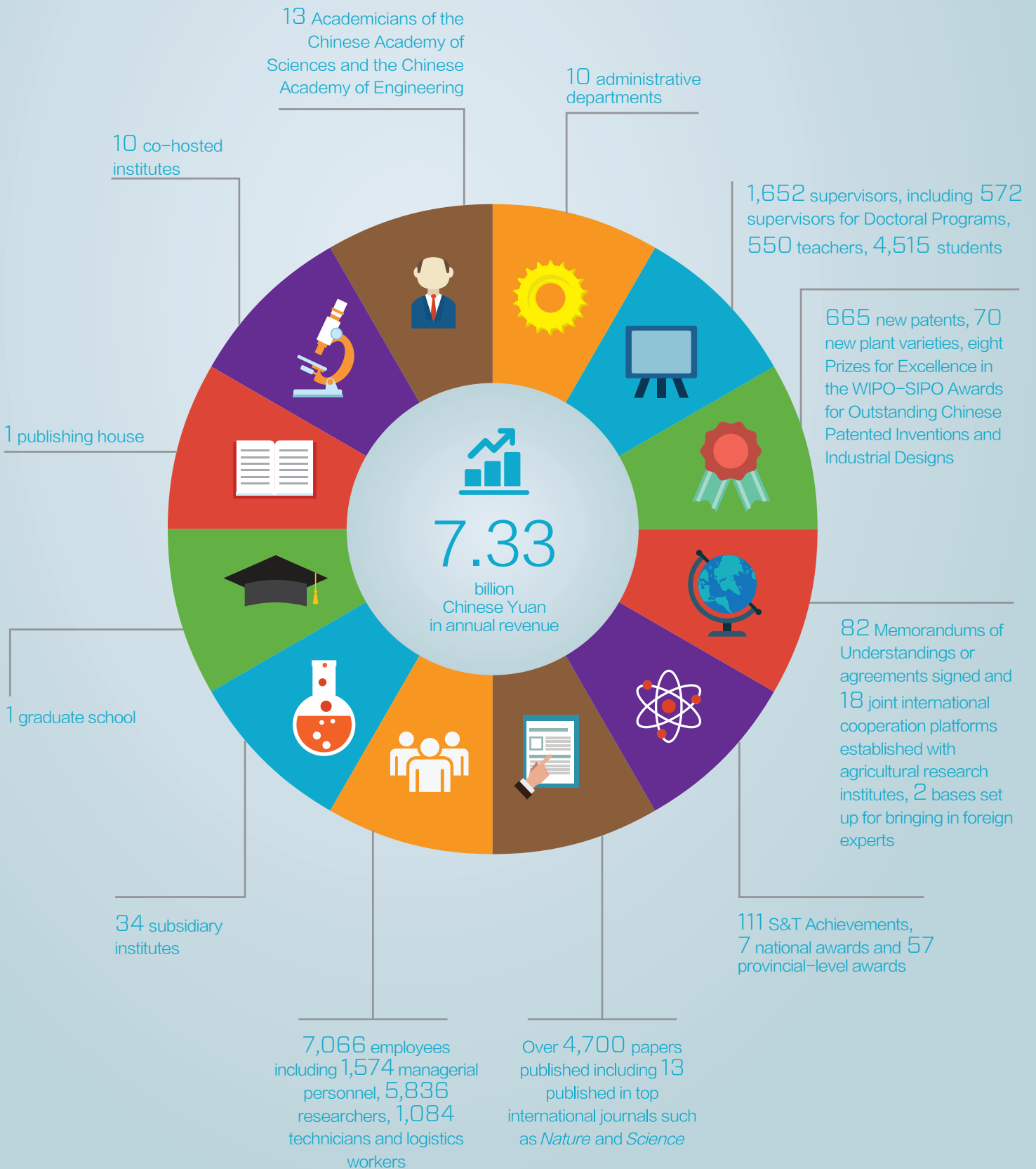




CAAS ANNUAL REPORT

2016

2016 IN NUMBERS



Message from the President

Unveiling China's 13th Five-Year Plan (2016-2020), the year 2016 was crucial for advancing the innovation-driven development strategy and pushing forward the institutional reform for scientific and technological development in this country. Facing profound changes in 2016, the Chinese Academy of Agricultural Sciences (CAAS) steadily moved ahead with all-round progress in the implementation of the Agricultural Science and Technology Innovation Program (ASTIP) and developed the National Agricultural Science and Technology Innovation Alliance (ASTIA), with a view to create an innovation-friendly climate by setting up a coordinated work mechanism for agricultural research across the nation, facilitating cooperation in research throughout the entire industrial chain, and seeking multi-discipline integrated agro-technological solutions. Advancement can be seen in the strengthened international cooperation with our partners, expanded talent pool by attracting scientists throughout the world and highlighting career development of CAAS staff, improved research infrastructures, stronger scientific innovation capacity and accelerated transfer of the research results. As for the progress achieved, CAAS provides more powerful momentum for the modernization drive in the agricultural sector of China.



In this fantastic year, seven achievements with CAAS researchers as first authors won national scientific awards, including the country's first agricultural innovation team award that was bestowed to a CAAS innovation team for their outstanding work on wheat germplasm resources and genetic improvement. Breakthroughs have been witnessed in researches on such issues as the analysis of leaf mustard's genomic structure and origin, the mining of regulatory genes related to the key traits of cabbage and rape, and a new mechanism for interaction between *Pyricularia grisea* and rice. The academy also continued the innovation efforts in coordinated research and development in major agricultural production regions. The integrated technology-based green production modes for 9 major agricultural products, including rice and amongst other agricultural products have been now promoted by the Food and Agriculture Organization of United Nations (FAO) as best practices for developing countries.

CAAS also signed more than 10 agreements with top-class agricultural research institutions worldwide in 2016, built 18 new international joint laboratories and hosted or organized 43 international academic conferences. The academy's technologies and products in such areas as crop breeding, plant protection, husbandry and veterinary drugs have been introduced and applied in a number of countries and regions, which has greatly contributed to the implementation of the Belt and Road Initiative and the agricultural "going global" strategy.

Lastly, I would like to take this opportunity to express my sincere gratitude and best wishes to friends from all sectors of society and to our overseas peers, who have long been helpful and supportive of CAAS' growth. Let's walk hand in hand in the path to explore the frontier of agricultural research and to address people's needs for better life and environment of today and tomorrow.

A handwritten signature in black ink, appearing to be 'Tang Huajun'.

Professor Tang Huajun, Ph.D.
President of CAAS
Academician of CAE





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2016 Summary

In 2016, with its goal of building the world first class agricultural research institution and its development strategy of “reaching the heaven while keeping the feet on the ground”, CAAS has comprehensively carried out the five development concepts of innovation, coordination, green development, opening-up and sharing. By taking agricultural science and technology innovation project (ASTIP) as a mean, CAAS also complied and published the CAAS Science and Technology Development Plan for the 13th Five-Year Plan (2016-20).

Research achievements: CAAS won 111 awards for a variety of research findings in 2016, including 7 national awards with CAAS as the first undertaker, one innovation-team award which is the first of its kind in the Chinese agriculture research sector , and 57 provincial and ministerial level ones.

High-level papers: CAAS staffs published more than 4,700 papers last year, among which 13 were in the top academic journals including *Science* and *Nature*.

