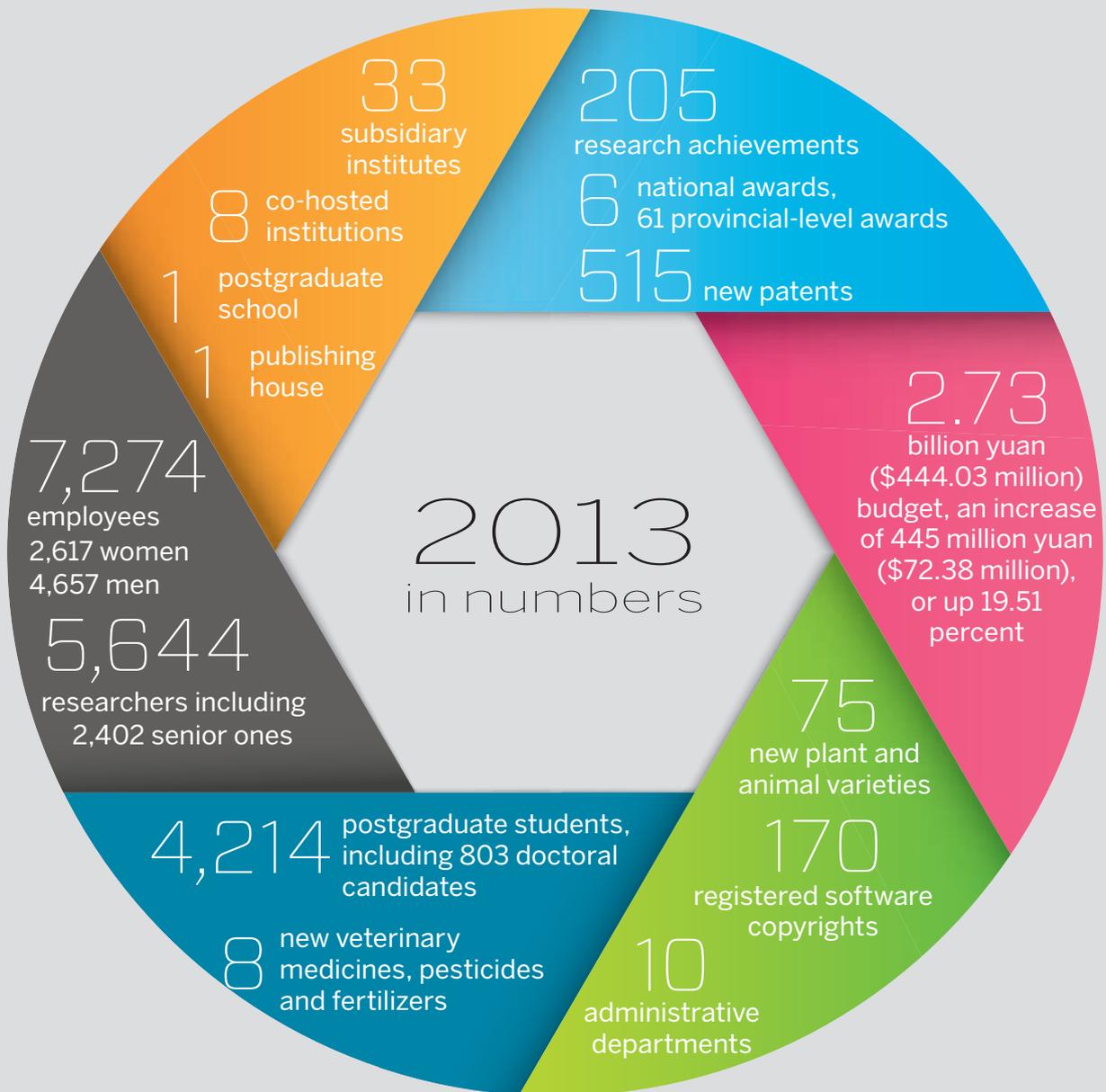




CAAS ANNUAL REPORT 2013





Message from the President

It is well recognized that agricultural science and technology are of vital significance to food security and safety, which are essential not just for China, but also the world. As the leading agricultural research organization in China, the Chinese Academy of Agricultural Sciences is leading the remodeling of China's agricultural system from the ground up, playing an indispensable role in modernizing the nation's agricultural science and technology through innovations and significant advances in agricultural practices.

2013 was a milestone year for CAAS, and this annual report highlights its achievements and the latest developments, including its vision for the future and its research priorities and strategic development plans. This report details the significant fruition of our past work and the activities we have underway.

With over 5,000 professional employees and the support of the central government, CAAS translates knowledge into practice in pursuit of improved varieties of crops and animals, more efficient farming equipment, and better monitoring systems to protect natural resources, as well as the rapid creation and dissemination of agro-products, including vaccines against diseases such as avian influenza.

A central driver of its efforts is the Agricultural Science and Technology Innovation Program, or AS-

TIP as it is known, one of the three national innovation projects. This 13-year program promotes interdisciplinary research and the expanding of research infrastructure, while fostering greater international research cooperation and collaboration and increasing the talent pool.

As China's "national team" for agricultural research, CAAS will further improve its innovation and academic capabilities over the next five to 10 years with the goal of contributing more to the common goal of a hunger free and sustainable world.

I hope this annual report will provide a window on the academy's vision, knowledge and progress, and the efforts it is making in its ongoing pursuit of innovations at the cutting edge of agricultural development, so readers can better understand and appreciate CAAS' efforts to ensure future generations enjoy abundant and safe foods and a healthy environment.

I would also 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.



A handwritten signature in black ink that reads "Jiayang Li". The signature is written in a cursive, flowing style.

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





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2013 Summary

In 2013, as well as safeguarding national food safety and advancing the nation's agricultural science and technology development, CAAS focused on its endeavor to become a world-class agricultural research institution. To achieve this ambitious goal, CAAS has increased its ability to produce innovations, improved its technology transfer to industry and strengthened and enhanced its research capacity.

At the beginning of 2013, CAAS launched the Agricultural Science and Technology Innovation Program (ASTIP), which is designed to implement a research system in three ranks: eight disciplinary clusters with 130 disciplines in more than 300 research fields. A total of 193 research teams in 22 institutes were selected to join the pilot program.

2013 was a fruitful year for CAAS due to the major breakthroughs it achieved in applied 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 exchanges and cooperation.

Research papers: A total of 4,394 research papers were published in various journals. Among the published papers, 1,557 were published in *SCI/EI*, an increase of 22.1 percent from 2012 and 16 were published in top international journals such as *Science*, *Nature* and *Nature Genetics*, etc., a 100 percent growth over the previous year.

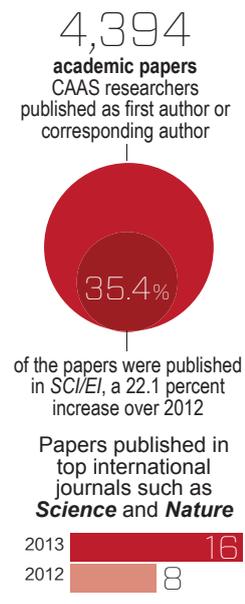
Technology transfer: More than 190 new varieties, 93 products and 228 technologies were developed and promoted in different

fields of agriculture. It is worth mentioning that of them, 31 new varieties were approved by the Ministry of Agriculture as superior varieties for nationwide promotion, representing 20 percent of all varieties promoted in China. And 35 percent of the total selected major technologies to be promoted and applied nationwide in 2013, or 35 new technologies, were from CAAS.

International cooperation: CAAS played a prominent role in international cooperation. It partnered its foreign peers and managed to establish six overseas facilities. One of them was accredited as a reference lab for the Food and Agriculture Organization of the United Nations, and three were accredited as centers for scientific research by the Ministry of Science and Technology. CAAS also signed memoranda of understanding/agreements for 19 major cooperation projects and organized 67 high-level international symposiums and summits, which had a big impact on boosting international exchanges in agricultural science and technology.

Intellectual property: A total of 515 invention patents were attained, 17.58 percent higher than the previous year. And a total of 272 books were published in 2013. But more importantly, 75 new varieties were successfully reviewed in the same year. Other achievements include 8 registration certificates for veterinary drugs, agricultural chemicals and fertilizers. About 170 software copyrights were registered.

CAAS won a total of 205 science and technology awards, including six national awards and 61 provincial or ministerial-level awards.



Major breakthroughs in applied fundamental research



Wheat, grain and cucumber genome studies

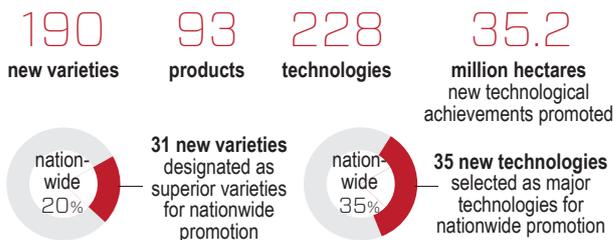


H7N9 influenza virus transmitting mechanism

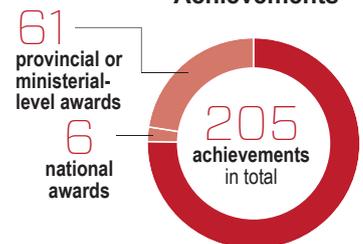


Rice tiller mechanism

Technology commercialization



Achievements



Key Events 2013

January

- CAAS launched the Agricultural Science and Technology Innovation Program (ASTIP), a new 13-year funding paradigm.



- The Sino-Swedish Joint Laboratory for Agricultural and Environmental Technology at the Agro-Environmental Protection Institute of MOA was inaugurated by Chinese Minister of Agriculture Han Changfu and Swedish Minister for Rural Affairs Eskil Erlandsson.

April

- CAAS and Murdoch University of Australia initiated a wheat-improving research program.

- Harbin Veterinary Research Institute researchers discovered the origin of the H7N9 virus.

February

- A high-level CAAS delegation attended the 10th Thailand-China Friendship Seminar and the Symposium on Science and Technology and Sustainable Rural Development held in Bangkok, Thailand.



May

- Harbin Veterinary Research Institute researchers found that the H5N1 virus might be transmitted among humans if combined with Influenza A.

- Three new key field stations (two in the Xinjiang Uygur autonomous region and one in Henan province) for CAAS were established.

March

- The Animal Influenza Laboratory of Harbin Veterinary Research Institute was designated the first FAO reference center in China and only the second in the world.



- The Sino-Australia Joint Laboratory for Sustainable Agro-Ecosystems based in the University of Sydney was inaugurated.
- The Institute of Crop Sciences finalized the sketch of the genome of *Aegilops tauschii*, the donor of the wheat D-genome. The result was published online in *Nature*.

June

- CAAS held the third International Advisory Board Meeting (IAB) in Beijing.

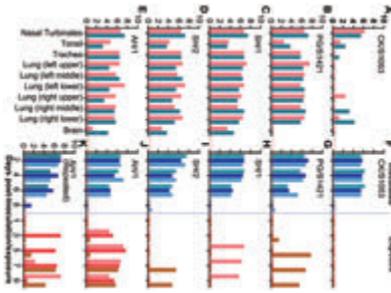


- CAAS sponsored and organized two important events from June 5 to 8: the GLAST-2013 and the 30th anniversary celebration for China-CGIA cooperation.

- Vice-Premier Wang Yang visited CAAS.
- CAAS scientists drafted first haplotype map of millet's genome.

July

- Eleven research institutes were selected as the first group to execute the ASTIP pilot work.
- Harbin Veterinary Research Institute researchers discovered when the H7N9 virus mutates it can easily be transmitted among humans.



August

- Kenyan President Uhuru Kenyatta visited the China National Rice Research Institute.



