMISSIBILITY IN MAMMALS OF NATURALLY ISOLATED H9N2 AVIAN INFLUENZA VIRUSES: Avian influenza viruses continue to present challenges to human health. Recently the H7N9 and H10N8 viruses that are of low pathogenicity for poultry have caused human infections and deaths in China. H9N2 influenza viruses have been isolated worldwide from wild and domestic avian species for several decades, and their low pathogenic nature to poultry made them a low priority for animal disease control, which has allowed them to continue to evolve and spread. The animal influenza team headed by Chen Hualan at the Harbin Veterinary Research Institute investigated a series of H9N2 influenza viruses that were detected in live poultry markets in southern China. They found that these viruses are able to preferentially bind to the human-type receptor, and some of them can cause disease and transmit between ferrets via respiratory droplets. All the transmissible H9N2 viruses have a similar internal gene constellation, which was also present in the H7N9 and H10N8 viruses. Their study indicates that the widespread dissemination of H9N2 viruses poses a threat to human health not only because of the potential of these viruses to cause an influenza pandemic, but also because they can function as "vehicles" to deliver different subtypes of influenza viruses from avian species to humans. Their research results were published in the journal of *PLoS Pathog.*



DEVELOPMENT OF A VACCINE AGAINST THE DUCK TEMBUSU VIRUS: Li Zejun and his team at the Shanghai Veterinary Research Institute are the first to have isolated and identified the causative agent causing pandemic infectious disease in duck farms. They named it the Duck Tembusu virus. They established standard methods for isolating and identifying the virus, and developed a Duck Tembusu virus ELISA antibody detection kit. Subsequently, Li and his colleagues developed an avirulent Tembusu virus. High doses of the virus were unable to infect susceptible ducks at high doses, nor be transmitted among them. The avirulent Tembusu virus elicited positive immune responses in ducks inoculated at low doses and provided complete protection against a virulent strain. The team is the first in the world to have developed a live vaccine against the Duck Tembusu virus based on an avirulent Tembusu virus. The Ministry of Agriculture has given a green light to clinical trials of the vaccine.

Agricultural Resources and Environment

REMOTE MONITORING TECHNOLOGIES TARGETED AT DROUGHT AND FLOOD DISASTERS: Since 1998, Tang Huajun and his team at the Institute of Agricultural Resources and Regional Planning, have stuck to the main line "theory innovation—breakthrough—application service", made great theoretical innovations in remote sensing monitoring of agricultural flood and drought, and broke three big technical bottlenecks — "quick access to information of drought and flood disasters, dynamic analysis of the disaster and the quantitative assessment of damage". Based on this, they have developed China's first high-precision, short-cycle and multi-scale remote sensing monitoring system targeted at agricultural drought and flood disasters. The system is able to quickly acquire agricultural disaster information within 24 hours, routinely monitor soil moisture for once 10 days and emergency monitoring once three days, while the water extraction technology based on a combination of optical and microwave bands has largely improved the regional monitoring capacity from 75 percent to more than 90 percent. Moreover, the technology for loss assessment at different crop growth stages due to drought and flood disasters was developed. Using this, it is possible to quickly evaluate the area and degree damaged by the disasters and to get the monitoring report ready within four hours. They won the 2014 National Science and Technology Progress Award (Second Prize).

RESEARCH ON THE NANO-BASED FORMULATION OF PESTICIDES AND VETERINARY DRUGS: After years of joint research with international and domestic collaborators, the research team led by Professor Cui Haixin at the Institute of Environment and Sustainable Development in Agriculture has developed a novel technological system for producing nano-based formulations of pesticide, veterinary drugs and vaccines with target-oriented and a controllable release function for increased efficacy and safety. With huge market potential, these technologies have been industrialized and are now promoted in crops and livestock production. The new products have generated a total of 4 billion yuan ($640 million) in production output value and up to 39 billion yuan in indirect economic benefits. The nano-pesticide has been used in more than 350 million mu (23 million hectares) for controlling plant diseases, pests and weeds in grain, vegetable, fruits and economic crops. Nano-vaccines and nano-veterinary drugs have been applied to 4.7 million livestock, including cattle, sheep and pigs, for prevention and cure of the parasites and infectious disease. These achievements won the team the 2014 Beijing Municipal Science and Technology Award (Second Prize).

NEW PROGRESS IN THE REMOVAL MECHANISMS OF ENVIRONMENTAL CONTAMINANTS, INCLUDING ORGANICS AND HEAVY METALS, BY BIOCHAR: Lian Fei and his team at the Agro-environmental Protection Institute found that the negative charge-assisted H-bond plays a crucial role in antibiotic sulfamethoxazole adsorption by low-temperature herb residue biochar, which throws light on the development and environmental applications of low-temperature biochars. Moreover, they developed a novel synthesis method to load MnOx nanoparticles on biochars uniformly. After a biochar is coated with manganese-oxide, its Cu2+ adsorption capacity can be significantly increased, higher than that of commercial activated carbons. The research finding provides novel methodology for the synthesis of efficient adsorbents and remediation of soils contaminated with heavy metals. The above two research results were published in *Chemical Engineering Journal* in January and March 2014, respectively.