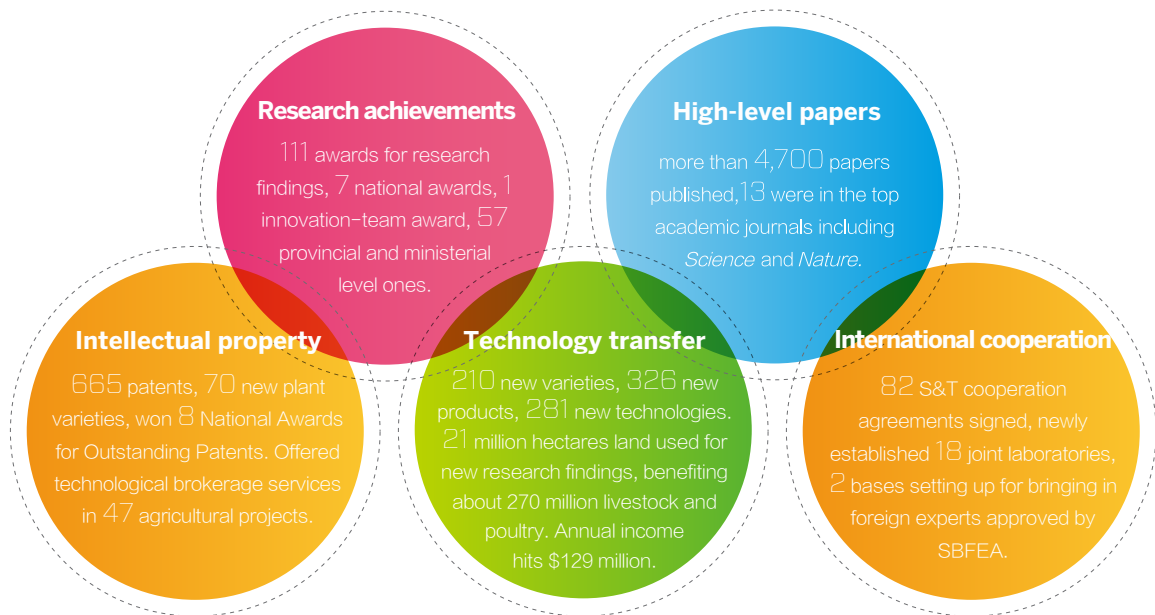
International cooperation: CAAS signed 82 S&T cooperation agreements with international institutions such as the Russian Academy of Sciences, newly

established 18 joint laboratories with foreign partners, including CAAS - Wageningen University Livestock and Poultry Waste Resource Center, 2 bases setting up for bringing in foreign experts were approved by the State Bureau of Foreign Experts Affairs.

Technology transfer: CAAS promoted 210 new varieties, 326 new products and 281 new technologies nationwide in 2016. The total area of land that used the new research findings reached 21 million hectares and about 270 million livestock and poultry benefited from the new findings. CAAS staged 16,800 shows, training sessions and consultation meetings in the countryside in 2016, benefiting 1.3 million grassroots technicians and farmers. CAAS’ annual income hits 889 million yuan in 2016. Technology contracts contributed 81 percent of the total, amounting to 717 million yuan.

Intellectual property: CAAS were granted 665 patents and 70 new plant varieties and won 8 National Awards for Outstanding Patents, offering technological brokerage services in 47 agricultural projects in various fields including processing, the seed industry, biotechnology, fertilizer and fodder.

Major Breakthroughs in Agricultural Scientific Research



Key Events

January

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• The CAAS 2016 Annual Congress was held in Beijing. Prof. Li Jiayang, then Vice Minister of Agriculture and CAAS President, delivered a work report at the meeting.

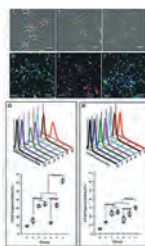


• The CAAS Center for International Agricultural Research was officially unveiled. Qu Dongyu, Vice Minister of Agriculture, Chen Mengshan, Secretary of the Leading Party Group of CAAS and relevant officials attended the inauguration ceremony.

• Experts including Li Jiayang, then Vice Minister of Agriculture and CAAS President, proposed a regulatory framework for Genome Edited Crops (GECs). And an article concerning the GECs regulatory framework was published in *Nature Genetics*.

February

• The Institute of Animal Sciences of CAAS induced cattle and sheep's epithelial cells to differentiate into nerve cells, using such technologies as external growth factors and endogenous gene expression regulation, and verified the biological functions of nerve cells by healing the spinal injury of mice. The research results were published in *Journal of Pineal Research*.



• Four CAAS experts - Liu Xu, Li Fuguang, Chen Wanquan and Yao Bin - won the 5th China Agricultural Elite Award.

• A study by the Institute of Plant Protection of CAAS found that the mutation of *ABCC2*, the receptor gene of *Bacillus thuringiensis* (Bt) toxin in cotton bollworms, led to high-level resistance to Bt crops and significantly increased the sensitivity of the bollworms to abamectin, another biotoxin. The findings were published in *PLoS Pathogens*.

March

• The Institute of Crop Sciences of CAAS was the first proposer of the concepts “envirotyping” and “envirotyping evaluation”, offering reference technologies and approaches for deciphering the environmental impacts on crop sciences, including crop breeding. The related article was published in the online edition of *Theoretical and Applied Genetics*.

• The Fourth CAAS International Advisory Board Meeting was held in Beijing.



April

• Chen Mengshan, Secretary of the Leading Party Group of CAAS, met a delegation headed by Sounthone Xayachack, a member of the Lao People's Revolutionary Party Central Committee, and held talks on such issues as grain security and food safety.



• Prof. Li Jiayang, then Vice Minister of Agriculture and CAAS President, met a delegation headed by Daniel Gustafson, Deputy Director General of FAO. They exchanged views on strengthening cooperation under the strategic frameworks of South-South Cooperation and the Belt and Road Initiative.

• The 2016 China Agricultural Outlook Conference was held. The China Agricultural Outlook Report (2016-25) was released at the conference.

May

• The 5th Meeting of G20 Agricultural Chief Scientists, was held in Xi'an, Shaanxi Province. The Communiqué of the 5th Meeting of G20 Agricultural Chief Scientists was passed at the meeting.

• Xu Nanping, Vice-Minister of Ministry of Science and Technology, visited CAAS, which inspected the progress of CAAS scientific innovation work and hosted a seminar on agricultural science and technology innovation for the 13th Five-Year Plan period (2016-20).

• The Seminar on the Development Strategy of the National Agricultural Laboratories, organized by the MoA and the MOST, was held at CAAS.



June

• The Sino-Dutch Livestock Waste Recycling Center was established by CAAS and Wageningen University of the Netherlands.



• The 1st Meeting of the 8th CAAS Academic Committee was held in Beijing. Li Jiayang, then CAAS President, attended the meeting and delivered an important work report. The meeting reviewed the projects competing for the 2016 CAAS Science and Technology Awards, and evaluated the feasibility of adding new teams to the Agricultural Science and Technology Innovation Program.