- CAAS commenced construction on a new branch in Tongzhou District in Beijing.
- A new rapeseed variety YN171 developed at the Oil Crop Research Institute has oil content of 64.8 percent, a new world record.

September

- The 2nd China-Mexico summit meeting on agricultural science and technology was held in Beijing.
- The Institute of Crop Sciences set a nation record by increasing corn production to an average yield of 1,511 kilograms per mu (0.067 hectare).

October

- Three research institutes — the IAS, IVF and HVRI — were certified by the Ministry of Science and Technology to be centers for international scientific and technological cooperation.
- A joint China-EU Food, Agriculture and Biotechnology Conference took place in Beijing from Oct 10 to 11.

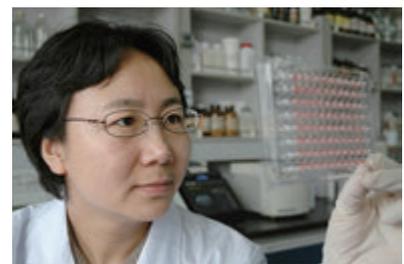


- Scientists at CAAS completed mapping the cucumber genome variations.

November

- Another 11 research institutes of CAAS were selected to join ASTIP, which increased the number of institutes participating in ASTIP to 22.
- The “Interactions Among Cotton, Insect Pests and Natural Enemies Project” was funded by the National Natural Science Foundation of China (NSFC), among 29 NSFC-funded projects in 2013.
- The Modern National Agricultural Library housed at CAAS was opened to the public.
- CAAS and the European Union signed a letter of intent for cooperation on research and innovation in food, agriculture and biotechnology at the Great Hall of the People, Beijing.

December



- CAAS researchers discovered that DWARF 53 acts as a repressor of strigolactone signaling in rice, their results were published online in *Nature*.
- The Graduate School of CAAS and University of Liège (ULg) of Belgium held their first working conference for a joint doctorate program in Beijing.
- *Nature* recognized Chen Hualan from the Harbin Veterinary Research Institute as one of the Top 10 People who mattered in 2013, for her work on the H7N9 avian flu virus.

Honors and Awards



Chen Hualan
among *Nature's*
Top 10 People

Chen Hualan was recognized by *Nature* as one of the Top 10 People who mattered in 2013. Chen and her research team from the Harbin Veterinary Research Institute were the first to discover the source of the H7N9 avian flu virus. They proved that there is a high possibility of the virus being transmitted from one person to another. Moreover, they predicted the possibility of the H5N1 virus being transmitted among humans once it combines with the H1N1 flu virus.



Guo Sandui
among the Elite
for Science and
Technology
Innovation of the
Year

Guo Sandui, professor at the Institute of Biology Research, was nominated and recognized among the Elite for Science and Technology Innovation of the Year by CCTV. Guo, known as the “father of Bt cotton” in China, is first to develop three-line hybrid pest-resistant cotton, which has not only greatly increased cotton yields it has also helped raise farmers’ incomes.



Yan Ping
among the Elite
for Agricultural
Research in CCTV's
second “Son of the
Earth” Award

Yan Ping was named as the “Elite for Agriculture” in CCTV’s second “Son of the Earth” Awards. Yan and her colleagues at the Lanzhou Institute of Husbandry and Pharmaceutical Sciences developed a new variety of yak, the Datong Yak, which helps improve about 300,000 domesticated yaks annually. The technology is applied in 75 percent of yak-producing areas.



Lu Yanhui
winner of the 13th
China Youth Science
and Technology
Award

Lu and his research team at the Institute of Plant Protection explained the status evolution mechanism of pest populations in the Bt cotton ecological system in China, and developed a green prevention and control system against miridae, a new pest species.



Gao Qingzhu
winner of the 9th
Qinghai-Tibetan
Plateau Youth
Science and
Technology Award

Gao and his research team at the Institute of Environment and Sustainable Development in Agriculture, mainly based in Naqu in Northern Tibet, have conducted research projects that have explained the impact of climate change on the alpine grassland degradation process and improved the technological system so alpine grassland can adapt to climate change.

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 launched its Agricultural Science and Technology Innovation Program (ASTIP)¹ in early 2013, with the goal of becoming a world-class agricultural research institute over the next 13 years. ASTIP is a funding paradigm dedicated to supporting research and innovation, improving research facilities and infrastructure, promoting human resources through capacity development, and expanding international cooperation.

ASTIP has three phases concurrent with 12th, 13th, and 14th Five-Year Plans between 2013 and 2025. 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.

In 2013, the academy designed a three-rank disciplinary system, mainly made up of disciplinary clusters, research areas and innovation teams. Under the new disciplinary system, CAAS developed an innovative mechanism for the distribution of resources and formed a sustainable and steady team-based organizational structure for research. There is also a performance appraisal system driven by research capacity and innovation achievements. A total of 193 research teams in 22 research institutes were selected to participate in the pilot innovation program.

For more information, please visit: http://www.caas.cn/en/research/research_program



¹ ASTIP is one of three major national-level innovation projects. The other two are the Knowledge Innovation Program launched by the Chinese Academy of Sciences in 1998, and the Philosophy and Social Science Innovation Program initiated by the Chinese Academy of Social Sciences in 2011.

2. The Elite Young Scientists Program

The Elite Young Scientists Program is one of the important initiatives launched by the CAAS to recruit high-quality scientists with a global vision under the age of 40. The program aims 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 “leapfrog 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 Youth Thousand Talent Program” and D refers to those introduced with funds from CAAS institutes.



The program has strict procedures for recruitment. 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. By the end of December 2013, the program had 37 young candidates.

For more information, please visit: http://www.caas.cn/en/scientists/talent_program



3. The Agricultural Science and Technology Transfer Program

CAAS launched the Agricultural Science and Technology Transfer Program (ASTTP) in May 2013 to further enhance the publicity and awareness of scientific breakthroughs to help lead the country's industrial development. Support priority will be given to the industrialization of technologies with regard new varieties of crops and livestock, plant protection, disease prevention and control, and agricultural product quality security and processing.

The program encourages the integration and research into the application of scientific achievements and the development of supported production technology systems to form an integrated technology production model that supports the progress of modern agriculture. Under the plan 206 important scientific achievements with proprietary technologies and bright market prospects have been selected.

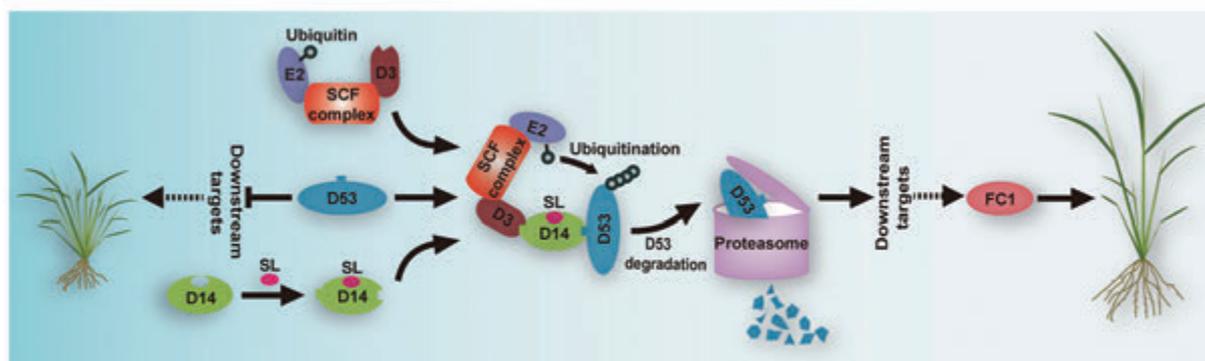
CAAS has organized collaborative research into technologies that help increase yields of rice, wheat, corn, beans and rape, as well as their promotion, with more than 350 researchers from 12 research institutes at CAAS and also over 1,400 researchers from about 210 related institutes participating in the program. Thanks to the program, a series of comprehensive agro-production technology systems are now taking shape, which are helping to increase agricultural efficiency and ensure the country's food security.



Research Progress

Crop Science

BREAKTHROUGHS IN THE FUNCTIONAL GENOME OF RICE: Wan Jianmin and his team from the Institute of Crop Sciences have made major breakthroughs in their pilot research into rice architecture, hybrid rice's reproductive development and adaptation. They have: (1) proved that *DWARF 53 (D53)* participates in regulating rice tillering as a repressor of Strigolactone (SL) signaling, which provides a theoretical basis for improving rice architecture; (2) found that the dioxygenase for auxin oxidation (*DAO*) gene controls rice reproductive development by regulating the metabolism of indole-3-acetic acid (IAA); (3) unveiled the importance of *DTH2* in the northward expansion of rice cultivation in Asia. Their findings are strong evidence for the crucial role minor-effect QTLs play in crop adaptation and diversification. Those results have provided valuable genetic resources and breeding materials for utilizing the heterosis of the indica-japonica hybrid rice. These findings were published in *Nature*, *Development Cell* and *PNAS*.



A schematic model depicting that SL promotes D14-SCF^{D3}-mediated degradation of D53.

DISSECTING YIELD-ASSOCIATED LOCI IN SUPER HYBRID RICE: Qian Qian and Guo Longbiao from the China National Rice Research Institute, together with researchers from Shenzhen Huada Gene Research Institute and Chinese Academy of Sciences, resequenced 132 core recombinant inbred lines of *Liang-You-Pei-Jiu*, also known as *LYP9*, the widely cultivated super hybrid rice and constructed a high-resolution linkage map. The team is the first to have successfully assembled the genome sequence of the maternal cultivar PA64 of *LYP9* and they have significantly improved the genome sequence of the paternal variety 93-11. Based on the high-density physical map, they detected 43 yield-associated quantitative trait loci, of which 20 are unique. Their research has provided an ideal platform for dissecting yield-associated loci in super hybrid rice and molecular breeding. Their research findings were published in *PNAS* on Aug. 12, 2013.

LIGHT-REGULATED ARABIDOPSIS THALIANA ASCORBIC ACID BIOSYNTHESIS:

Researchers headed by Huang Rongfeng at the Biological Research Institute found that COP9, a photomorphogenesis signaling compound, takes part in regulating the biosynthesis of Arabidopsis thaliana Vitamin C, through affecting target protein ubiquitination and degradation in the regulation process, revealing the molecular basis of light for Vitamin C biosynthesis of plants.

MONOPLIOT PHYSICS MAPS OF THE MILLET GENOME SEQUENCE: A team led by Diao Xianmin at the Institute of Crop Sciences finished the construction of the first haplotype map of the foxtail millet genomes and genome-wide association analysis of 47 main agronomic characters. These genomic sequence variations clearly classify foxtail millet germplasm into two clusters, namely spring sowing and summer sowing types. Genetic loci related to the differentiation between spring and summer sowing types were identified. More than 500 genetic loci controlling major agronomic characters in foxtail millet were identified in five environments by association mapping. All those promote the establishment of foxtail millet as a novel model organism for functional genomic study of cereals. The results marked an important breakthrough in China's millet genetics, and they were published in *Nature Genetics* on June 24, 2013.

NEW PROGRESS IN GENETIC ENHANCEMENT FOR HIGH OIL CONTENT IN RAPESEED: Researchers headed by Wang Hanzhong, director-general of the CAAS Oil Crops Research Institute, have discovered different mechanisms for regulating oil content in rapeseed and identified four high oil genetic resources and six genes with novel functions. The team has also developed a new rapeseed line, the YN171, setting a new world record of 64.8 percent for its oil content. Wang and his team have also developed five new rapeseed cultivars, including *Zhongshuang 11* that possess improved characteristics such as high oil content, strong resistance to pod shattering and plant lodging, resistance to *Sclerotinia* rot, low erucic acid, low glucosinolates and adaptation to mechanized harvesting.