CONSTRUCTION OF HIGHER EFFICIENCY, STRESS-TOLERANT ENGINEERED *ZYMOMONAS MOBILIS* STRAINS AND THEIR APPLICATION IN BIOMASS ENERGY: To construct higher efficiency, stress-tolerant engineered *Zymomonas mobilis* strains for biomass energy production, Hu Guoquan's research team at the Biogas Institute of the Ministry of Agriculture focused on improvements to *Z. mobilis* strains. Based on the previous studies on transcriptomics under environmental stress conditions, adaptive laboratory evolution, genome engineering, global transcription machinery engineering, EZ-Tn5-based random mutagenesis system and other modern microbial breeding techniques were used to break through fermentation bottlenecks under environmental stress conditions. More than 10 engineered strains were developed, and they showed higher furfural acetic acid, ethanol and salt stress tolerance. On the other hand, new biomass resources such as bamboo, wetland plants and dextran industrial waste water were also explored for biomass energy production. Based on engineered *Z. mobilis* strains, the key technologies for ethanol production from these biomass resources were also created. Some results have been published in international academic journals, such as *Biotechnology for Biofuels*, *Carbohydrate Polymers*, *Environmental Progress and Sustainable Energy*, *Bioscience Biotechnology and Biochemistry*, and *The Korean Journal of Chemical Engineering*.

A NOVEL MUTULISTIC VIRUS IN *HELICOVERPA ARMIGERA*: The research led by Professor Wu Kongming at the Institute of Plant Protection discovered a novel virus, named HaDNV-1, which is beneficial to its host (*H. armigera*). The cotton bollworms carrying HaDNV-1 were heavier, fatter and developed at a faster rate, and adult females produced more offspring and lived longer. Moreover, densovirus-carrying individuals were more resistant to *Bacillus thuringiensis* at low doses, and were more resistant to the HaNPV baculovirus across a range of doses, suggesting a mutulistic relationship between HaDNV-1 and its host. HaDNV-1 was found to be widespread in wild populations of cotton bollworm adults. The research using the samples of different bollworm groups in various regions from 2008 to 2012 showed about an 80 percent prevalence. It suggested that the relationship among organisms is complicated in the natural ecosystem and also showed new challenges to the biocontrol method. These results showed new insight into the relationship between viruses and their insect hosts, and have far-reaching research significance in revealing the co-evolution of species in the agricultural ecosystem and developing novel theories and methods for pest management. Related results were published in the international peer-reviewed journal *PLoS Pathogens* in October 2014.

Agricultural Mechanization and Engineering

CROP WATER REQUIREMENT INFORMATION COLLECTION; IRRIGATION TECHNOLOGY AND EQUIPMENT: Duan Aiwang and his research team at the Farmland Irrigation Research Institute organized related domestic units to carry out research on crop water information collection and precision irrigation control technology and equipment. Six dominant technologies and 15 supported products were developed, including soil moisture monitoring equipment, diagnosis of crop water needs via differences in stem diameters, analysis of crop transpiration by heat pulse monitoring, irrigation forecasting equipment, diagnostic index system for crop water status and decision-making. The technologies were granted eight invention patents and six utility model patents in China. Their research results have been widely used and have significant social and economic benefits in fields such as soil moisture monitoring and the efficient management of medium- and large-scale irrigation areas. The achievement won the 2014 Henan Provincial Science and Technology Progress Award (Second Prize).

8
invention patents

6
utility model patents

RHIZOME TUBER CROPS COMBINE HARVESTER: Hu Zhichao and his research team at the Nanjing Research Institute for Agricultural Mechanization have proposed a creative concept to establish a shared technology platform for an optimized module design for a combine agricultural machine, which enables replacement of key parts for harvest mechanization of various underground fruits such as peanuts and garlic. The design addresses the problems of existing underground fruits (rhizome tuber crops) harvester machines which are only suitable for one crop. Their problems include poor adaptability, low utilization rate and a long period for investment returns, and face difficulties in their promotion for application large areas. The team realized making one machine with multiple functions would increase the utilization rate and shorten the investment-for-returns period. Their innovation can not only increase harvest efficiency while greatly reducing labor intensity and freeing farmers from heavy labor, it also saves operating costs, increases farmers' incomes and would achieve remarkable economic and social benefits. Their patents won a 2014 Annual Outstanding Chinese Patent Award, which is awarded by the State Intellectual Property Office and the World Intellectual Property Organization in 2014.

4HLB-4 PEANUT COMBINE: To speed up the technology maturation and industrialization development of a four-line head-feed peanut combine, the team led by Hu Zhichao at the Nanjing Institute of Agricultural Mechanization conducted in-depth research targeted at the problems found in its first-round prototype. As a result, they have systematically optimized and improved the machine's total configuration, seedling transport and delivery, and cleaning quality and reliability. The new-version combine machine features speedy adjustment, copying depth-limited mechanism, seedling delivery and transport and a double wind system for smooth screening and cleaning. The test shows that the combine boasts a reasonable total configuration, a stable the of gravity center, convenient spacing adjustment, and reliably copying depth-limited mechanism. The steps in its operation, including digging, seedling picking and transport, soil cleaning, connecting and merging, fruit picking and cleaning, impurities discharge, seedling screening, and fruit collection and unloading were smooth and reliable. As a result, it helps increase the peanut picking rate while reducing peanut broken rate, losing rate and impurities. The production efficiency of the equipment can reach 6-7 mu (some 0.4 hectares) per hour, which is more than two times that of the two-line head-feed peanut combine on the market. With four invention patents, the technology of the four-line head-feed peanut combine getting mature, which provides powerful technical support to satisfy the requirements of peanut mechanization and efficient harvest in China.