July

- The Biotechnology Institute of CAAS recently found that *Pseudomonas stutzeri* A1501 genome, which was isolated from rhizosphere soils in southern China, carries a nitrogenfixation island. The expression of A1501 is precisely controlled by two different sources of network regulating systems. Non-coding RNA played a crucial role in regulating nitrogen fixation, according to the study. The related article was published online in *PNAS*.

- CAAS organized an observation meeting for the coordinated innovation in comprehensive prevention and control of heavy metal pollution in paddy areas of southern China in Hunan.

- CAAS Vice President Wu Kongming met a delegation headed by Yang Dazhu, Deputy Director of the International Atomic Energy Agency.



August

- The Institute of Vegetables and Flowers of CAAS obtained a large amount of genome-wide mutations of the Chinese cabbage and *Brassica oleracea* L. and discovered the crucial genes in forming the vegetables' bulbs and inflated roots. The findings were published online in *Nature Genetics*.

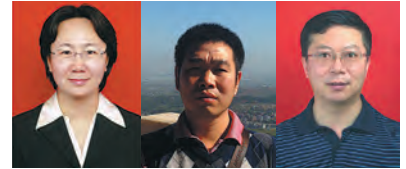
- The 7th International Crop Science Congress, jointly hosted by CAAS and the Crop Science Society of China, was held at the Beijing.

- The International Symposium on Agricultural Ecosystem and Sustainable Food System, jointly hosted by CAAS and FAO and organized by Yunnan Academy of Agricultural Sciences, was held in Kunming.



September

- Chen Hualan, Deng Guohua and Tian Guobin, at Harbin Veterinary Research Institute of CAAS, were included in the 2016 Highly Cited Researchers List, which was



published by Thomson Reuters.

- Li Jiayang, then Vice Minister of Agriculture and CAAS President, headed a delegation and visited Kyrgyzstan, Tajikistan and Russia to promote China's agricultural technological cooperation with countries along the Silk Road Economic Belt.

- CAAS held a meeting for on-the-spot research and demonstration of integrated technology-based green production of corn through environmental-friendly technologies.

October

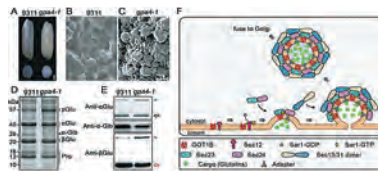
- China's first multi-functional garden machine for fertilization and residue seedling processing was developed by the Nanjing Research Institute of Agricultural Mechanization Ministry of Agriculture, the up-to-date machine boasts three key techniques - realizing solid fertilizer broadcasted evenly in greenhouses, covering soil with solid fertilizer in orchard, and chopping, collecting and transporting residue seedlings.

- The National Innovation Alliance of Crops Germplasm Resources was founded.



November

- The Institute of Crop Sciences of CAAS focused on the key role of the GPA4 protein in regulating the output of the endoplasmic reticulum of rice storage protein from cellular, genetic and biochemical levels. The finding was published online in *The Plant Cell*.



- The Institute of Vegetables and Flowers of CAAS completed a research work on a long research article, entitled "Convergence and divergence of bitterness biosynthesis and regulation in Cucurbitaceae", published in the *Nature Plants*.

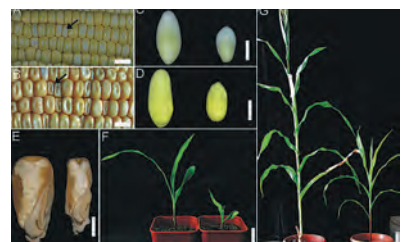
- Chen Mengshan, Secretary of the Leading Party Group of CAAS, and Wu Kongming, Vice President, met a delegation headed by Tabare Aguerre, the Minister of Agriculture and Fisheries of Uruguayan.

December

- The 5th Global Forum of Leaders of Agricultural Science and Technology (GLAST-2016) was held in Hainan. "Linshui Declaration" was released.

- The State Council of China appointed Tang Huajun as Member of the Leading Party Group, Ministry of Agriculture and CAAS President.

- The Institute of Crop Sciences of CAAS made breakthroughs in research on the development of maize grain and found out the key role of *UBL1* gene in corn growth and its regulatory mechanism. The related article was published in *Molecular Plant*.



Honors and Awards

4



The Institute of Crop Sciences' innovation team for wheat germplasm resources and genetic improvement won the first-ever National Innovation Team Award at the 2016 National Science and Technology Progress Awards.



A program headed by Zheng Yongquan, a researcher at the Institute of Plant Protection, won a second prize at the 2016 National Science and Technology Progress Awards for the creation and application of a highly-efficient and low-risk technological system for pesticides.



A program headed by Wen Jie, a researcher at the Institute of Animal Sciences, won a second prize at the 2016 National Science and Technology Progress Awards for the breeding and application of a new variety of grain-saving and disease-resistant yellow-feathered chicken.



A program headed by Zhou Wei, a researcher at the Institute of Agricultural Resources and Regional Planning, won a second prize at the 2016 National Science and Technology Progress Awards for their work on key technology for improving the soil quality of low-yield paddy fields in South China.



A program headed by Yan Gentu, a researcher at the Institute of Cotton Research, won a second prize at the 2016 National Science and Technology Progress Awards for the breeding technology and application of Variety 49, a new multi-resistant, stable-yield cotton variety developed by the institute.

Honors and Awards



A program headed by Huang Fenghong, a researcher at the Oil Crops Research Institute, won a second prize at the 2016 National Science and Technology Progress Awards for key technology for the highly-efficient manufacturing of oil plants' functional lipids and related products.

5



A program headed by Cai Xuepeng, a researcher at the Lanzhou Veterinary Research Institute, won a second prize at the 2016 National Science and Technology Progress Awards for the production and application of a highly-efficient vaccine for newly-imported prevalent strains of foot-and-mouth disease.



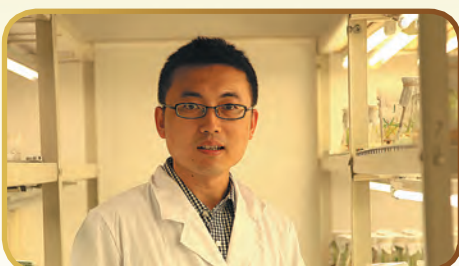
Zhang Yubo, Leading scientist of the National Thousand Young Talents Program

Zhang Yubo and his research team at the CAAS Agricultural Genomics Institute in Shenzhen, Guangdong province have been focusing on interpreting distal interactions and their effects on porcine muscle growth and adipose deposition via multiple dimensional transcription networks. Their research aims to improve the muscle quality, which is expected to benefit future animal breeding.



Zhang Zhonghua, Winner of the National Award for Youth in Science and Technology

Zhang Zhonghua and his research team at the CAAS Institute of Vegetables and Flowers revealed the genomic basis of the origin, domestication and divergence of cucumber, dissected the key genes in cucumber conferring sex determination and bitterness among other things. Their research has paved the way for the development of high quality vegetable cultivars.



Liu Bin, Leading scientist of the Innovators Promotion Program initiated by the Ministry of Science and Technology

Liu Bin and his research team at the CAAS Institute of Crop Sciences dedicate themselves to the research on molecular genetics. A major focus of their research is to answer how cryptochromes regulate soybean agronomic traits, including plant height, leaf senescence and flowering time in response to blue light. The research will help to improve the adaptability and yield of soybean varieties in different latitudes through molecular breeding.