RESEARCH INTO THE USE OF RAMIE AS FEED AND ITS MULTIPLE FUNCTIONS: Researchers headed by Xiong Heping from the Institute of Bast Fiber Crops developed the “*Zhongsizhu No 1*”, the world's first ramie genotype specially for feed materials. They also analyzed the features of ramie as feed and studied how to use its byproducts as resources for mushroom cultivation, etc. The processing technology has been promoted in different rural areas in Hunan, Sichuan and Hubei provinces, with marked economic, social and ecological effects. The achievement was granted the 2013 Hunan Province Science and Technology Progress Award (First Prize).

STUDY OF THE BRANCHING OF COTTON'S IN VITRO FIBER GUIDED BY TRANSCRIPTION GABTL, GASIM AND ATSTI:

A team led by Du Xiongming at the Institute of Cotton Research found that the transcription of genes GaGL1 GaTRY GaCPC GaGL3 and GaGL2 happens in fiber cells, and the GaTRY protein exists in undifferentiated epidermal non-fiber cells. In addition, there is a sharp decline in the GL2 content in the mutant without fiber initiation ability. *Gossypium arboreum* BRANCHLESS TRICHOMES (GaBLT) is not transcribed in fibers. The homologue of STICHEL (STI), which is essential for trichome branching, was a pseudogene in *Gossypium*. Targeted expression of GaBLT, Arabidopsis STI, and the cytokinesis repressing GaSIAMESE in *G. hirsutum* fiber cells cultured in vitro resulted in branching. The findings suggest that the distinctive developmental mechanism of cotton fibers does not depend on endoreduplication. This important component may be a relic function that can be activated in fiber cells. The results were published in *Journal of Experimental Botany*.

AEGILOPS TAUSCHII DRAFT GENOME SEQUENCE:

A team led by Jia Jizeng from the Institute of Crop Sciences was the first in the world to finish a draft genome sequence of *Aegilops tauschii*, the donor of the wheat D-genome. The result, putting an end to the history of no assembly genome sequence for wheat, was published on the online edition of *Nature* on March 24, 2013.



Special genes in the wheat D-genome are identified via crop genome sequence comparison

CREATION AND IDENTIFICATION OF THE TOBACCO MUTANT LIBRARY: Researchers headed by Liu Guanshan from the Tobacco Research Institute have finished the creation, screening and identification of the tobacco mutant library. They acquired more than 200,000 mutational tobacco materials through ethyl methane sulfonate (EMS) mutagenesis and activation tagging insertional mutagenesis. After the screening processes, they had more than 6,000 mutants, with high quality, disease resistance, harm reduction and visible traits, etc., and they identified more than 400 mutants that feature strong aroma, resistance to the tobacco mosaic virus (TMV), resistance to tobacco black shank, and tolerance to low potassium, etc. They also established and improved the tobacco mutant database and the mutant resource reserve, providing a technical and material basis for the nation's research on the functional genome of tobacco.

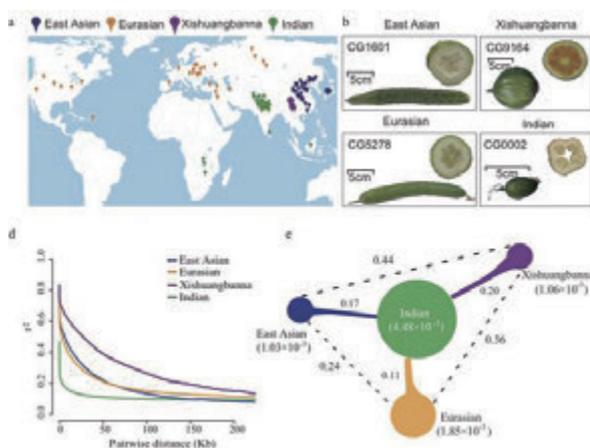
Horticulture Science

DEVELOPMENT OF PEACH SPECIES: Wang Lirong and her team at the Zhengzhou Fruit Research Institute bred 19 new peach varieties, consisting of 12 nectarines including *Zhongyoutao* No 4, two for peaches named *Chunmi* and *Chunmei* respectively and five for ornamental peaches, such as *Baocun* and *Mantianhong*. They also established a cultivation system for high-quality and protected culture in greenhouses. These varieties have been widely planted across China, and account for more than 20 percent of the peach plantation areas in the country, realizing remarkable economic benefits. Their achievement was granted the 2013 National Science and Technology Progress Award (Second Prize).

ESTABLISHMENT OF BREEDING TECHNOLOGY SYSTEM ON MALE STERILE LINE OF NEW CABBAGE VARIETIES: A team led by Fang Zhiyuan at the Institute of Vegetables and Flowers for the first time succeeded in large-scale seed production of a male dominant sterile line of cabbage, achieving a 100 percent hybrid rate of hybrid species. The technology has been used on 231,733-hectares of fields in recent years, bringing about additional profit of more than 1 billion yuan (\$162.46 million). The team won the 2013 China Agricultural Science and Technology Award (First Prize).

RESEARCH ON THE ANCESTRAL GENOME OF THE BRASSICA RAPA: Wang Xiaowu and his team at the Institute of Vegetables and Flowers identified an ancestral genome consisting of seven chromosomes shared by the *Brassica rapa* and related species, based on the genome sequence of the Chinese cabbage, which showed the key to the evolution of the *Brassica rapa* genome. They then reconstructed three subgenomes of *Brassica rapa*, and refined intervals for seven of the genomic blocks of the Ancestral Crucifer Karyotype, thus revising the key reference genome for evolutionary genomics of crucifers. The results were published in the online edition of *Plant Cell* on May 7, 2013.

Establishment of the Genome-wide Genetic Variation MAP OF THE CUCUMBER: A team led by Huang Sanwen at the Institute of Vegetables and Flowers conducted in-depth sequencing of 115 cucumber species and established the genome-wide genetic variation map, which contains more than 3.6 million loci. Based on the variation map, thousands of genes have been identified as being under the domestication selective sweep or highly divergent. Furthermore, the *ore* gene controlling the accumulation of beta-carotene in fruits was isolated. The results were published in the online edition of *Nature Genetics* on Oct 20, 2013.



CONSTRUCTION OF THE SSR MOLECULAR MARKERS LINKAGE MAP: A team led by Cheng Hao at the CAAS Tea Research Institute constructed the simple sequence repeat (SSR) molecular markers linkage map of tea plants that covered 1,156.9 cm with 237 SSR markers distributed in 15 linkage groups. The results have provided the foundation for molecular biology investigations such as functional gene isolation, QTL mapping and marker-assisted selection (MAS) breeding in this important species. The results were published in the online edition of *PLoS One* on Nov 26, 2013.

Animal Science

NEW PEKING DUCK STRAINS' BREEDING AND KEEPING: Hou Shuisheng and his team at the Institute of Animal Sciences have created comprehensive technologies to breed the Peking duck and developed six new strains of the duck. Among them are the rapidly growing *Z-type* duck featuring feed efficiency and a high proportion of lean meat, and the *Nankou-1* duck with high skin fat (and thus a perfect candidate for roast duck). Over the past three years, more than 3.1 million breeding ducks have been adopted and 475 million meat ducks have been sold, generating 9.5 billion yuan (\$1.54 billion) in combined sales revenue. The achievement won the 2013 National Science and Technology Progress Award (Second Prize)

DAIRY ANIMALS' MILK PROTEIN MAPPED: Wang Jiaqi and his team at the Institute of Animal Sciences quantified the milk serum of dairy cows, yaks, buffalos, goats and camels by proteomic technologies. A total of 211 kinds of milk protein were identified and a subset of 113 proteins was classified according to their molecular functions, cellular components and biological processes. The team is the first in the world to finish the quantified expression profiles of milk serum proteome and to reveal the characteristic traits in the milk from dairy cows, yaks, buffalos, goats and camels. The team's studies were published in the *Journal of Proteome Research*.

Z-type Peking duck



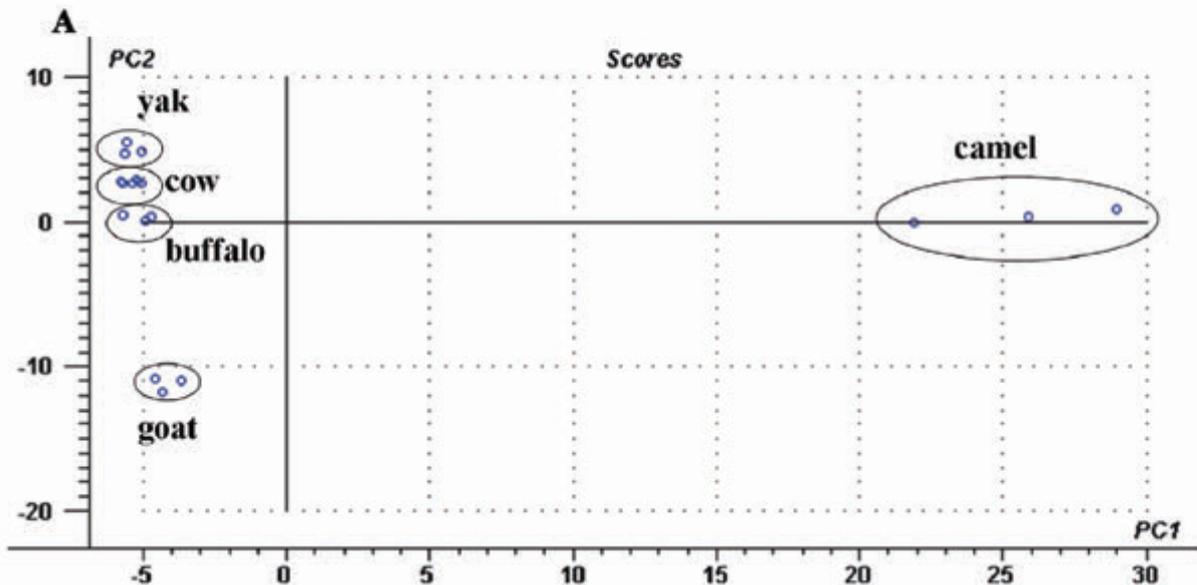
Strain W2 (maternal line)



Strain Z2 (maternal line)



Strain Z4 (paternal line)



Inbreeding Line Culture of Wuzhishan Mini-pig and the Innovation in Nurturing Inbred for Chinese Genetic Resources



原引种猪
Introduce bred



原始种猪群
Original breed herd



原始种母猪
Sow of original breed



F₁₆ 公猪
F₁₆ boar of new bred



F₂₀ 种猪群
F₂₀ new breed herd



F₃₆ 母猪
F₃₆ sow of new breed

STUDY ON MINIATURE PIG INBRED LINE: Feng Shutang and his team at the Institute of Animal Sciences, with one male and one female Hainan *wuzhishan* pigs of china as progenitor, took comprehensive measures of “Son-mother” and “sibling” mating, after 25 years, overcome step by step “three stages” problems, such as high offspring deformity rate, high rate of weak young, the piglets’ living rate less than 20 percent, and then recover the rate of survival. So that successfully set up the F20-F24 generation inbred line groups, and complete the pigs’ family tree. The validation of the inbred line by skin allograft transplantation, found that the immune rejection reaction did not occur, and their homozygosity is up to 60 percent by the whole genome sequencing, which is different from Hainan *wuzhishan* pig on their genetic basis, to provide the further evidence for the successful culture for the inbred pig line, and then realize the innovation in genetic resources. The results show that the inbred line is an ideal animal model for human. Now F24 has an inbreeding coefficient of 0.994.