Agro-product Quality, Safety and Processing

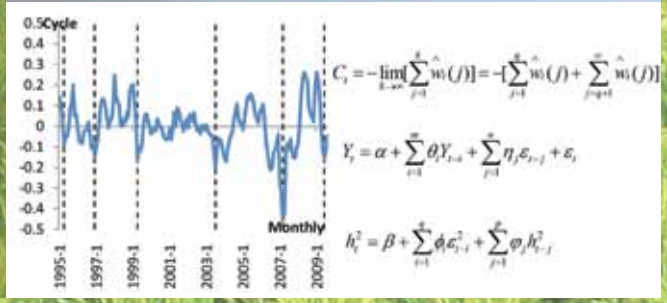
LOW-TEMPERATURE PRESSING TECHNOLOGIES FOR PEANUT OIL AND HIGH-VALUE UTILIZATION TECHNOLOGY FOR THE PROTEIN IN OILSEED RESIDUES: Wang Qiang and his team at the Institute of Agro-Products Processing Science and Technology developed low-temperature pressing technology and subcritical extraction equipment for peanut oil and protein powder production, which has realized the innovation of peanut oil extraction. They also developed the technologies for peanut protein concentrate production and modification, conarrachin production, which has filled a void in the domestic industry, and they were the first in China to use peanut protein for meat processing. They also developed technologies for the production of functional peanut peptides, which has greatly improved the added value of products. These technologies have been industrialized in enterprises mainly in Shandong and Henan provinces, producing 15 billion yuan ($2.41 billion) in accumulative sales revenues, 800 million yuan in new profits, and 200 million yuan in tax revenues in three years. These technologies have overcome the technical bottleneck and equipment problems currently existing in the peanut processing industry, created a precedent for the high value-added use of cold pressing and peanut protein, and provided technology support for the improvement of grain nutritional quality and a guarantee of national grain security. This achievement won a National Award for Technological Invention (Second Prize) 2014.

15
billion yuan
in sales for
three years

PILOT SCALE TESTS AND PRODUCT DEVELOPMENT OF RAPID SAMPLE PRETREATMENT TECHNOLOGY BASED ON MOLECULARLY IMPRINTED SOLID PHASE EXTRACTION: A research team headed by Wang Jing at the Institute of Quality Standards and Testing Technology for Agro-Products optimized the polymerization conditions including functional monomer, template molecules, cross-linking agent, initiator and polymerization methods, and synthesized the molecularly imprinted polymers, also known as MIPs. The surface morphology and select properties of MIPs were subsequently characterized by electron microscope, pore volume and pore size determination, infrared spectroscopy, nuclear magnetic resonance and chromatography. Furthermore, the conditions for pilot scale tests, solid phase extraction columns and adsorption extraction were improved. The six kinds of molecularly imprinted solid phase extraction columns for 17 kinds of triazine herbicides, three kinds of sulfonylureas herbicides, chloramphenicol, melamine, β-agonists and nonylphenol were developed. Based on the six kinds of molecularly imprinted solid phase extraction columns, the fast, highly sensitive detection methods for 17 kinds of triazine herbicides, three kinds of sulfonylureas herbicides, chloramphenicol, melamine, β-agonists and nonylphenol were established. Finally, the mature products of molecularly imprinted solid phase extraction columns were stably worked out.

Agricultural Information and Economics

A STUDY OF THE FLUCTUATIONS IN THE PIG INDUSTRY AND RELATED COUNTERMEASURES: A research group led by Wang Mingli at the Institute of Agricultural Economics and Development has conducted systematic research into the industry's cycle of fluctuations. They took the lead in applying Beveridge and Nelson decomposition techniques to identifying the fluctuation rules and influential factors in the Chinese industry and designing a market early warning mechanism and a regulation system for the industry. They used a GARCH model to explore the aggregation and leverage effects in pig production and price fluctuations in the Chinese market and provide guidance on a short-term emergency mechanism and a long-term pork security mechanism, in a bid to deal with excessive volatility in the pig industry. The study results have been adopted by the animal husbandry department of the Ministry of Agriculture, Beijing's bureau of animal husbandry and other government agencies when they made major industrial policies such as subsidies for sows and a control plan for pig production and price regulation. The team also published the results of their research in "*A Study of the Fluctuation Rules and Control Measures in China's Pig Industry*" with the China Agricultural Press.