Strategic Programs

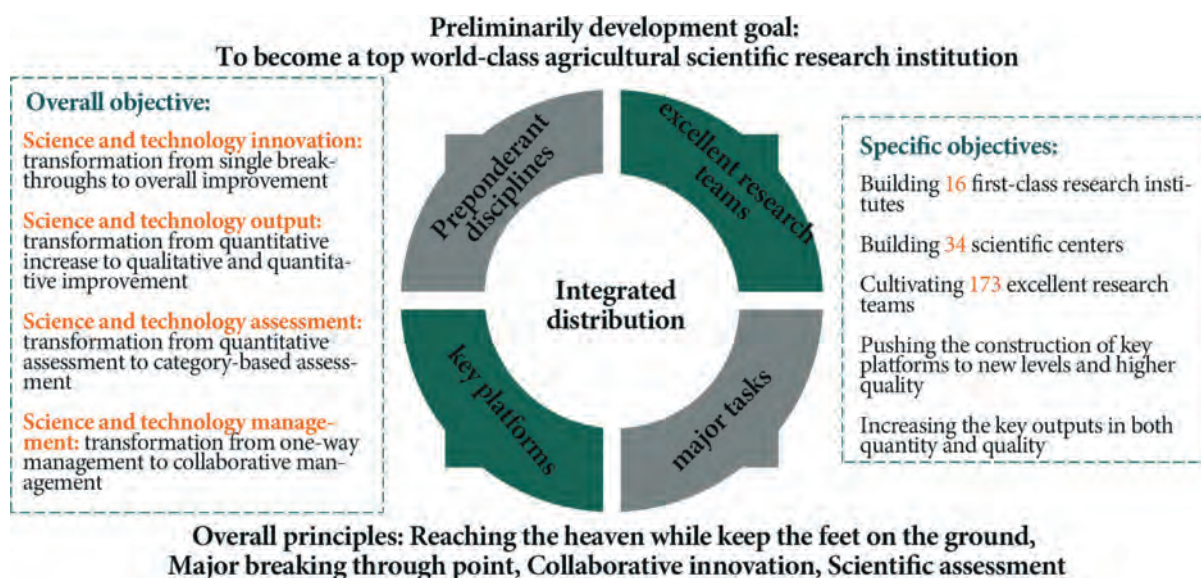
1. Strategic Planning for Development of Agricultural Science and Technology

Releasing of the CAAS Science and Technology Development Plan Initiative for the 13th Five-Year Plan (2016-2020) and its implementation action program

CAAS published its *Science and Technology Development Plan for the 13th Five -Year Plan (2016-20)* and its implementation action in 2016, in response to National innovation-driven development strategy and related series of national plans.

CAAS has pioneered the implementation of the Plan by building world-class agricultural science center and national science and technology hub center, which a systematic approach have been adopted to aim at the key tasks such as constructing CAAS as the leading world-class modern agricultural institutions and agricultural science (technology) centers, fostering excellent research teams, advancing collaborative innovation, and building major science and technology platforms.

To become a top world-class modern agricultural scientific research institution by 2020, CAAS strengthened its efforts into 5 plans which are deepening S&T management mechanism innovation plan: implementing fundamental research guidance plan, major projects storage plan, major research achievements nursing plan, advancing progress in key research platforms plan and agricultural think tanks constructing plan.



Publishing the 2030 Agricultural Science and Technology Development Strategy

The 2030 *Agricultural Science and Technology Development Strategy* profoundly analyzes the trends of the global agricultural science and technology revolution and the S&T needs for China's agriculture modernization, accurately keeps its finger on the pulse of the situation for agricultural science and technology, as well as its internal and external environments. The strategy published by CAAS in 2016 proposes overall solutions and development path for the development of China's agricultural science and technology in the medium and long term, clarifies a number of major research tasks that have been pressing strategic needs and competitive advantages, and proposes suggestions for a range of major science and technology projects.

The strategy, as a research achievement, shows foresight, enlightenment and instructiveness. It provides important references for macro-agricultural policymakers in China and is of strategic significance for guiding and promoting Chinese agricultural science and technology's leap-over development and the construction of agricultural research institutes nationwide.



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.

2. The Agricultural Science and Technology Innovation Program (ASTIP)

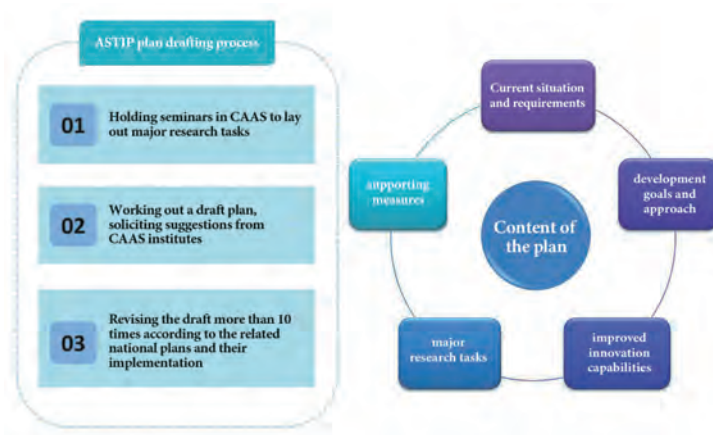
In 2016, ASTIP was comprehensively pushed forward by further improved its research system and mechanisms, optimized the structure of its research teams, created a coordinated innovation mechanism that features systemically cooperation, and worked out a ASTIP development plan for the 13th Five-Year Plan period (2016-2020). The Ministry of Agriculture and the Ministry of Finance have both spoken highly of ASTIP performance appraisals achievements in the pilot periods.

Optimizing the structure of its research teams: 17 new research teams joined ASTIP, which bringing the total number of ASTIP research teams to 332. 19 research teams were renamed and 12 chief scientists were changed which further improved the structure of ASTIP research teams.

Conducting systemically innovation actions: Under thoroughly investigation and discussion, 13 systemically innovation tasks were raised across CAAS institutes. The CAAS presidents act as chief administrative executive and the DG of institute act as officers of the administrative office as the innovation management measure, in order to guide the action's whole process and ensure this kind of innovation actions moving smoothly.

Formulating a ASTIP development plan for the 13th Five-Year Plan period and the related implementation scheme for key tasks: According to the world scientific frontiers and requirements from industrial development, 19 priority tasks have been identified. It has also designated departments in charge of the tasks as well as the heading or participating institutes and announced the requirements for drafting and demonstrating the implementation plan for each task.

Completing the ASTIP performance appraisals work the in its pilot period: CAAS assisted the Ministry of Agriculture and the Ministry of Finance in appraising ASTIP performance during its pilot period. Regarding to the performance assessment, 10 of CAAS 32 institutes rated as excellent and 16 rated as good.



3. The Elite Young Scientists Program

Launched by CAAS in 2013, the Elite Young Scientists Program (EYSP) is an initiative that features high goals, high standards and high intensity. The program aims to recruit top scientists with global vision under the age of 40, who play leading roles in researches of their respective fields or who are innovators.

The recruitment of the program has strict procedures of “two-tier qualification examination and two-tier academic evaluation”. This plan takes 2 steps reviews, firstly a young scientist need to pass reviews to become the candidates, then the young scientist need to pass another review after one year’s work before they can be finally selected as the Elite Young Scientist.