GENETIC STUDIES OF CHICKEN

MEAT QUALITY: Adopting a series of frontier technologies and tools including genome-wide association study with the high density chicken SNP Beadchip, Wen Jie and his team at the Institute of Animal Sciences firstly found 14 new candidate genes that had strong effects on chicken meat quality traits. They also found an important gene that influences the production efficiency of breast muscle in chicken. Papers about the research findings were published on *BMC Genomics* and *PLoS One*.

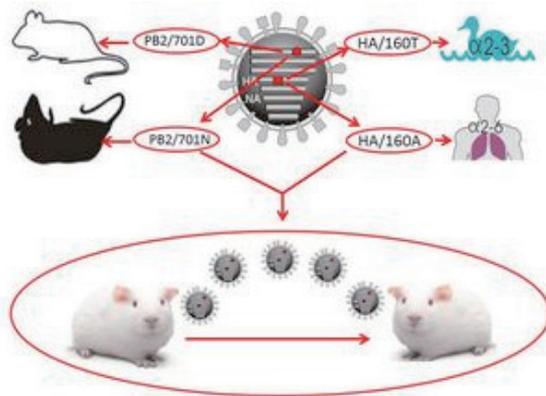
FOR INCREASING ROYAL JELLY PRODUCTION AND ITS BIOLOGICAL

CHARACTERISTICS: Applying the cutting-edge biotechnology of proteomics, Li Jianke and his team at Bee Research Institute conducted an in-depth study into the mechanism to increase the production of royal jelly and its bio-chemical features produced by the bees (jelly bees) selected for increasing royal jelly production in China. The findings show the size of the hypopharyngeal glands (where royal jelly is secreted) is significantly increased in the jelly bees and the period of royal jelly secretion was extended from 3-15 days relative to the control bees (Italian bees 6-12 days). The enhanced royal jelly production is driven by induced activity of protein synthesis and process, as well as the metabolic level in the hypopharyngeal glands. Also, the composition of the functional proteins in royal jelly produced by the jelly bees doesn't change and 19 new proteins are identified. Moreover the team has found a freshness protein marker (major royal jelly protein 5) for royal jelly.



Veterinary medicine

PROGRESS IN AVIAN INFLUENZA RESEARCH: Chen Hualan and her team from Harbin Veterinary Research Institute discovered that the H5N1 viruses gradually acquired the ability to infect and kill mammalian hosts during their evolution in nature. The team also identified several genetic markers that facilitate the avian influenza virus jumping from birds to mammals and transmitting between mammals, and they further revealed that the hybrid H5N1 viruses bearing the gene segments of human influenza viruses could transmit between mammals through respiratory droplets. Chen and her colleagues found the newly emerged H7N9 viruses are not lethal for chickens and mammals, but during their replication in humans, the viruses are able to acquire more mutations and become more virulent in the human population. Two papers that reported their findings were published in *Science* in May and July, 2013, respectively. The team won the 2013 State Natural Science Award (Second Prize).

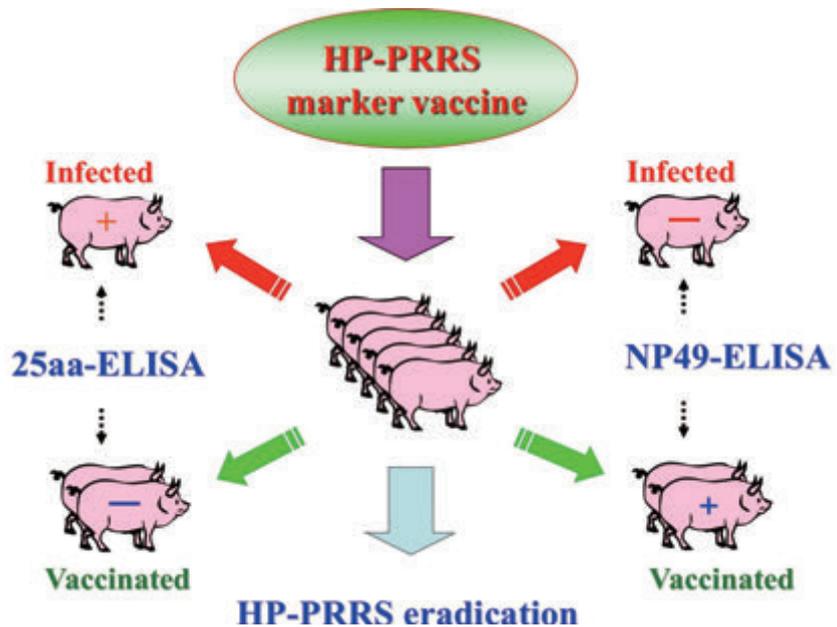


LIBRARY OF VIRUS STRAINS OF FMD AND STUDIES INTO RELATED VACCINES: Zhang Yongguang and his team at the Lanzhou Veterinary Research Institute are the first in China to build a bank of the different strains of the foot and mouth disease (FMD) virus. They also made innovations in the key technology for vaccine production and developed vaccines against type O, A, and Asia I FMDV strains of the virus. Researchers screened nine vaccine seed strains. They also provided strong support to China's efforts to control FMD by drawing up two sets of industry standards on vaccination and sterilization. The team won the 2013 China Agricultural Science and Technology Award (First Prize).

PROGRESS IN ANTI-PARASITIC DRUGS FOR ANIMALS: Zhang Jiyu and his team at the Lanzhou Institute of Husbandry and Veterinary Pharmaceutical Sciences developed a chemical technique to synthesize arecoline. The technique made it possible to prepare non-toxic raw materials and solutions on a large scale under normal temperatures. The team developed a micro-emulsion system that enables the production of the first water-soluble Avermectin preparation. Another micro-emulsion system they created can ensure the stability of Artesunate. The team also developed four anti-parasitic drugs for animal use. The achievement won the 2013 Gansu Province Science and Technology Progress Award (First Prize).

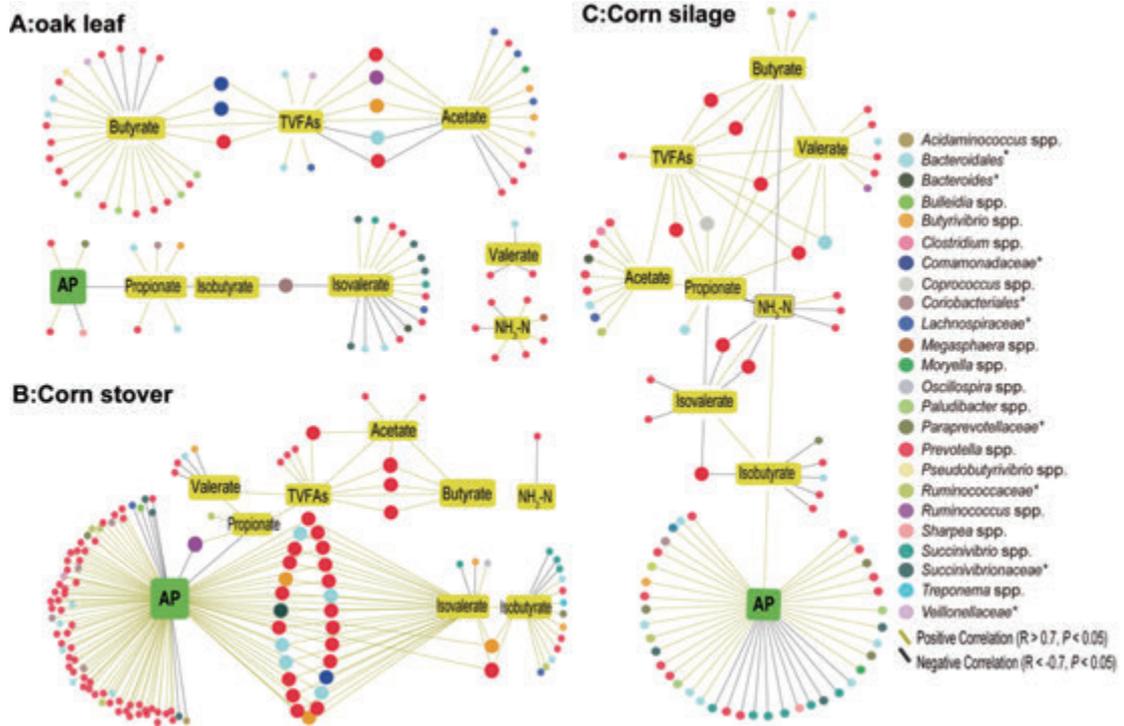
STUDY IN HIGH-TEMPERATURE-RESISTANT

A-GALACTOSIDASE: Taking α -galactosidase, one kind of important feed additive to decrease the antinutritional effect in feed grains, as one of their research subjects, Yao Bin and his team at the Feed Research Institute obtained new gene resources from thermophilic microorganisms and cultured gene-engineered strains that yield a steady and high output of enzymes so as to provide high-quality, cheap and highly productive α -galactosidase for industrial use. The team found six new α -galactosidases in three thermophilic organisms, one of which has the highest hydrolysis ability at 75 C, higher than all its peers in the GH27 family. The team was also the first to study the degrading results of the enzyme to galactomannan (21-38 percent) and glucomannan, and their related mechanism thus laying a foundation for research on features of α -galactosidase substrate as well as industrial use. Their research findings were published in *Bioresource Technology* and *Applied Biochemistry and Biotechnology*.



PROGRESS IN THE DEVELOPMENT AND USE OF VACCINES

AGAINST PRRSV: Tong Guangzhi and his team at Shanghai Veterinary Research Institute made progress in the study and use of vaccines against porcine reproductive and respiratory syndrome virus (PRRSV). On the basis of infectious clones, the research team obtained the attenuated vaccine rHN4- 25+NP49 by deleting some non-essential genes for replication and introducing marker genes. Like the HuN4-F112 vaccine, the rHN4- 25+NP49 vaccine strain is immunogenic and not pathogenic. It also has two markers that can differentiate vaccinated animals and naturally infected ones. The vaccine offers a 100 percent protection of pigs 28 days after vaccination and the immunity period lasts four months.



INSIGHTS INTO RUMEN MICROBIAL ECOLOGY OF CERVIDAE ANIMALS: Li

Guangyu and his team at Institute of Special Animal and Plant Sciences comprehensively examined the rumen microbiota of sika deer (*Cervus nippon*) fed three forage-based diets. They found that the rumen of sika deer was dominated by many novel *Prevotella* spp., which play potential roles in degrading the fibrous plants, and that *Methanobrevibacter millerae* was the predominant methanogens in the rumen of sika deer. Further, they revealed that the interplay patterns between bacteria and butyrate, isobutyrate, isovalerate, and the ratio of acetate to propionate in the rumen of sika deer fed a diet based on oak leaves were significantly different from that in corn stover and corn silage based diets, indicating that energy metabolism was considerably changed, and that the composition and content of proteins in the diets may be an important factor affecting the rumen fermentation of sika deer. The team also firstly illustrated the microbiota composition in the gastrointestinal tract of Chinese roe deer (*Capreolus pygargus*), and showed that the rumen microbiota significantly differed from that in the intestines and feces. Three peer-reviewed papers were published in *Microbial Ecology* and *PloS One*.