CONSTRUCTION AND APPLICATION OF A SERVICE PLATFORM FOR SHARING SCIENTIFIC AGRICULTURAL DATA: A research team led by Meng Xianxue at the Agricultural Information Institute has set up a database for sharing scientific agricultural data. The system is comprised of a main center (http://www.agridata.cn), seven professional data sub-centers for crops, animals, fishery, tropical crops, regionalization, prataculture and technology foundation, and 10 sub-provincial service centers. The team has also rolled out 71 management measures and standard specifications for sharing scientific agricultural data and services, including Agricultural Scientific Data Sharing Management Measures, Agricultural Scientific Data Checking and Quality Control Measures, Agricultural Scientific Data Classification Norms, Agricultural Scientific Data Process Flow Norms and Agricultural Scientific Metadata Standards. The portal has nearly 3 terabytes of data from 12 agricultural science disciplines. In addition, it also provides many online services, including searches and downloads, as well as special services such as data customization, data product development, and data mining and analysis.

Domestic Cooperation

1. Cooperation with local governments

☞ The Chinese Academy of Agricultural Sciences continued cooperation with the governments of Henan, Hubei, Shandong and Hebei provinces last year. In Shandong, it built a partnership with the Dezhou city government for collaboration in a range of fields, such as crops, vegetables, plant protection and animal husbandry. CAAS also initiated five cooperative projects in Ankang city, Shaanxi province, and set up a research team. Their cooperation has made substantial progress, and CAAS gave an onsite demonstration of a corn project. It also deepened cooperation with the Daxing district government in Beijing, with their fourth group of projects completed and a fifth group confirmed.

☞ CAAS accelerated the pace of collaboration on innovation, information exchange and training with local research institutes including Southwest University and CAAS branches in Heilongjiang province and the Guangxi Zhuang autonomous region.
It promoted a rice mechanical transplanting technology for pot-mat seedlings in 21 million mu (1.4 million hectares) areas in Heilongjiang province, which increased the yield by 12.4 percent on average.

2. Cooperation with research institutes

☞ **National Agricultural Science and Technology Innovation Alliance:**

Proposed by the Ministry of Agriculture, the National Agricultural Science and Technology Innovation Alliance was jointly established by CAAS and the Chinese academies of fishery sciences, tropical agricultural sciences and agricultural engineering, as well as several provincial academies of agricultural sciences and related research institutes.

At the inauguration ceremony in December, Li Jiayang, vice-minister of agriculture and president of CAAS, was selected chairmen of the alliance.

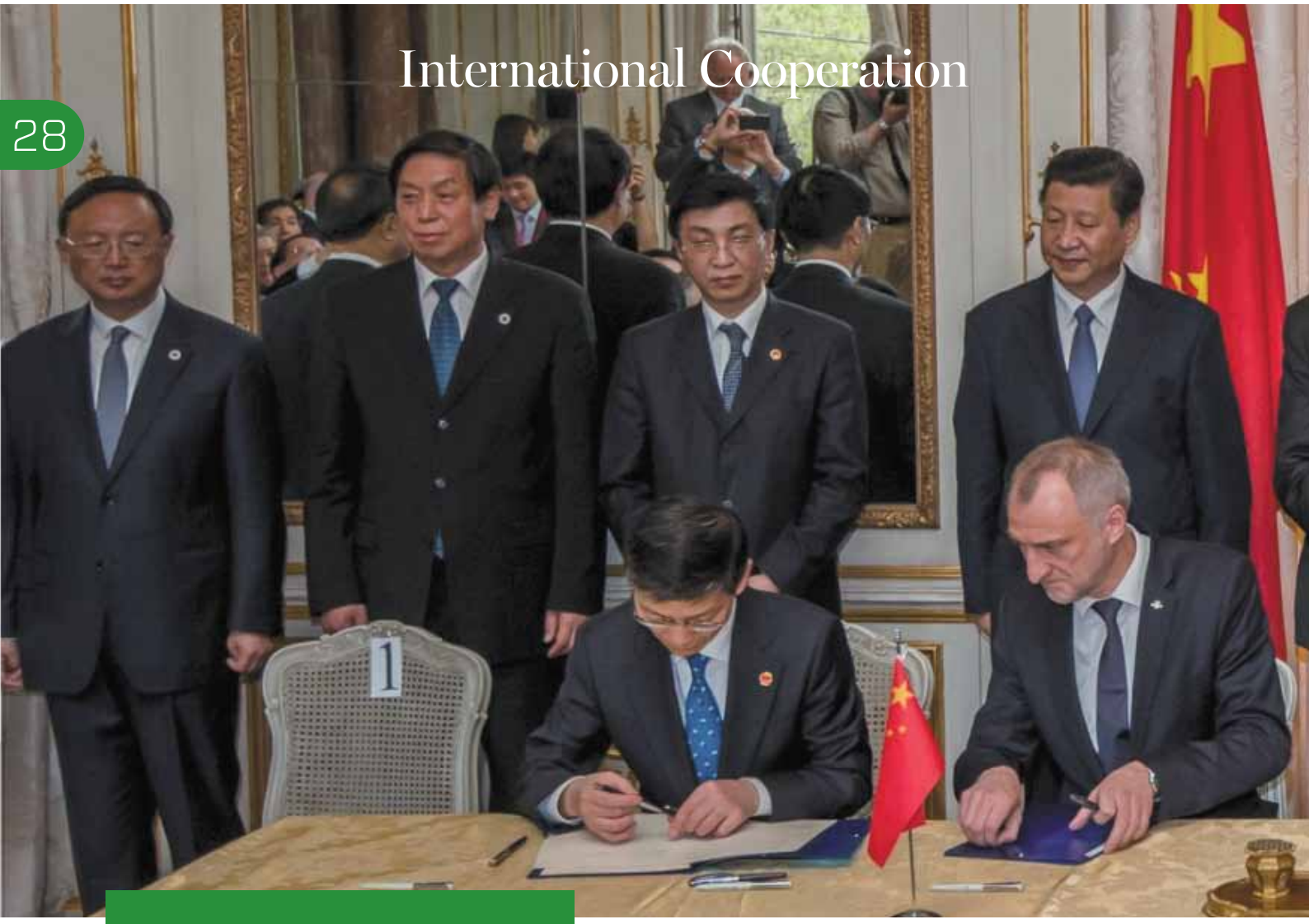
The National Agricultural Science and Technology Innovation Alliance, which serves as the main force for innovation in China's agricultural science and technology, provides a nationwide platform for coordination and cooperation.