The program was on the list of China’s first 55 initiatives aimed at recruiting high-level overseas experts and specialists in 2014 and has attracted attention worldwide.

In 2016, the fourth EYSP recruitment work was launched. 13 candidates became the candidates by passing their first step reviewing. So far, CAAS has brought in a total of 172 scientists (61 were already named as the Elite Young Scientist) through the program, among which 100 are experts recruited from overseas and 20 were winners listed in the National Science Fund for Distinguished Young Scholars, the National Excellent Young Scientists Fund, the National Hundred, Thousand and Ten Thousand Talents Program, and the National Thousand Young Talents Program. Those that have already taken office all became the research team members of ASTIP, with 20 of them serving as chief scientists of ASTIP research teams.

4. Post-doctoral Work

CAAS has 10 postdoctoral research centers stations for post-doctoral studies since and the first one was founded in 1991. The stations centers now cover 4 four major disciplines fields- natural science, engineering, agronomy agriculture science and management. They are dedicated to carrying including the stations of researches into veterinary medicine, animal husbandry, crop sciences, agricultural resources and the environment, plant protection, agricultural and forestry economy management, biology, horticulture, agrostology, and agricultural engineering. There were 437 postdoctoral researchers in the centers stations by the end of 2016. During a nationwide comprehensive appraisal of post-doctoral work in 2015, four 4 stations of post-doctoral studies in CAAS were rated as “excellent”, accounting for 50 percent of CAAS’ total then all centers and the rest were all were rated as “good”. The rankings were among the best in the country top nationwide.

In 2016, 55 postdoctoral researchers successfully received funding for their post-doctoral studies grants, and 35 postdoctoral people were selected as CAAS “Excellent Post-Doctoral Researchers”. The academy CAAS has been the group champion for three consecutive years in the Beijing post-doctoral games ports meetings.



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



In 2016, CAAS continued its efforts and made remarkable progress on the on Integrated Technology-based Green Production Research and Demonstration Program to increase the productivity and proficiency on 9 major crops and animals, including rice, corn, wheat, soybean, rape, cotton, potato, dairy cattle and sheep.

This research and demonstration program integrated a total of 140 advanced, applied technologies, developed 29 sets comprehensive technology-based production modes that can be reproduced and extended. Application of these production modes on 7 crops increased average crop yields by 29.6 percent, reduced water use by 30 percent, reduced fertilizer use by 26 percent, and reduced pesticide use by 23 percent. As a result, the average revenue generated from the 7 crops increased by 538 yuan (\$78) per mu (0.07 hectares). The models also helped to increase the income from husband by 1,100 yuan per head of cattle and by 150 yuan per head of sheep.

This research and demonstration program has won recognitions and praises Vice-Premier Wang Yang and Minister of Agriculture Han Changfu. Some of the production modes have been adopted and extended as the main demonstration technology by the Ministry of Agriculture and relevant local governments, and spread as good practices by FAO in developing countries.

In all, 19 CASS research institutes, 45 research teams, 214 scientists and technicians were involved in the work, along with more than 2,200 researchers from 210 other units. 98 demonstration bases were established, covering an area of 136,000 mu and involving 330,000 heads of dairy cattle and sheep, in 17 provinces and autonomous regions, comprising all the main agricultural production areas and typical ecological regions in China.



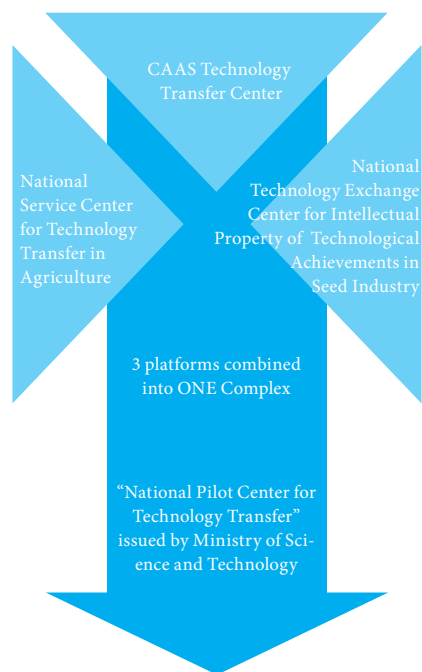
6. Intellectual Property Achievements

In 2016, CAAS was granted 665 patents, developed 70 new plant varieties and won eight Prizes for Excellence in the WIPO-SIPO Awards for Outstanding Chinese Patented Inventions and Industrial Designs. To improve the quality of patents and promote their industrialization, CAAS conducted the value analysis on 198 patents to be classified and categorized. In addition, the academy held its first senior training session for agricultural intellectual property (IP) specifically designed for the Ministry of Human Resources and Social Security, which attracted 78 participants from 29 provinces and municipalities, aiming to improve their standard IP management and patent portfolio analysis level.

CAAS has also completed the initial construction on the National Service Center for Technology Transfer in Agriculture and the National Technology Exchange Center for Intellectual Property of Technological Achievements in Seed Industry, which were included as central government priorities in 2015 and 2014 respectively. Integrated with the academy's own technology transfer center, these above 3 platforms were combined into one complex to improve agricultural IP operations mechanism in CAAS. The website of the complex has been upgraded with an expanded database and has been ready for professional and business-friendly services.

The National Service Center for Technology Transfer in Agriculture has absorbed more resources, making complementary advantages to the CAAS Center for International Agricultural Research. Based on these platforms, 47 technological brokerage services were offered, referring in the fields of processing, seed industry, bio-technologies, fertilizers and fodder.

In 2016, CAAS participated in 14 exhibitions, promoted more than 200 research achievements. CAAS contributed 191 technological achievements IP deals, with a total value of 253 million yuan (\$36.74 million).