Agricultural Resources and Environment

STUDIES INTO THE IMPACTS OF CLIMATE CHANGE ON CHINESE FOOD SYSTEMS: Tang Huajun and his team at the Institute of Agricultural Resources and Regional Planning carried out studies on the impacts of climate change on Chinese food systems in a holistic and systematic way. Tang and his team addressed some major issues, such as: 1. What impacts has climate change over the past decades had on the spatiotemporal dynamics of agricultural resources for food production? 2. How have natural disasters, pests and diseases, and other extreme events occurred and evolved over time and space under the effects of climate change? 3. How and to what extent has climate change affected multiple cropping systems, cropping patterns, crop yields, and ultimately the overall food security in China? In total, eight research papers were published in the same edition of *Regional Environmental Change* in 2013. The team's findings have enriched current knowledge and understanding of recent climate trends and the impacts of these trends on food production in China, which can help to assist the development of effective adaptation measures, as well as more targeted improvement of current climate change adaptation practices in China.

RESEARCH ON KEY TECHNOLOGIES OF DRYLAND AGRICULTURE AND THEIR INTEGRATED APPLICATION: Mei Xurong and his team at the Institute of Environment and Sustainable Development in Agriculture discovered for the first time, through 15 years of research, the quantitative proportion of rainwater allocation in rainfed farmland, the structural characteristics of crop water consumption, as well as the improvement mechanism of soil water holding/supply capability, crop water adaptation, and water-carbon-nitrogen interactions on rainwater use efficiency. The findings lead to breakthroughs in key technologies for “harvest, store, conserve and improve” rainwater use for dryland agriculture, and also to innovative core technology for “water harvesting in fall or summer, conserving in winter and using in spring”. Following the foregoing exploration, the team integrated and popularized the growth models and related technical systems for various patterns of dryland regions. In recent three years, these technologies have been applied in rainfed farmland up to 14.2 million hectares, leading to an increment of 9.95 million tons in crop production and 20,030 million yuan (\$3,257 million) in production value. The technologies won the 2013 National Science and Technology Progress Award (Second Prize).







INVENTION AND APPLICATION OF SLOW AND CONTROLLED RELEASE FERTILIZER MATERIALS FOR LOW COAST AND EASY DEGRADATION: Zhang Fudao and his team at the Institute of Agricultural Resources and Regional Planning invented a series of slow and controlled release fertilizer materials. They also invented related technologies and equipment for the production of slow and controlled release fertilizer for field crops, enabling the materials to be produced at low-cost and making them more easily degradable and reducing the nitrogen lost during fertilization. This improved fertilizer production efficiency has been used by major companies in Guangdong and Shandong provinces. The team's achievements were granted the 2013 National Technology Invention Award (Second Prize).

STUDIES ON BREEDING COTTON CULTIVARS AGAINST VERTICILLIUM WILT: Dai Xiaofeng and his team at Institute of Agro-Products Processing Science and Technology achieved progress in breeding novel cotton cultivars against *Verticillium wilt*. They developed molecular marker-assisted *Verticillium wilt*-resistant cotton breeding technology and cultivated a new cotton germplasm—*Zhongzhi 372*. In the context of *Zhongzhi 372* as parent material, they further obtained the world's first 14 novel *Verticillium wilt*-resistant cotton cultivars, including *Zhongzhi 2*, *Zhongzhi 6*, *Xinzhiza 2* and *Xinluzhong 46*. The technology has been applied in 4.67 million hectares, generating 20 billion yuan (\$3.3 billion) in revenue. The team won the Gold Kangaroo World Innovation Award and the 2013 China Agricultural Science and Technology Award (First Prize).



RESEARCH ON NEW MECHANISM FOR VIRAL SUPPRESSION OF RNA SILENCING:

Zhou Xueping and his team at the Institute of Plant Protection have achieved progress in the interaction between geminivirus and plants. By providing lines of molecular and genetic evidences, the team demonstrated a distinct mechanism of β C1, the pathogenesis factor of geminivirus, for counteracting host RNA silencing defense. The mechanism revealed that this defense was mediated by induction of an endogenous suppressor of RNA silencing and by subsequent repression of RNA-dependent RNA polymerase 6 (RDR6) expression, thus highlighting an essential role for RDR6 in RNA silencing response against geminivirus infection. Related results were published in the international peer-reviewed journal *PLoS Pathogens*.

RESEARCH ON THE IMPACT OF CLIMATE CHANGE IN GRASSLAND AREAS:

Hou Xiangyang and his team at the Institute of Grassland Research have been carrying out researches on the grassland area in North China. The objects of the research include a regional natural ecosystem, a social and economic system of county-level regions, as well as a household production system. Covering the influence of climate change, the systematic response and adjustments afterwards, the research results illustrate the spatial and temporal pattern of climate variation in grassland areas in North China, as well as its impact on the vegetation productivity of grassland. The team also systematically evaluated the drought vulnerability in the region and the climate change vulnerability at the county and household livelihood levels. It mainly elaborated on how the household, as a basic unit which maintains the grassland ecosystem services and animal production, recognizes and responds to climate change. Their research offers strategies and solutions for the whole area, county-level regions and independent families. Related research results were published in *Proceedings of the National Academy of Sciences* and *The Rangeland Journal*.

INVENTION OF PROTEIN BIOLOGICAL PESTICIDE:

Qiu Dewen and his team at the Institute of Plant Protection, for the first time, separated two new types of protein that can trigger plant immunity from *Alternaria tenuissima*. They also identified the receptor protein in the cell membrane of tobacco. They have developed techniques for fermentation, extraction of the immune protein and the processing of

18

invention patents

granted in China

667,000

hectaresof demonstration
planting**CROP CYST NEMATODES CONTROL**

TECHNOLOGY: Peng Deliang and his team at the Institute of Plant Protection have been carrying out research on the distribution and damage of cyst nematodes and the regular patterns of its disasters. The research showed the cereal cyst nematodes have occurred in 16 provinces and cities in North, Middle, West and Northwest China. The team has developed six diagnostic kits for a range of cyst nematodes, including *Heterodera avenae*, *H. filipjevi* and *H. elachista*. Specifically for wheat and soybean cyst nematodes, the team developed four kinds of nematicides and three biological agents. It holds 18 invention patents. Their control technology has been applied in over 7 million hectares in different rural areas.

preparations. In addition, the team has invented the first protein biological pesticide against plant virus disease, “6 percent oligosaccharide protein wettable powder”, which has been given the green light for rolling out to the market. Related results were published in *Plant, Cell & Environment* and *PLoS One*.

FORECASTING AND MONITORING TECHNOLOGIES FOR MAJOR BIOLOGICAL INVASIONS:

Wan Fanghao and his team at the Institute of Plant Protection have identified invasive alien species in China and their risk classification. They have made innovative development in the quantitative risk analysis for invasive alien species. They have also developed new monitoring, blocking and protection technologies, and created a comprehensive regional protection system for large biological invasion. It has been applied in fields totaling 30,000 square kilometers in 21 provinces across the country. The team won the 2013 National Science and Technology Progress Award (Second Prize).

Agricultural Mechanization and Engineering



STUDY ON UNMANNED AERIAL INSECTICIDE-SPRAYING TECHNOLOGY:

Xue Xinyu and her research team at the Nanjing Research Institute for Agricultural Mechanization of the Ministry of Agriculture developed an unmanned aerial insecticide spraying technology that features automatic and low-altitude navigation, as well as related equipment by combining the technologies of agricultural aviation delivery, GPS automatic navigation, and ultra-low altitude and low volume anti-drift spraying. The innovative high-precision GPS automatic navigation technology and equipment the team invented has increased the efficiency of China's aerial protection of plants. It is 100 to 150 times more efficient than ground machines with increased insecticide utilization of 10 to 20 percent.



GREENHOUSE ENERGY STORAGE AND TEMPERATURE CONTROL TECHNOLOGY:

Yang Qichang and his research team at the Institute of Environment and Sustainable Development in Agriculture are the first to propose a revolutionary theory and method that actively stores and releases heat by using fluids as a medium in greenhouse. They also developed related active heat storage and release (AHS) system and equipment, and integrated the AHS system with heat pumps in the greenhouse to increase the system's energy use efficiency to support the development of low-carbon and energy-saving technologies in greenhouses.

RESEARCH AND APPLICATION OF SMALL UTILITY MACHINES FOR ORCHARDS:

Researchers from the Institute of Pomology and the Shandong Agricultural University, headed by Hao Zhiqiang, carried out application studies on 13 types of small utility machines used in orchards. These included an inter-row and in-row weeders, an offset ditching/fertilizing/stirring backfill machine, an offset vibrating fertilizer application machine, a reciprocating/rotary grapevine pruning machine, an atomizing air-assisted electrostatic sprayer, a portal frame sprayer, a grapevine burying machine, a cold-resisting soil removing machine and a low-gap power work platform for orchard machines. They have been granted 16 patents. Of these machines, those related to the fertilization of fruit trees and cold-resistance management were the first developed in China.



RESEARCH ON EFFICIENT TRANSFORMATION OF AGRICULTURE AND FORESTRY CELLULOSIC BIOMASS RESOURCES BY *ZYMOMONAS MOBILIS*: He Mingxiong and his research team at the Biogas Institute of the Ministry of Agriculture, focusing on the key scientific issue about the molecular mechanism of environmental stress factors on energy microbiology, conducted China's first systematic study on the effects of environmental stress factors on *Zymomonas mobilis* during the cellulosic biomass conversion process. They also developed new biomass resources, such as bamboo and wetland plant biomass resources, and innovative biomass transformation technologies. Related research findings were published in *Applied Microbiology Biotechnology* and *Biotechnology for Biofuels*.





EFFICIENT WATER-SAVING IRRIGATION TECHNOLOGY AND EQUIPMENT: Huang Xiuqiao and his team at the Farmland Irrigation Research Institute, focusing on irrigation technologies about water-saving, water-use efficiency and low energy consumption, have conducted studies on efficient running mechanism of sprinkler irrigation unit, micro-pressure drip irrigation design, filtration disposal of irrigation water and optimization design of pipe network. They have: (1) made analysis on products and improved structure optimization to equipment, then developed light-small sprinkler machine unit, micro-pressure emitter, self-adaptive dripper, full-automatic back-washing filter and reversing valve, and equipment for irrigation water distribution; (2) found variations of the hydraulic characteristics and key parameters about irrigation products by indoor and outdoor hydraulic performance tests and field trials; (3) put forward the specific combined applications of micro-pressure drip irrigation, multi-purpose sprinkler irrigation, low-pressure pipe irrigation and other water-saving technologies, greatly solving problems brought by conventional system, such as low availability due to repeated equipment, large energy consumption, operation inflexibility and high cost for unit area. The achievement was granted the DAYU Water Conservancy Science and Technology Award (Second Prize) and 13 patents in 2013.

RICE MECHANICAL TRANSPLANTING TECHNOLOGY FOR POT-MAT SEEDLINGS: Zhu Defeng and his team at the China National Rice Research Institute developed a new mechanical transplanting technology for pot-mat rice seedlings that is an advance on the existing technology. It features easy operation, labor-saving and less transplanting shocks, and fast green returning, and it produces uniform seedlings per hill and increases yield among other characteristics. Its application in the cold rice growing regions especially shows fast green-returning and early growth after transplanting, with greater tolerance to cold and higher yields. More than 20 patents have been granted. The technology has been listed as leading rice production technology by the Ministry of Agriculture in the past three years. It has been applied in more than 20 provinces in the main rice growing regions with remarkable social and economic benefits.



Agro-product Quality, Safety and Processing

Low-temperature Compressing 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 compressing technology and subcritical extraction equipment for peanut oil and protein powder production. The low-temperature compressed peanut oil is 50 percent lower in acid value than those made by traditional methods, as well as 53 percent higher in β -sitosterol content and its protein nitrogen solubility index is 6.3 times higher. They also developed

the technologies for peanut protein concentrate production and modification, the conarachin production, and they were the first in China to use the peanut protein for meat processing. The technologies for functional peanut peptides production were established, with 89 percent of the trichloroacetic acid-nitrogen solubility index (TCA-NSI), 90.3 percent of the purity and 30 to 35 times higher prices than peanut meal. In total, seven owned invention patents have been industrialized by nine famous enterprises, mainly in Shandong and Henan provinces. The team won the 2013 China Agricultural Science and Technology Award (First Prize).