The organization focuses on strengthening primary and long-term technological work to consolidate the foundations for agricultural sciences, advancing key technological research to eliminate bottlenecks in agricultural development, enhancing research into both primary and frontier technologies, and increasing innovation in major technological projects in different ecological areas for regional agricultural transformation and sustainable development.

☞ **Cooperation with Chinese Academy of Sciences and Peking University:**

CAAS drafted a report on building a collaborative center and a strategic cooperation framework with the Chinese Academy of Sciences. It also organized a meeting with the school of life sciences at Peking University and proposed the key fields for cooperation.

International Cooperation

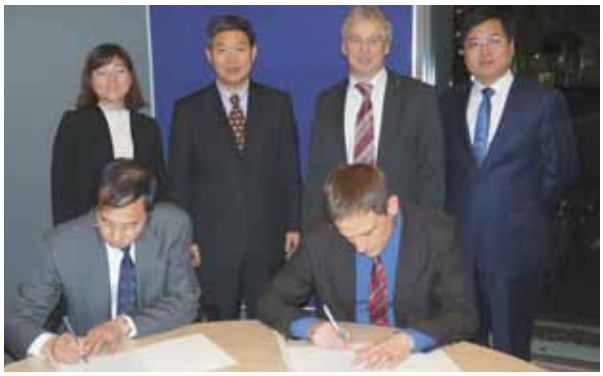


• **Sino-Belgium joint laboratory for global change and food security:** In March 2014, CAAS and Ghent University of Belgium signed an agreement on building a joint laboratory to deal with global climate change and food security. Chinese President Xi Jinping and Belgian Prime Minister Elio Di Rupo attended the signing ceremony. It is the first lab CAAS has founded in Europe, marking a new stage of technological cooperation between CAAS and the university.

1. Partnerships with overseas peers

In 2014, CAAS further promoted collaboration on agricultural sciences with international institutions. It founded or planned five international labs and signed 34 strategic cooperation agreements. It also defined the priority areas and directions for bilateral and multilateral cooperation in the industry, and pursued being more international based on China's Silk Road Economic Belt and 21st Century Maritime Silk Road initiatives.

• **China-Australia joint laboratory for sustainable agro-ecosystems:** In February, the China-Australia joint laboratory for sustainable agro-ecosystems was inaugurated at the University of Sydney. CAAS and Sydney University will make full use of their research findings and expertise to promote cooperation in the field and accelerate commercialization of related scientific achievements.



• **Sino-German agricultural platform for science and technology cooperation:** CAAS and Germany's agricultural ministry reached an agreement on establishing a collaborative platform for agricultural research in December. Its founding will be one of the Sino-German Agriculture Center's main priorities in 2015.

• CAAS organized a parallel session on agricultural technology and food security during the International Conference on Engineering Science and Technology 2014 that opened in Beijing on June 2. About 200 Chinese and overseas academicians, experts and scholars attended the two-day event, sharing the latest technologies and discussing future development trends.

2. Boosts to academic exchanges and information sharing

In 2014, CAAS organized 49 international academic forums, science summits and agro-related symposiums, attracting a total of 3,715 attendees, 751 of them from abroad. These events helped CAAS learn from the forefront of international research in related fields, deepened its relations with overseas research institutes, expanded cooperation, broadened the horizons for its academic endeavors, and increased CAAS' participation in and influence on international research.

• CAAS held the 2014 International Mycotoxin Conference, attracting more than 300 experts and scholars from 32 countries and regions. They had in-depth discussions on global prevention and control of mycotoxin and exchanged insights into a range of mycotoxin topics such as the mechanisms for formation, metabolism and degradation.

• To celebrate the third APEC Ministerial Meeting on Food Security, CAAS held the 18th annual meeting of the APEC Agricultural Technical Cooperation Working Group and an exhibition of agricultural scientific research achievements. Zhang Lubiao, head of CAAS' international cooperation department, was selected as the eighth chairman of APEC ATCWG.

3. New breakthroughs in South-South cooperation

CAAS continuously strengthened its cooperation with the United Nations Food and Agriculture Organization and the World Bank under the South-South cooperation framework. They have achieved many breakthroughs in research, training and capacity construction.