National Pilot Center for Technology Transfer



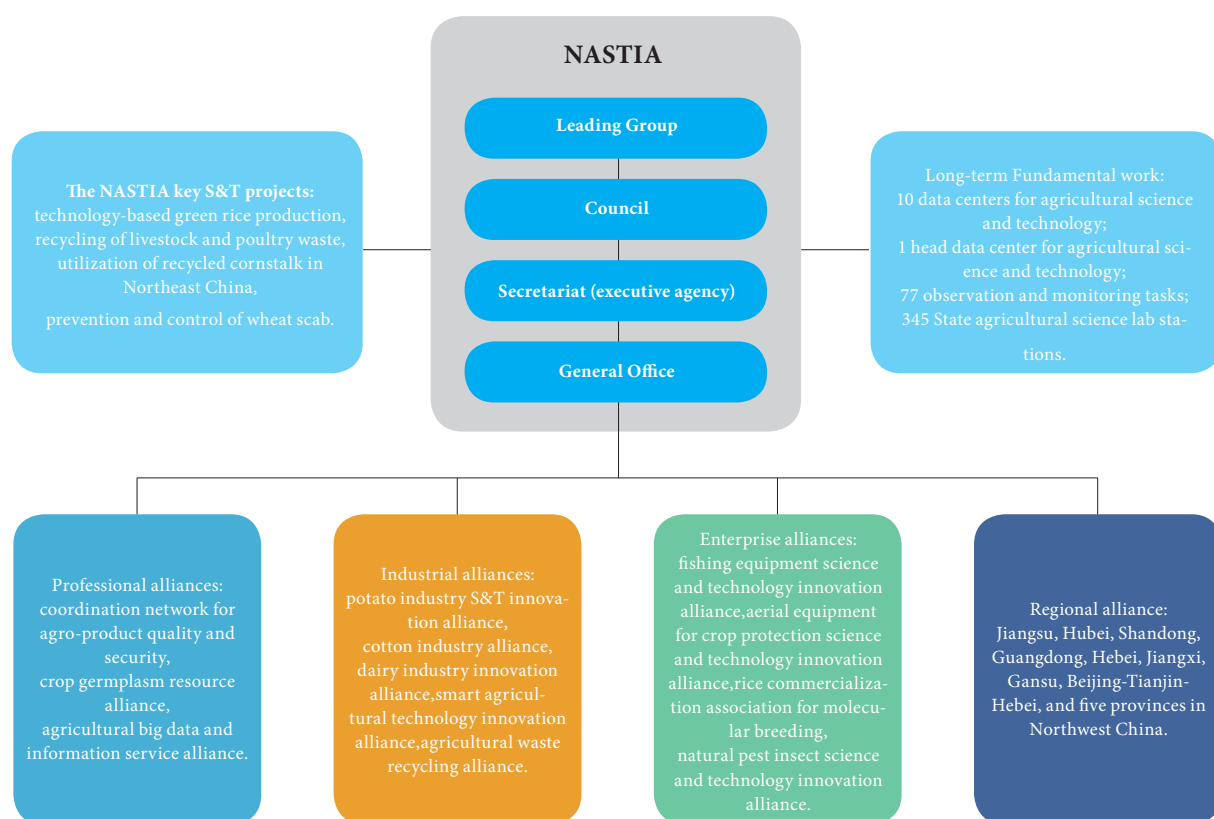
7. National Agricultural Science and Technology Innovation Alliance

Since its establishment at the end of 2014, NASTIA has actively explored to improve the working mechanism to serve China's major demands for agriculture and the central tasks of the Ministry of Agriculture. It played great roles in consultation, organization, collaboration and service.



NASTIA has actively fostered and helped to form a new integrated mechanism for agricultural research nationwide, identified prioritized research tasks involving the entire industry, and explored integrated comprehensive solutions for a batch of key agricultural issues. NASTIA also formulated proposals for key research and development projects included in the Regional Green Technology System for Increasing Agricultural Efficiency, and constructed 10 data sub-centers agricultural science and technology and one main center, which all together comprise a basic data network platform of agricultural science and technology, launched long-term fundamental agricultural science and technology work.

As a successful exploration of mechanism innovation, NASTIA has gained common acceptance nationwide, and plays an increasingly important role in promoting agricultural science and technology innovation as well as in supporting modern agricultural development.



Research Progress

Crop Science

WHEAT GERMLASM RESOURCE AND GENETIC IMPROVEMENT PROGRAM AT THE INSTITUTE OF CROP SCIENCES RECEIVED THE NATIONAL INNOVATION TEAM AWARD, CHINA.

The Wheat Germplasm Resource and Genetic Improvement Program at the Institute of Crop Sciences, Chinese Academy of Agricultural Sciences, has been established in the 1950s. Significant progress has been made in five aspects such as germplasm collection, conservation and utilization, utilization of dwarfing sterile wheat (Ms2), quality improvement, and genomics. The research team won the National Science and Technology Progress Award by the State Council, China, three times for the First Class Award, four times for the Second Class Award, and won international award five times in recognition of its achievements in scientific progress. Five scientists have been selected as Fellows of Chinese Academy of Sciences or Chinese Academy of Engineering. The number of publications and citations in peer-reviewed international journals were ranked the second and fourth position globally, respectively. This program has been recognized as the leading wheat program in China as well as internationally.



BREEDING TECHNOLOGY AND APPLICATION OF A NEW COTTON VARIETY, CCRI49, WITH MULTI-RESISTANT AND STABLE YIELD CHARACTERISTICS.

A research team led by YAN Gentu from Institute of Cotton Research, Chinese Academy of Agricultural Sciences, has developed a new cotton variety using innovative breeding technology and application with the efforts of more than two decades. Characterized by its multi-resistance and stable yield characteristics, the newly-developed variety CCRI49 has effectively replaced other varieties in the main cotton-producing areas of China. This new breeding technology has enriched cotton breeding methods by selecting crosses of multi-adversity resistant cotton for a short generation phenotypes. This breeding technology offers control of genetic purification of phenotypic characteristics to provide a foundation for long-term and large-scale planting of the CCRI49 cotton variety. Moreover, CCRI49 has provided an example for a new standardization regimen for cotton planting in China. Until 2015, up to 4.746 million hectares of land had been planted with CCRI49, reaching profits of 12.33 billion RMB yuan. In 2016, this scientific research received the Second Class Award for the National Scientific and Technological Progress of China.



A NUMBER OF MAIN CROP VARIETIES CONSECUTIVELY PLAY A LEADING ROLE IN THE PRODUCTION.

Zhongjiazao 17 is an early indica variety developed by the research team led by HU Peisong, China National Rice Research Institute (CNRRI), and it offers many desirable traits including high-yield potential, high quality (special-use), stress tolerance, wide adaptability, and environmentally-friendly. It was recommended as a national dominant variety by the Ministry of Agriculture of the People's Republic of China (MOA) during 2010-2016. Its popularity in the Middle and Lower Reaches of Yangtze River has rapidly grown. It utilizes N, P and K with high efficiency and low-grain Cd accumulation, and was listed as a government procurement of low-grain Cd accumulation rice variety in Hunan, China in 2016.



Zhongmai 175 was developed by the Wheat Breeding Program under the leadership of HE Zhonghu at the Institute of Crop Sciences, Chinese Academy of Agricultural Sciences (ICS, CAAS). It was characterized by combination of high yield potential, short stature and good lodging resistance, high use efficiency in water and fertilizer, resistance to diseases and high temperature, excellent noodle quality, and broad adaptation. Zhongmai 175 has become the most widely sown cultivar in the Northern China Plain Winter Wheat Region (NCPWWR) during the last 6 yr, and also become a leading cultivar in the rainfed area of Yellow and Huai Valleys Winter Wheat Region as well as a leading winter cultivar for replacement of spring wheat in Gansu and Qinghai. Its accumulated sowing area reached around 2 million ha, and served as a check cultivar in the regional yield trials in the NCPWWR as well as in Beijing, Shanxi and Hebei.



Zhongdan 909 was developed by a research team led by HUANG Changling at ICS, CAAS. It exhibits desirable characteristics such as high stable yield, wide adaptability, strong resistance and good seed quality. And can yield an average of 9,000–12,000 kg ha⁻¹, with the highest yields reaching 20700 kg ha⁻¹. It is suitable for planting across the Huang-Huai-Hai Plain region and the remainder of northern China. Zhongdan 909 has been recommended as a leading variety by the MOA, and has been promoted for a total of over 2 million ha, had been planted in 683,000 ha in 2016.





PROGRESS IN THE THIRD NATIONAL SURVEY AND COLLECTION ACTION ON CROP GERmplasm RESOURCE.