INNOVATION AND APPLICATION OF MUTTON VALUE-ADDED PROCESSING TECHNOLOGIES:

Researchers headed by Zhang Dequan at the Institute of Agro-Products Processing Science and Technology developed key technologies for controlling losses related to mutton carcasses, which included pre-slaughter stress regulation, meat controlled freezing-point storage technology, low-variable temperature with high humidity thawing technology and high-barrier packaging. These technologies reduce the loss rate of mutton carcasses from five to eight percent to lower than 1.5 percent and extend the shelf life from seven days to 45 days. They also established mutton carcass cutting methods for 25 bone-in cuts and 13 bone-free cuts, and divided the mutton carcass produced in China into four grades and 16 specifications. They also developed a vacuum pulse assisted pickling method, a non-refrigerated texture recombination technology and an artificial climate air-dried technology to produce air-dried mutton that can reduce energy use by 36.9 percent and double the product's shelf life. These technologies have been applied by the leading mutton processing enterprises in the Inner Mongolia, Ningxia Hui and Xinjiang Uygur autonomous regions.

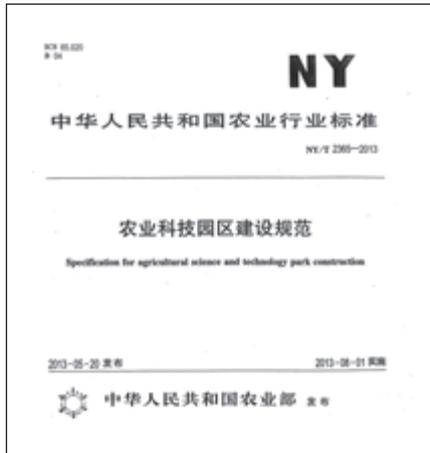
36.9%

reduction in energy consumption

TECHNIQUES FOR SCREENING UNKNOWN ADDITIVES IN ANIMAL BREEDING:

Yang Shuming and his research team at the Institute of Quality Standard and Testing Technology for Agro-Products accomplished the construction of an animal feed additive information monitoring network which covers nearly 38 percent of China's total animal feed production regions. They have constructed two new databases of nuclear magnetic resonance spectrum and infrared spectrum for additives, and increased the total number in the tandem mass spectrum database to 622 compounds. They have combined Q-TOF screening technologies with quantitative LC-MS/MS confirmatory technologies to scrutinize several thousand batches of animal feed samples, veterinary drugs and livestock products, and discovered several new types of prohibited additives and illegal drugs.

Agricultural Information and Economics



HIGH-TECH TRANSFORMATION OF TRADITIONAL AGRICULTURE PROJECTS: Jiang Heping and his research team at the Institute of Agricultural Economics and Development took the lead in China in proposing fundamental theories for transforming traditional agriculture with high technology. They include theories on related penetration, technology choice, technology assembling and high-tech parks, agricultural science and technology parks of the *Three Zones Theory* (core area, demonstration areas, radiating zone). Based on these theories, the team has summarized the operation mechanism and mode of high-tech transformation of traditional agriculture. Compiled by Jiang's team, the *Agricultural Science and Technology Park Construction Standards* was released by the Ministry of Agriculture on May 20 with its implementation on Aug 1, 2013.

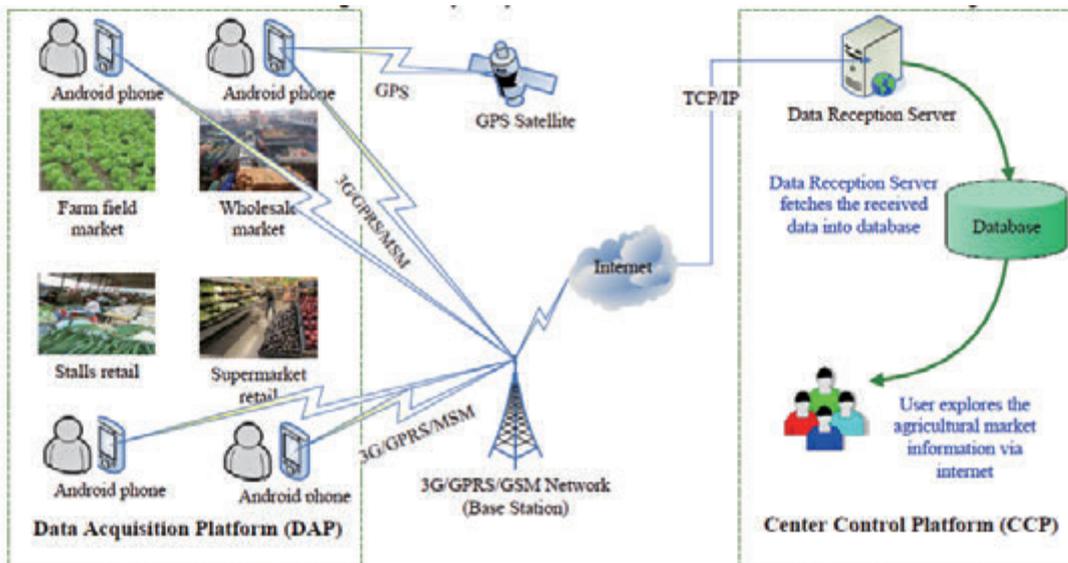
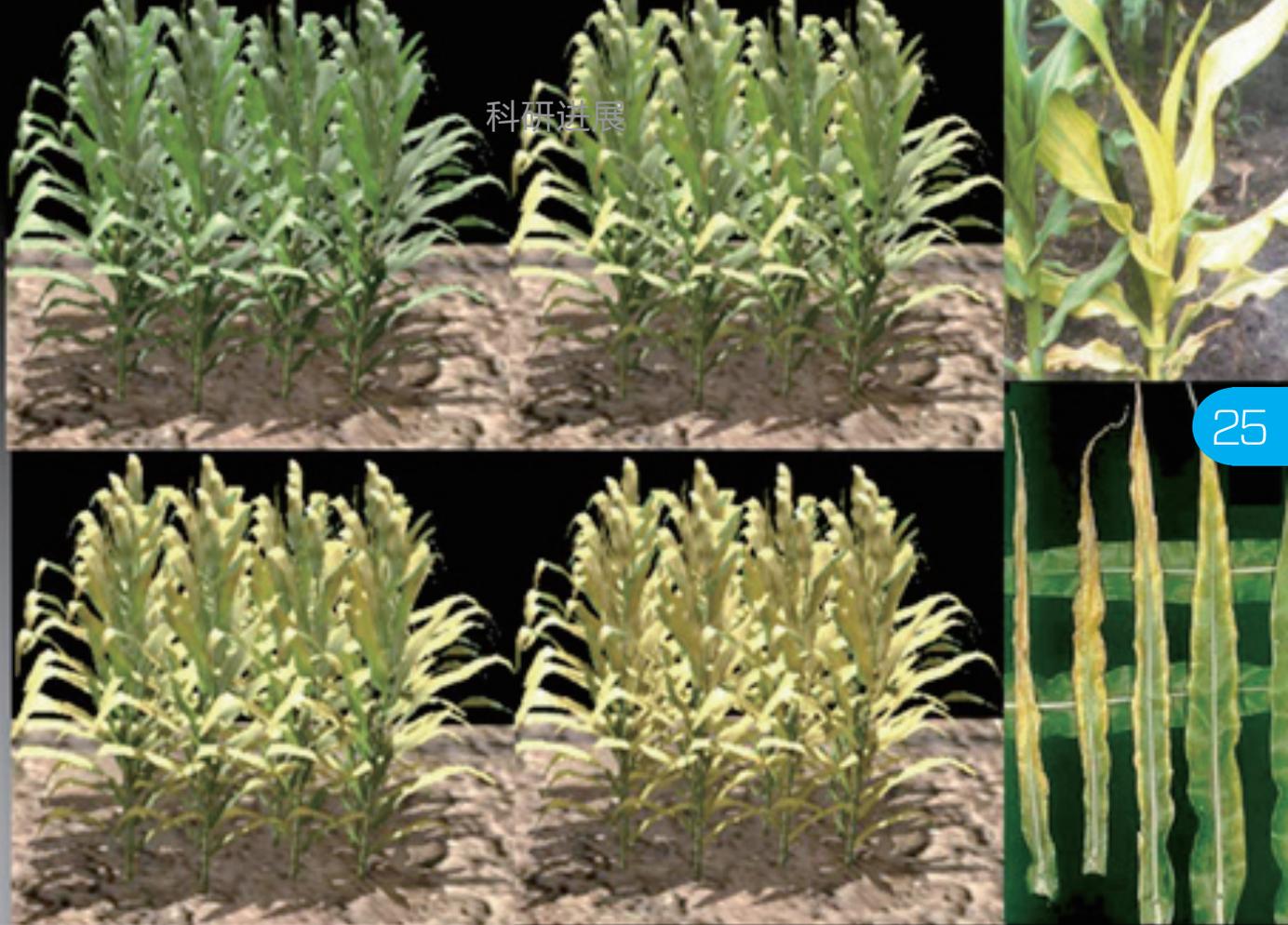
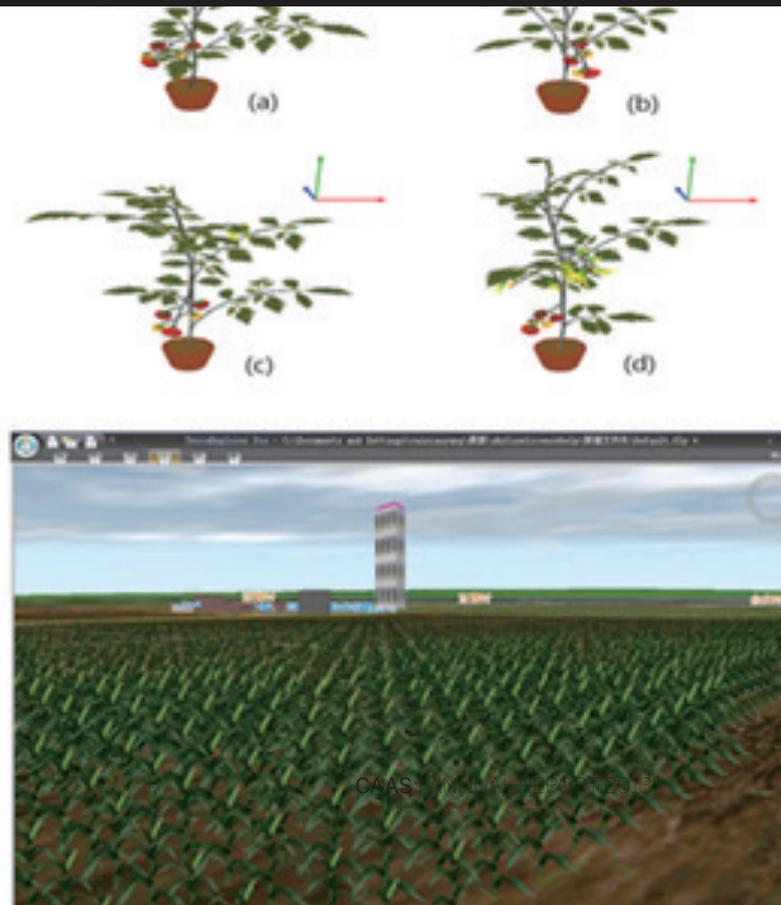


Fig.3 System architecture

AGRO-PRODUCT MARKET INFORMATION COLLECTION DEVICE: Xu Shiwei and his research team at the Agricultural Information Institute are the first to propose an agri-product market holographic information theory and the first to develop a standardized agricultural market information collection system, as well as key technologies for agri-product market information positioning, matching collection and optimized transmission. Their technologies realized the automatic positioning and field matching of agricultural markets, and real-time information collection. They also improved the agri-market data intelligence processing and analysis techniques, proposed combining the embedded technology and the component technology, and developed easy-used market information collection equipment that features automatic positioning, standardized collection and CAMES (China Agriculture Monitoring and Early-warning System) intelligent support.