They offered management and technical training that benefited a total of 430 people from nearly 30 African countries including Ghana, Mauritius, Tanzania and Mozambique and nine Asian countries such as Sri Lanka, Myanmar and Pakistan. Technologies covered by the training programs included biogas and new energy, super rice cultivation and breeding, foot-and-mouth disease prevention and control, and vegetable cultivation.

• FAO biogas research and training reference center

The Biogas Institute of the Ministry of Agriculture was approved as an FAO reference center for biogas research and training in May 2014. The institute will leverage its technological prowess and provide policy and technology support for FAO operations in biogas and its new South-South cooperation strategy in the next four years.

• New China-Africa agricultural cooperation model

CAAS and the World Bank jointly initiated a China-Africa training program on agricultural production technologies, through academic reports and field studies. It attracted more than 50 senior agricultural managers and researchers from 15 African countries, including Ethiopia, Uganda, Kenya, Benin and Zambia, to learn about agricultural production and studies of major crops, technology application and promotion, agricultural machinery production and research, agro-biotech utilization and the development of agricultural informatization.

Divided into three teams, they visited Shanxi, Hebei, Shandong, Jiangsu and Zhejiang provinces to see the development of dry farming, vegetable planting, agricultural machinery promotion, and wheat and rice production.

For more information, please visit http://www.worldbank.org/en/news/feature/2014/07/28/africa-in-china-new-knowledge-sharing-effort-kick-starts-collaboration-in-agricultural-productivity

4. Strengthened talent training and exchanges

• Revolving around the plans for the Agricultural Science and Technology Innovation Program, CAAS enhanced the nurturing and training of international professionals with the aim of building itself into a top world agricultural research institute. The academy sent 74 young researchers in 16 groups to internationally renowned foreign universities, such as the University of California and the University of Sydney, to conduct collaborations. It also sent 12 senior researchers and managers from nine research institutes to the FAO headquarters and six research centers of the Consultative Group for International Agricultural Research for training ranging from three to six months.

Also, with the help of State Administration of Foreign Experts Affairs, CAAS invited 10 renowned experts from the United States, the United Kingdom, Italy, Australia and New Zealand to give lectures in China and conduct research with their Chinese peers.

• Thomas A. Lumpkin, director general of the International Maize and Wheat Improvement Center, or CIMMYT (by its Spanish acronym), and Yamashita Ichiji, chief scientist of the largest Sino-Japan cooperation project on sustainable agriculture research and development, received 2014 Friendship Awards from the Chinese government, the highest level of recognition awarded to expats who have made a great contribution in China.

Lumpkin made an outstanding contribution to promoting the agricultural cooperation between CIMMYT and CAAS, spreading specialty crops from China worldwide and boosting Sino-US agricultural education over the past six years.

Yamashita works at the Japan International Cooperation Agency. Over the past eight years, he has acted as an ambassador for agricultural technological exchanges between China and Japan. He also led a research team devoted to the research and development of sustainable agriculture technology in China, which has yielded remarkable social, economic and ecological benefits.

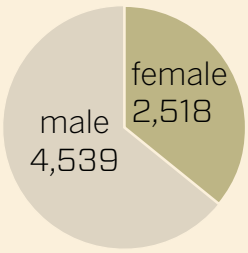
Staff

Now 11 members of the Chinese academies of Sciences and engineering work at CAAS. Eight CAAS researchers are listed among the "Ten Thousand Talents" national recruitment plan. Nine young and middle-aged professionals in science, technology and management have been granted the status of State-level experts for their outstanding contributions, and 112 of its faculty are paid special government allowances issued by the State Council. The CAAS staff include 56 researchers on the lists of the "Hundred", "Thousand", "Ten Thousand Talents" programs, 14 individuals and five teams ranked among the Innovative Talents Growth Program initiated by the Ministry of Science and Technology, seven winners of the honorary title of the Chinese Agricultural Talents granted by the Ministry of Agriculture, 41 distinguished agro-researchers and 16 project leaders whose research teams won national agricultural awards.