The third national survey and collection action on crop germplasm resource was initiated in 2015 and organized by the Institute of Crop Sciences, Chinese Academy of Agricultural Science. This action has been carried out in Hubei, Hunan, Guangxi, Chongqing, Jiangsu, and Guangdong, China. To date, 20,320 accessions of crop germplasm resource have been collected based on a general survey in 375 counties and collecting missions in 92 counties. At the same time, the identification and evaluation on the phenotype of crop germplasm resource collected have been conducted in the field, and following with cataloguing and to be conserved in the National Genebank. With this action, a large number of farmer's varieties and wild species and relatives related to the food and agriculture were collected and protected in China.

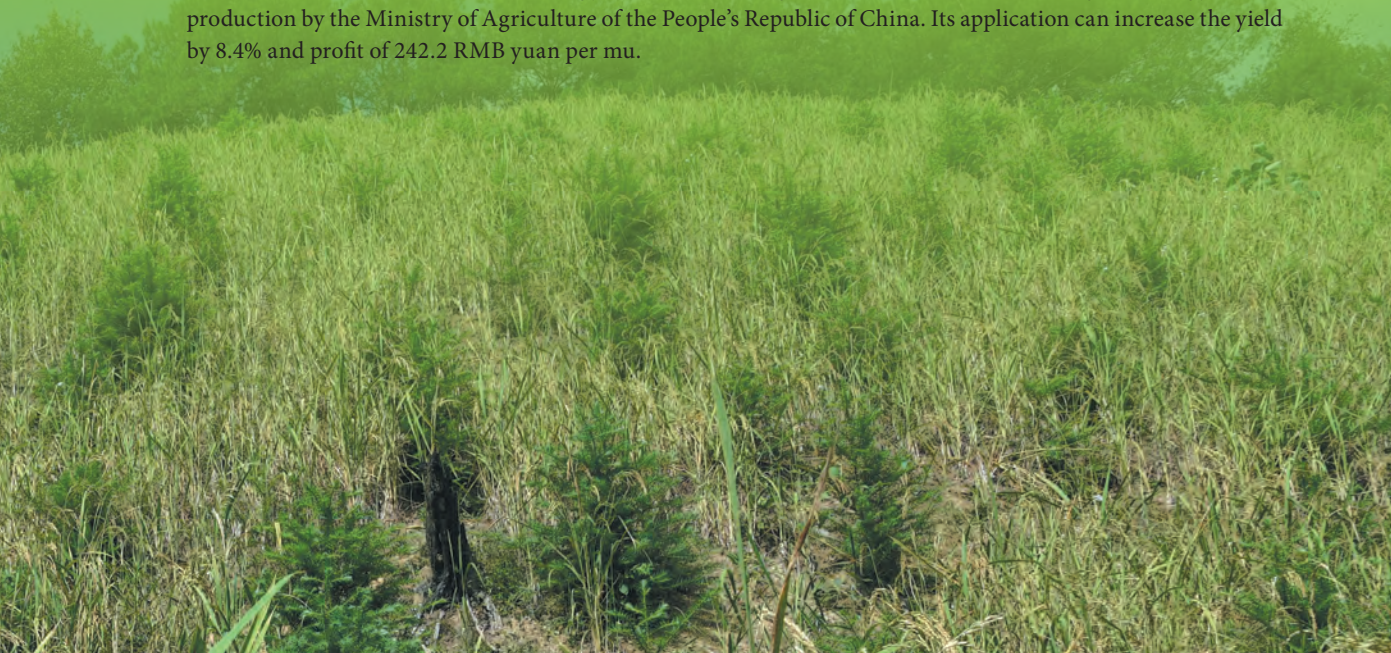




MECHANIZATION PRODUCTION TECHNOLOGY OF DOUBLE CROPPING RICE AND ITS APPLICATION. A research team led by Prof. ZHU Defeng, China National Rice Research Institute established the production technology system of double cropping rice through multidisciplinary cooperation of farm machinery and agronomy in the face of lack of suitable varieties, poor machine transplanting and no coordination of mechanization for double cropping rice and other limitations.

More than 10 varieties of early and late rice suitable for machine transplanting were selected to optimize the regionization and combination of rice varieties in double cropping rice. Model of seedling nursery with seedling tray-piled emergence was innovated to improve the quality of seedling and capacity of seedling supply for machine transplanting. Machine precision sowing and transplanting of large pot seedling were developed to improve the efficiency of machine transplanting of hybrid rice.

The mechanization production technology of double cropping rice has been listed into leading technology for rice production by the Ministry of Agriculture of the People's Republic of China. Its application can increase the yield by 8.4% and profit of 242.2 RMB yuan per mu.



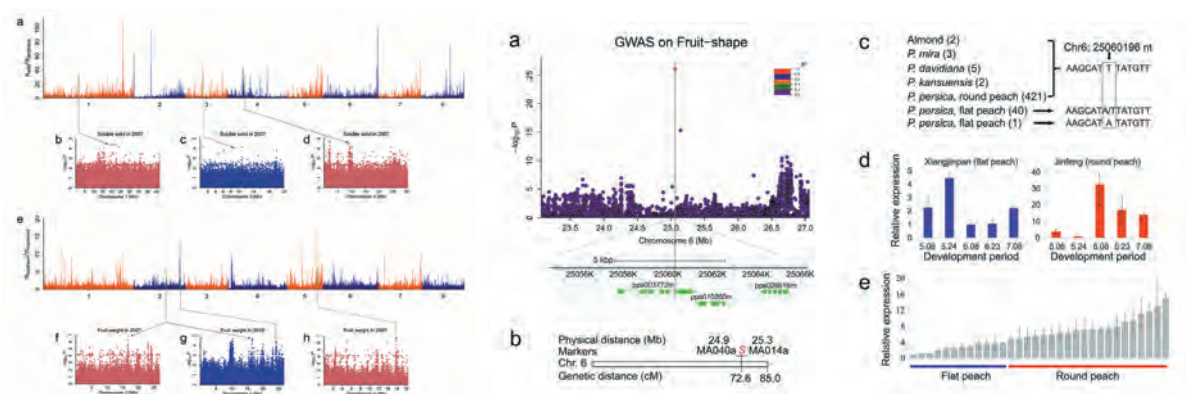
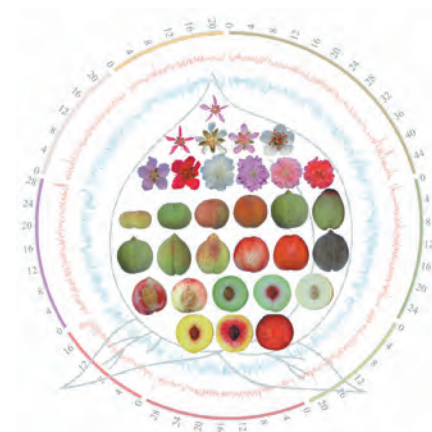
Horticulture Science

SUBGENOME PARALLEL SELECTION IS ASSOCIATED WITH MORPHOTYPE DIVERSIFICATION AND CONVERGENT CROP DOMESTICATION IN BRASSICA RAPA AND BRASSICA OLERACEA. A research team led by Prof. WANG Xiaowu from the Institute of Vegetables and Flowers, Chinese Academy of Agricultural Sciences studies the evolution of crop species on the genomic level. A systematic study based on ancestral karyotype information of Brassica species used genomic sequencing technology to uncover mechanisms of convergent gene selection. By looking into the independent evolution of similar morphotypes of Brassica rapa and Brassica oleracea, they discovered that whole-genome triplication (WGT) was one of the most important driving factors to contribute to morphotype diversification and convergent phenotypes in Brassica species. Multiple regulated genes linked to leaf-heading and stem/root shape were identified. These results may be highly valuable for molecular-based breeding for highly desired traits in Brassica species.