CROP VIRTUAL DESIGN AND VISUALIZATION TECHNOLOGIES: Zhu Yeping and her research team at the Agricultural Information Institute have carried out research and development on a service-oriented field crops growth intelligent interactive and visualization research platform on the basis of crop growth simulation models and crop visualization models, a greenhouse crops growth regulation visualization platform, as well as crop growth and canopy temperature digital detection technology. Systematology, crop modeling, artificial intelligence, simulation visualization, network computing, the Internet of things, and multimedia were integrated into the models to simulate crop growths and to recommend an optional planting plan according to different simulation goals that integrate the effects of soil, crop phenotype, weather, and management options. The platforms can provide intelligent sensing technologies and products for modern agriculture, and offer intelligent decisions and support for agricultural production and agricultural management departments.



Domestic cooperation



1. Forge partnerships to meet local agricultural development demands

In the context of implementing its mission for agricultural and rural development, CAAS strengthened cooperation with local governments in 2013. Agreements of strategic cooperation were signed with the local authorities in Chengdu and Guang'an in Sichuan province, Dalian in Liaoning province, Zhuzhou in Hunan province, Dezhou in Shandong province and a number of cities in Helongjiang province. Based on the agreements, CAAS initiated research programs with these local governments and helped them draw up plans for local agricultural development. CAAS also worked closely with localities in innovation and technology transfer and the capacity building of local agricultural professionals.





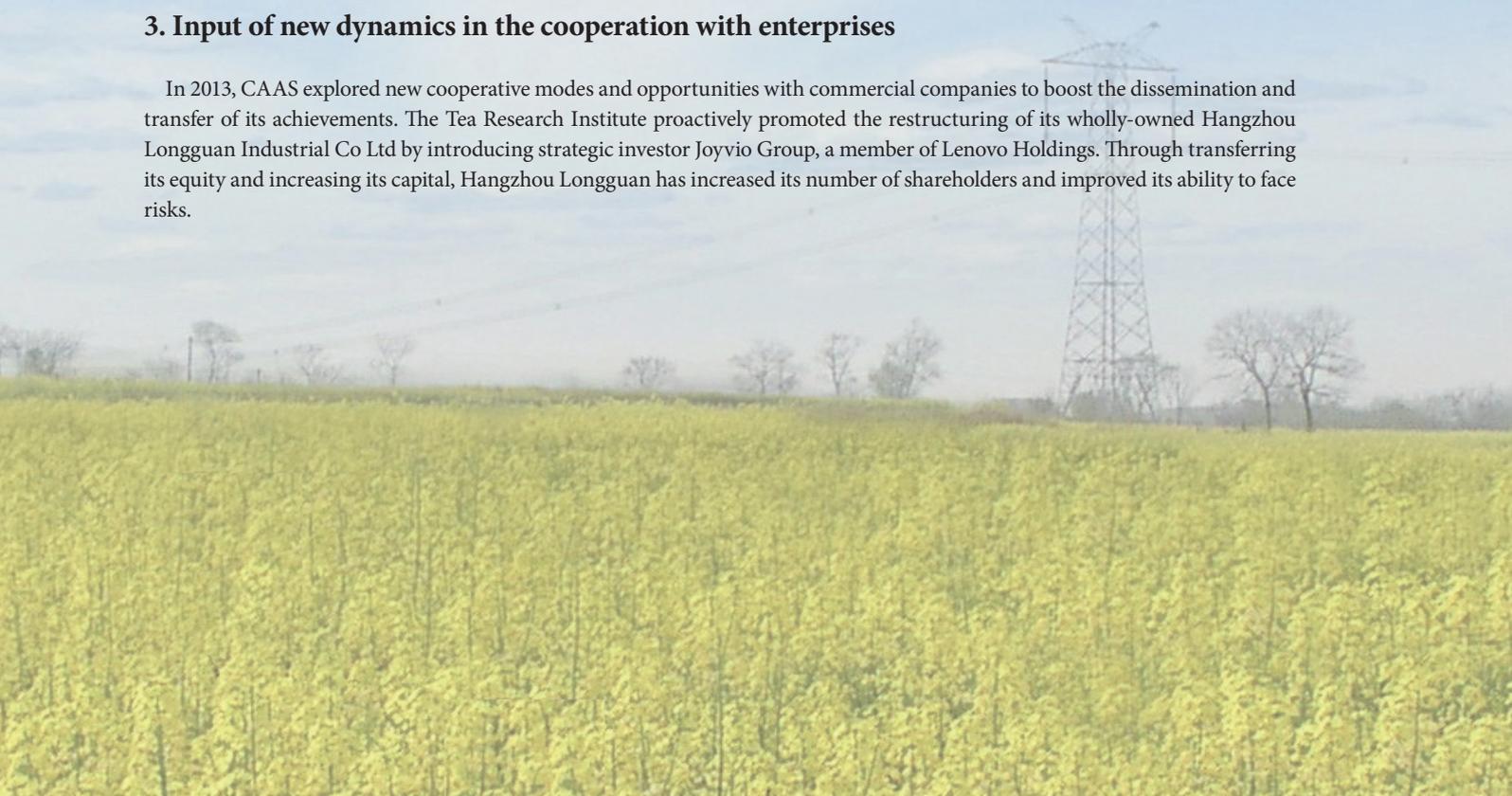
2. Consolidate CAAS' leading role in the national agricultural research system

To align with the central government's plans for agricultural technologies and the guidelines for major scientific and technology programs, CAAS proposed and coordinated a series of nationwide cooperative projects aimed at improving the yield of major crops and cash crops, as well as the development of animal husbandry. Coordinated and extensive collaboration with agricultural institutes and universities throughout China has led to many new technologies and integrated technical modes that are providing strong support to modern and sustainable agricultural production in China.



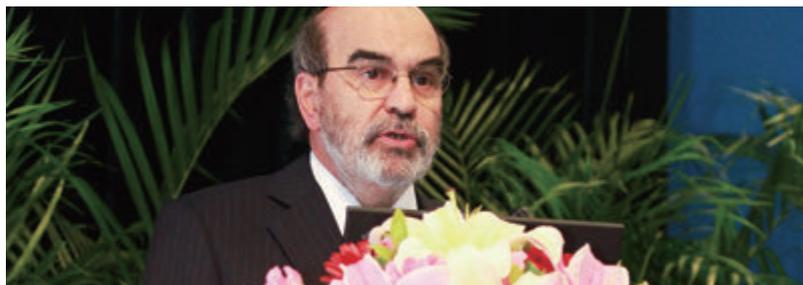
3. Input of new dynamics in the cooperation with enterprises

In 2013, CAAS explored new cooperative modes and opportunities with commercial companies to boost the dissemination and transfer of its achievements. The Tea Research Institute proactively promoted the restructuring of its wholly-owned Hangzhou Longguan Industrial Co Ltd by introducing strategic investor Joyvio Group, a member of Lenovo Holdings. Through transferring its equity and increasing its capital, Hangzhou Longguan has increased its number of shareholders and improved its ability to face risks.



International Cooperation

1. Forums for international collaboration



Director General of FAO **José Graziano da Silva**



Secretary-General of OECD **Angel Gurría**



Under Secretary of US Department of Agriculture **Catherine Woteki**



Chair of the Consortium Board of CGIAR **Carlos Pérez del Castillo**



Vice-President of World Bank **Makhtar Diop**



Assistant Deputy Minister for Agriculture and Agri-Food Canada **Gilles Saindon**

☞ THE 4TH GLOBAL FORUM OF LEADERS IN AGRICULTURAL SCIENCE AND TECHNOLOGY

In collaboration with the Food and Agriculture Organization of the United Nations (FAO), the Consultative Group on International Agricultural Research (CGIAR) and the Beijing Municipal Science and Technology Commission, CAAS hosted the fourth Global Forum of Leaders in Agricultural Science and Technology (GLAST-2013) in Beijing between June 5 and 6.

The forum attracted 300 participants from over 60 countries, including the United States, Russia, Germany and South Korea. Among the issues discussed during the meeting were global collaboration on agricultural technological innovation, improving agricultural innovation ability of developing countries, the role of public research institutions and private enterprises in global agricultural innovation, and advancements in the agricultural technology and rural development through agricultural technology transfer.

The forum released the *Beijing Declaration of the Global Forum of Leaders in Agricultural Science and Technology*, which is expected to play an active role in promoting the development of international cooperation in global agricultural technology.



Executive Director of the Forum for Agricultural Research in Africa (FARA) and co-winner of the 2004 World Food Prize **Monty Patrick Jones**

“China's agricultural development cannot be achieved without the rest of the world, just as the world's agricultural development needs contributions from China. We need to enhance technological exchanges with the agricultural departments of different nations, international organizations and agricultural enterprises. We will continuously expand and deepen our collaboration to boost agricultural technological innovation together and make greater contributions to the agricultural development and food security of the whole world.”

Han Changfu, Minister of Agriculture



☞ THE 30TH ANNIVERSARY OF CHINA-CGIAR COLLABORATION

CAAS and CGIAR co-hosted a forum to celebrate the 30th anniversary of their collaboration.

The forum provided a systematic summary of the collaboration between CAAS and CGIAR over the past 30 years, and allowed thorough discussions on common efforts to tackle global challenges, such as reducing rural poverty, increasing food security, improving human health and nutrition, and ensuring sustainable management of natural resources.

The two sides released a joint declaration, in which they agreed to deepen cooperation in a range of areas of common interest, including genetic resources, the breeding of crops and animals, biotechnology, biosecurity, plant conservation, management of natural resources, agricultural policy, and food quality.



The release of the book *30 Years of Strategic Collaboration between China and CGIAR*

2. Outline of mission and vision with an international outlook

☞ THE THIRD MEETING OF THE INTERNATIONAL ADVISORY BOARD

CAAS held its third International Advisory Board Meeting in Beijing. The board continued to implement its mission of improving the governance and management functions through extensive discussion with CAAS management and key staff. The meeting discussed several issues on their agenda and came out with constructive advice for the academy's future development, including its mission and vision, strategic planning and balanced development, as well as the intra- and inter-flows of researchers, international exchanges and promotions. The proposals were developed to improve and shape the future of the Academy.



☞ NATIONWIDE NETWORK FOR INTERNATIONAL COLLABORATION

The National Network for International Collaboration organized by CAAS offers a platform for the agricultural research community to increase technology exchanges. In September 2013, the network held its 18th national meeting in Hefei, Anhui province to discuss mid-term and long-term plans for agricultural scientific cooperation.

Nearly 70 representatives, including directors of agricultural or animal husbandry academies from more than 30 provinces, municipalities or autonomous regions around China participated in the event. They shared information about international collaboration in agricultural sciences and discussed how to boost integrated development of international collaboration in agricultural technology.

The representatives agreed that to ensure food safety and boost technology innovation and smart agriculture in the future, international cooperation should emphasize information sharing and talent exchanges; build platforms for diversified cooperation; improve the designs of flagship programs according to partners' features and advantages; and enhance collaboration and coordination mechanisms.