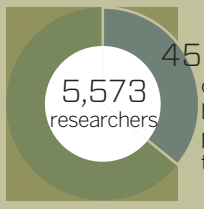
01

7,057 members of staff by the end of 2014

11 members of the Chinese academies of sciences and engineering



02



45.4% of researchers have senior professional titles

Doctorate degree

2,147 holders

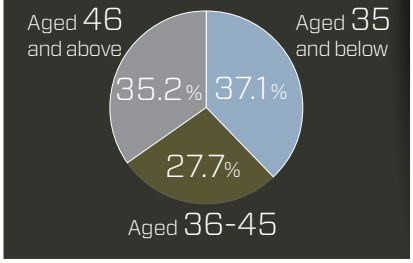
Master's degree

1,626 holders

03

1,613 employees in the administration

5,573 researchers, including 1,454 involved in the administration



Graduate Education

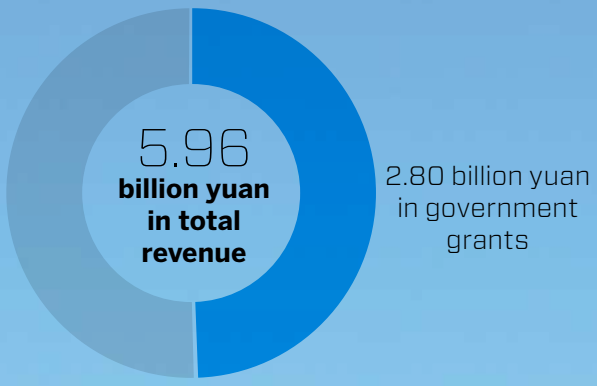
The graduate school of CAAS, also known as GSCAAS, shoulders the responsibility of training high-level innovative talent for China's agricultural scientific and technological development. It has been ranked among China's first-class graduate schools since 2012, with its overall competitiveness ranked top in the discipline of agriculture. The subjects and programs that GSCAAS offers are related to four major academic categories — natural sciences, engineering, agriculture and management sciences, including authorizing Ph.D degrees in 10 primary disciplines—biology, ecology, crop science, horticulture, natural resource management, plant protection, animal science, veterinary medicine, grassland science and economics, and management of agriculture and forestry—and 12 master's degrees in primary disciplines. In addition, GSCAAS has two professional master's degree-authorizing qualifications which are agricultural extension and veterinary medicine. In 2012, in the evaluation by the China Academic Degrees and Graduate Education Development Center, GSCAAS ranked No 1 among all Chinese universities in crop science and veterinary medicine. There are 1,560 supervisors in GSCAAS and about 560 of them are supervisors for doctoral programs. A total of 550 CAAS researchers and famous professors and experts in the field of agriculture make the list of the faculty members at the school.

The school enrolled 1,382 students in 2014 — 255 of them are PhD candidates, 710 master's candidates, 334 for professional degrees and 23 in joint-PhD programs, as well as 60 international students. Altogether 4,492 students study in GSCAAS — 2,904 full-time postgraduates, 1,436 students for professional degree and 152 overseas students.

In 2007, the Ministry of Education authorized GSCAAS to accept foreign students who receive scholarships from the Chinese government. Now there are more than 152 foreign students from 42 countries, with 80 percent of them studying for a doctorate. The school offers its students various scholarships including the Chinese Government Scholarship, the Beijing Government Scholarship and the GSCAAS Scholarship, and 98 percent of international students are sponsored by a scholarship. GSCAAS has launched a joint-PhD program in cooperation with University of Liege in Belgium, which has enrolled 41 students, and the school plans to launch several more joint-PhD programs with other world-class universities.

Budget

CAAS had 5.96 billion yuan ($ 960 million) in yearly revenue in 2014, including 2.80 billion yuan in government grants. Both were the highest in the academy's history.



Yearly revenue

0.52% growth

Government grants

2.46% growth

Basic expenditure

9.92% growth

Research projects spending

0.41% reduction

Research Facilities

CAAS has established a range of research facilities, which serve as a platform for technological innovation, support and services. They include the National Key Facility for Crop Gene Resources and Genetic Improvement and the National Agricultural biological Security Science Center, the only ones of their kind in China. CAAS has six key national labs and 42 key Ministry of Agriculture labs, as well as three national reference labs, two FAO reference centers respectively for animal influenza and biogas research, and seven reference labs designated by the World Organization for Animal Health.

In addition, CAAS has developed one national long-term gene bank and 10 medium-term gene banks for crop germplasm storage and built 12 crop germplasm gardens, which together secure 420,000 crop varieties for the long term — this is the second highest number in the world. Also, the academy boasts a national agricultural library, whose stockpile of agricultural journals ranks No 1 in Asia and third in the world.

2 major national facilities

6 key national labs

42 key MOA labs

3 national reference labs

2 FAO reference centers

7 OIE reference labs

Organizational Structure

President **Chairman**

Vice-President

ADMINISTRATIVE DEPARTMENTS

- General Office
- Research Management
- Human Resources
- Finance
- Capital Construction
- International Cooperation
- Technology Transfer
- Party Committee
- Supervision and Auditing
- Logistics

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
- Bee Research Institute
- 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 the MOA
- CAAS Graduate School
- China Agricultural Science and Technology Press