“ Each organization in the cooperation network should know exactly the direction of future agricultural development, and increase exchanges and collaboration to advance the internationalization of China's agricultural research institutes and scientific researches, and create a new situation for international collaboration together.”

Li Jiayang

Vice-Minister of Agriculture and CAAS President

3. Boosts to international research cooperation

According to a general plan for its innovation programs and requirements for the construction of modern research institutes, CAAS has established six international joint labs based on key disciplines and signed a total of 19 agreements on major programs or memorandums of understanding for technology cooperation.

CAAS also held or organized 67 high-level international ac-

ademic symposiums or scientist forums, which have played an important role in advancing the development and exchanges of the world's agricultural sciences.

CAAS has increased the level of cooperation with the European Union. It signed a letter of intent on technological research and innovation of food, agriculture and biology with the European Commission in Beijing on Nov 21, 2013.



Premier Li Keqiang (middle, second row), President of the European Council Herman Van Rompuy (left, second row) and President of the European Commission Jose Manuel Durao Barroso (right, second row) attend the signing ceremony.



CAAS Vice-President Wu Kongming, then Chinese Ambassador to Australia Chen Yuming and then Australian Prime Minister Julia Gillard attend the signing ceremony for the joint lab based at University of Sydney.

CAAS AND THE UNIVERSITY OF SYDNEY JOINT LABORATORY FOR SUSTAINABLE AGRO-ECOSYSTEMS

On March 6, 2013, CAAS and the University of Sydney signed a new agreement on the establishment of a Sino-Australian Joint Laboratory for Sustainable Agro-ecosystems. This is the first joint lab that CAAS has set up in Oceania.



MOA Chief Veterinary Officer Yu Kangzhen and FAO Chief Veterinary Officer Juan Lubroth inaugurate the lab.

HVRI ANIMAL INFLUENZA LABORATORY DESIGNATED AS FAO REFERENCE CENTER

On March 4, 2013, the Ministry of Agriculture and the Food and Agriculture Organization (FAO) of the United Nations held a ceremony to designate the Animal Influenza Laboratory at the Harbin Veterinary Research Institute to be the Reference Center for Animal Influenza of the FAO. It was China's first and the world's second international reference center approved by the FAO in the sector.

4. 'A gift from Chinese agricultural innovation to the world'

In cooperation with the Bill and Melinda Gates Foundation, CAAS tested more than 370 Chinese rice varieties in 15 countries in Southeast Asia, Southern Asia and sub-Saharan Africa in the first phase of the Green Super Rice project.

The second phase started in 2013 and aims to establish the world's largest functional rice genome database via gene sequencing of a core collection of 3,000 rice varieties that account for around 90 percent of the world's total.



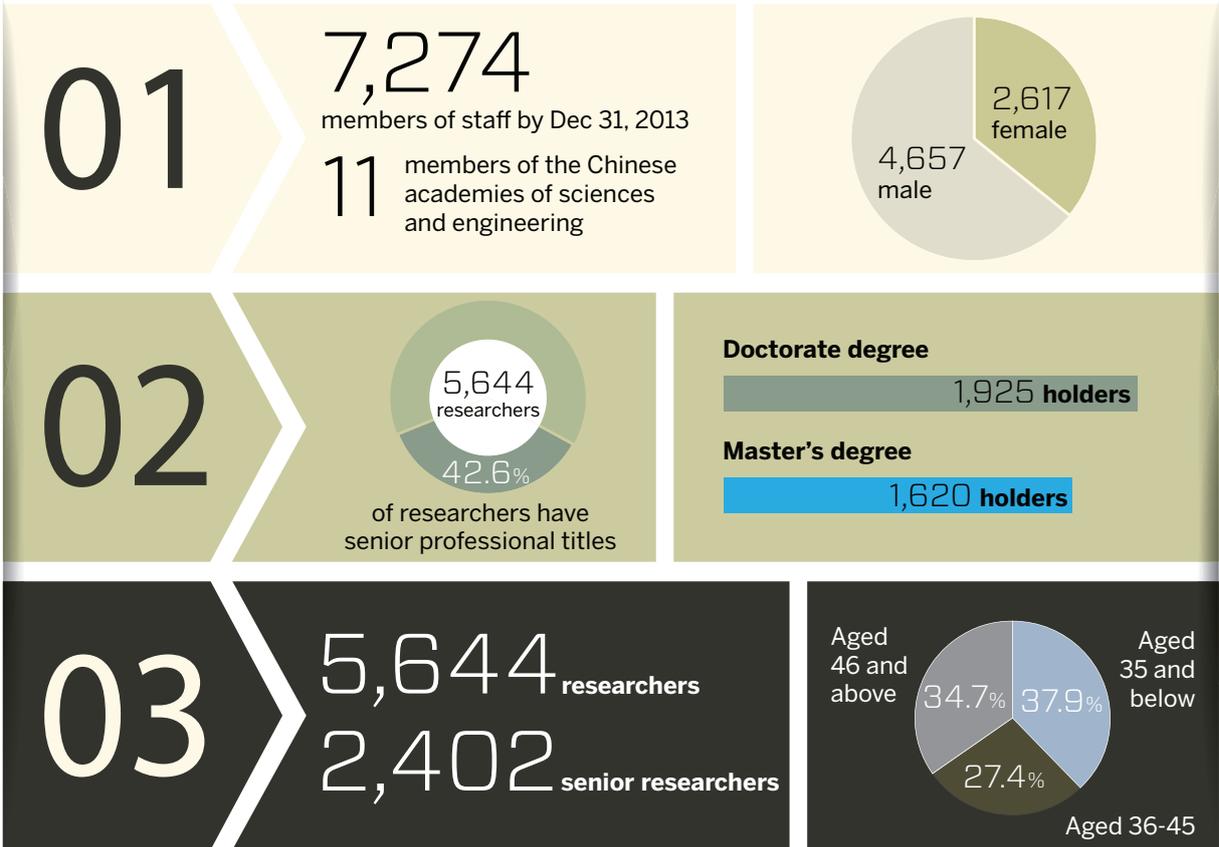
5. Global outreach

CAAS increased its publicity worldwide with a supplement in the US magazine *Science*. With 20,000 copies of *The Chinese Academy of Agricultural Sciences—Envisioning an Innovative Future* distributed to agrotech organizations around the world, the supplement has helped CAAS broaden its international cooperation channels and attract more overseas experts.

The English version of the official CAAS website (<http://www.caas.cn/en/>) went online on Nov 12, 2013 to facilitate global partners to look for cooperation and learn about the academy's latest research progress.



Staff



The CAAS Graduate School

The school has the task of training high-level innovative talent for China's agricultural technological development. It has been evaluated as one of China's first-class graduate schools for 13 consecutive years since 2012, with its overall competitiveness ranked among the top 30 of all graduate schools in the country.

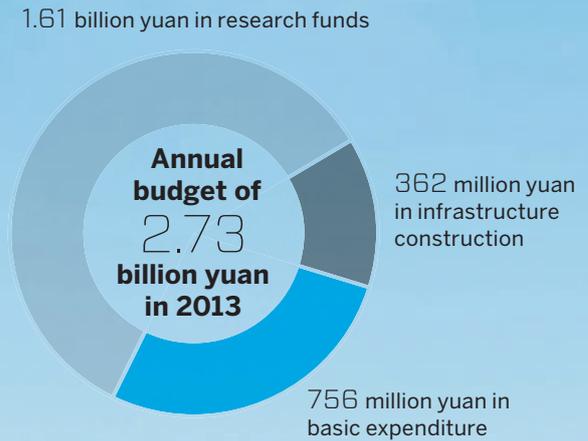
In 2007, the Ministry of Education designated the school as one able to accept foreign students who receive scholarships from the Chinese government. It enrolled 11 foreign students in 2008 and now has 152 foreign students.

The school enrolled 1,348 students in 2013 including 241 for doctorates, 700 for masters, 275 for specialized masters, and 66 foreign students. By 2013, there were 4,214 students in the school, including 2,807 full-time postgraduates, 1,268 specialized postgraduates, and 139 foreign students.



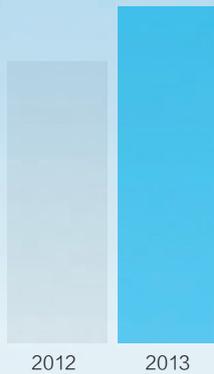
Budget

CAAS had an annual budget of 2.73 billion yuan (\$ 443.4 million) in 2013. This was an increase of 445 million yuan (\$ 72.32 million) or 19.51 percent, on the year before. Of the funds, 756 million yuan (\$ 122.87 million) was basic expenditure, up 30 million yuan (\$ 4.88 million) or a 4.13 percent rise compared to 2012. The academy got research funds of 1.61 billion yuan (\$ 261.7 million) last year, 385 million yuan (\$ 62.57 million) more than 2012, up 31.4 percent. And the appropriation for infrastructure construction was 362 million yuan (\$58.84 million), 31 million yuan (\$ 5.04 million) more than 2012, up 9.25 percent. The increase in funds is mainly because CAAS launched technological innovation projects.



Annual budget

19.51% growth



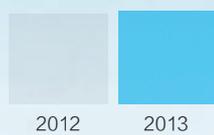
Research funds

31.4% growth



Basic expenditure

4.13% growth



Infrastructure construction

9.25% growth



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 two of their kind in China. CAAS has six key national labs and 42 key MOA labs, as well as three national reference labs, one FAO Reference Center for Animal Influenza, 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 keep 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**

1
**FAO
reference
center**

7
**OIE
reference
labs**



Organizational Structure



Research Institutes Distribution



Field Stations

CAAS has three comprehensive experimental bases in Beijing's Nankou town, Langfang in Hebei province and Xinxiang in Henan province, which together cover an area of 470 hectares. CAAS also has 95 specialized experimental stations located in 28 major agricultural areas across China, covering an area of 5,500 hectares. The stations have laid a solid foundation for scientific and technological development of CAAS.



Key Laboratories and Centers

1 Major national facilities

	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

	Labs	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 the 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	SKLVB has focused 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

	Labs	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	OIE Reference Laboratory for Equine Infectious Anemia	The researches of this laboratory focus on epidemiology and immunology of Equine Infectious Anemia. An equine infectious anemia virus vaccine model is used to study the mechanism of protective immunity for lentiviruses.	Harbin Veterinary Research Institute
3	OIE Twinning Laboratory for Equine Influenza	The laboratory is to carry out the research on the epidemiology, etiology, and diagnosis of Equine Influenza and to development the vaccine and diagnostic reagent.	Harbin Veterinary Research Institute
4	OIE Foot and Mouth Disease Reference Laboratory	Technical consultation and service, etiology study, molecular epidemiology research and immunology research; R&D on techniques and products for FMD prevention and control.	Lanzhou Veterinary Research Institute
5	OIE Ovine Theileriosis Reference Laboratory	Pathogen identification, epidemiology, diagnosis, prevention and control of ovine theileriosis	Lanzhou Veterinary Research Institute
6	OIE Twinning Laboratory for Infectious Bursal Disease	The Laboratory's studies relate to the pathogen basic research, epidemiological studies and the prevention and control of infectious bursal disease virus (IBDV)	Harbin Veterinary Research Institute
7	OIE Reference Laboratory for Avian Influenza	The Laboratory is in charge of the confirmative diagnosis of avian influenza, avian influenza surveillance, development and update of vaccines and diagnostic reagents	Harbin Veterinary Research Institute
8	OIE Collaborating Center for Zoonoses of Asia Pacific	The center carries out the 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

2013



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