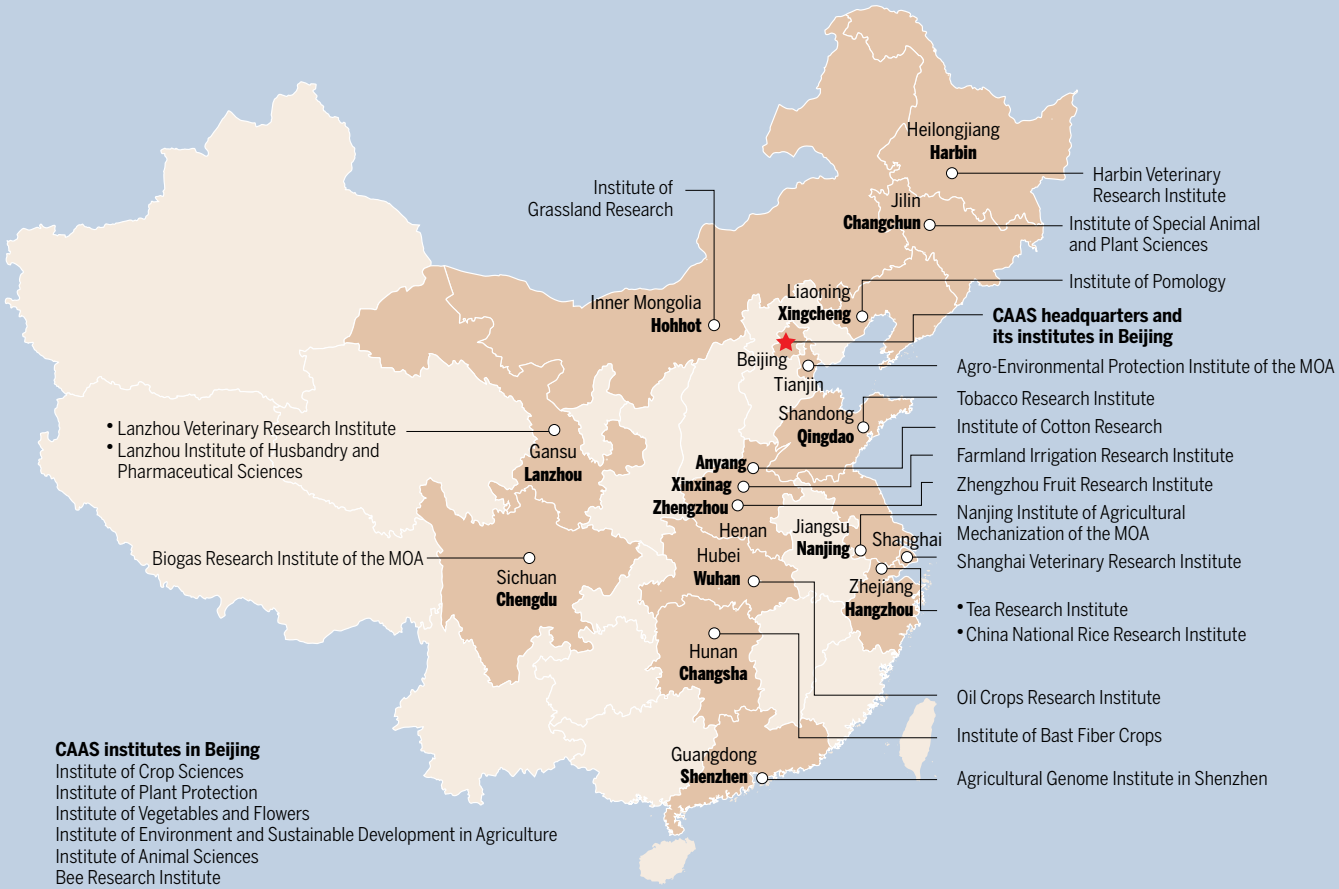
INSTITUTES OUTSIDE BEIJING

- Farm 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 the MOA
- Biogas Institute of the MOA
- Nanjing Institute of Agricultural Mechanization of the MOA
- Tobacco Research Institute
- Agricultural Genome Institute in Shenzhen (in preparation)

CO-HOSTED INSTITUTES

- Citrus Research Institute
- Institute of Sugar Beet
- Sericultural Research Institute
- Institute of Chinese Agricultural Civilization
- Buffalo Research Institute
- Institute of Grassland Ecology
- Poultry Institute
- Institute of Sweet Potato

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
Bee Research Institute
Feed Research Institute
Institute of Quality Standards and Testing Technology for Agro-Products
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 Food and Nutrition Development of the MOA
Graduate School
China Agricultural Science and Technology Press

Field Stations

CAAS has 98 research field stations with established facilities in 27 provinces, autonomous regions and municipalities, which together together cover an area of 5,970 -hectares. They areas in 27 provinces, autonomous regions and municipalities and provide strong support for the academy to conduct experiments in the field. Among them are three comprehensive experimental bases — two located in Beijing's Nankou township and the High-tech Industrial Park in Hebei province and the other in Xinxiang city, Henan province. The two Beijinge and Hebei comprehensive experimental bases are home to eight research institutes and the one in Henan province now houses six research institutes. They have laid a solid foundation for integrated research and coordinated innovation.

CAAS boasts

98 **research field stations**

27 **provinces, autonomous regions and municipalities**

5,970 **hectares in total combined area combined**

providing various CAAS institutes strong support for research and innovation

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
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 labs

No	Facilities	Research	Institutes
1	State Key Laboratory for Biology of Plant Diseases and Insect Pests	The mechanisms of the calamities caused by important crop diseases, monitoring and forecasting, and control technologies; the mechanisms of the calamities caused by important insect pests, monitoring and forecasting, and the control technologies; and the mechanism of invasive alien species; functional genome for plant protection, and gene biosafety.	Institute of Plant Protection
2	State Key Laboratory of Animal Nutrition	Nutritional requirement 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 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	Focuses on the research of 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 diseases of veterinary and zoonotic importance.	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 labs

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 for Biogas Research and Training	Policy study and technology research in biogas-related sectors	Biogas Institute
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 Twinning 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

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