GENOME-WIDE ASSOCIATION STUDY OF 12 AGRONOMIC TRAITS IN PEACH.

A research team led by Prof. WANG Lirong at the Zhengzhou Fruit Research Institute, Chinese Academy of Agricultural Sciences is interested in the genomics behind agronomic traits of peach (*Prunus persica* L.). A study using large-scale resequencing of 129 peach accessions searching for genome-associated markers of agronomically desired traits resulted in a total of 4.06 million high-quality single nucleotide polymorphisms (SNPs). This comprehensive genome-wide association study uncovered candidate genes which were predicted to encode a number of agronomic traits. The genomic regions harbouring association signals for soluble solid content and fruit weight overlapped with predicted regions were selected for as a consequence breeding during peach domestication and improvement. As a result of this study, five associated loci have been used for marker-assisted breeding in peach. These findings would contribute the molecular mechanism of agronomic traits and effects of human selection in peach.



COLLECTION, CONSERVATION, EVALUATION AND UTILIZATION OF WATERMELON (*CITRULLUS VULGARIS* SCHRAD.) AND MELON (*CUCUMIS MELO* L.) GERMPLASM.

The Zhengzhou Fruit Research Institute, Chinese Academy of Agricultural Sciences has established the only mid-term germplasm genebank for watermelon (*Citrullus vulgaris* Schrad.) and melon (*Cucumis melo* L.) in China. This genebank is based on the investigation, introduction and exchange of germplasms around the world. Thus, a safe conservation system for watermelon and melon germplasm was created with hopes to enrich the diversity of the repository. Extensive watermelon and melon research has been implemented to better maintain this germplasm. A standardized evaluation system of watermelon and melon germplasm was established to collect and conserve desired lines. An elite germplasm was selected to further improve its value by comprehensively selecting for highly desired traits. Another aspect of these studies regards the distribution of watermelon and melon germplasm on the largest scale and longest duration ever seen before in China. This social study was designed to promote the research, breeding and personnel training for watermelon and melon in China.





Animal Science

THE CULTIVATION OF NEW MEAT-TYPE CHICKEN BREEDS WITH QUALITY MEAT, DISEASE RESISTANCE AND FEED-SPARING CHARACTERISTICS. A research team led by Prof. WEN Jie from the Institute of Animal Sciences, Chinese Academy of Agricultural Sciences has uncovered many key findings regarding chicken cultivation quality, involving discovering the key genes and effective molecular markers associated with meat quality and disease resistance, establishing the breeding technology on the intramuscular fat content and lymphocyte rate as good indicators. A breeding technique using dwarf chicken lines was implemented and has been applied to 30% of meat-type chicken breeds in China. Four meat-type chicken breeds were cultivated. The national and industry standards of the new breeds have been created, promoting uniformity in meat-type chicken production. These breeds have accounted for 30% of market shares in farms in the Yangtze River Delta region, Northern and Southwest areas of China. Taken together, more than 11 million parental stocks of new breeds and 1.55 billion commercial chickens can be found across China, with fiscal benefits reaching 3.415 billion RMB yuan. This project has awarded the Second Class Award for the National Science and Technology Progress of Chi in 2016.



GENOMIC ANALYSES REVEAL DEMOGRAPHIC HISTORY AND TEMPERATE ADAPTATION OF THE NEWLY DISCOVERED HONEY BEE SUBSPECIES APIS MELLIFERA SINISXINYUAN N. SSP. A research team led by Prof. SHI Wei from the Institute of Apicultural Research, Chinese Academy of Agricultural Sciences has discovered a new subspecies of the western honey bee, *Apis mellifera sinisxinyuan*, in Xinjiang Uygur Autonomous Region, China. Integrative analyses have highlighted the role of historical global temperature in long-term population dynamics of *A. m. sinisxinyuan* and shed light on the underlying mechanisms of temperate climate adaptation in *A. mellifera*. These findings have important theoretical and practical significance regarding the protection of the newly discovered subspecies, *A. m. sinisxinyuan*, and the potential outcomes of facilitated selective breeding of *A. mellifera* to improve the survival of overwintering colonies.

STUDIES AND APPLICATION OF CALF NUTRITIONAL PHYSIOLOGY AND REARING STRATEGIES. A research team led by Prof. DIAO Qiyu at the Feed Research Institute, Chinese Academy of Agricultural Sciences, has significantly advanced understanding in the field of calf development and nutrition physiology. A novel rearing approach for replacement calves has been established and applied in the dairy industry throughout China. The basis of this new rearing approach began with the discovery of the molecular foundation of early gastrointestinal development as well as a detailed description of rumen microbiome establishment. This research created a theoretical concept for the improvement of calf rearing industrial practice. This improvement was based on nutrient level optimization and the concept of replacing animal milk supplements with plant-derived alternatives. This new plant-based milk replacer liberated calf milk's heavy dependence on imported milk products that were a limited replacement option in industry. Implementation of a calf rearing system including this new feed formulation, supporting equipment and facilities improved the standards and efficiency of feeding practices. This novel rearing approach allows calves to wean off of milk on less than 10 days instead of the previous industrial standard of 60 days with the survival rate as high as over 95%. Body weight of replacement heifers can reach 400 kg at 14-month of age, which meets the first mating requirement. In addition, milk yield in the first, second and third lactation was significantly improved by 1.7 to 3.2 ton. These technologies and standards are highly recommended

by the Ministry of Agriculture of the People's Republic of China and have been applied nationwide in various dairy farms in 31 provinces of China. The calf milk alternative is now the most popular brand with the highest market occupancy. This project highly impacted calf rearing industrial practice with 15 patents, 10 software copyrights and more than 200 publications. It has been awarded several honorable prizes, such as First Prize in the Beijing Science and Technology Award, First Prize in the Harvest Award by the Ministry of Agriculture of the People's Republic of China, and the Excellent Patent Award of China.

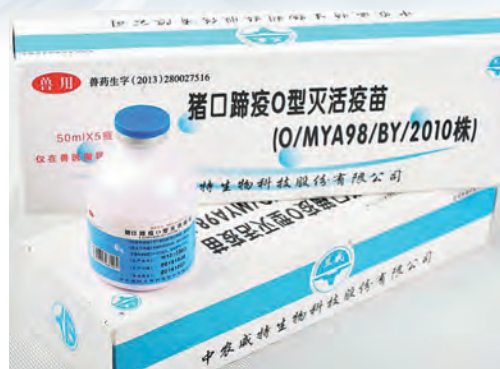


Veterinary Medicine

THE DEVELOPMENT AND APPLICATION OF AN EFFECTIVE VACCINE AGAINST EMERGING STRAINS OF FOOT-AND-MOUTH DISEASE.

Variant strains of foot-and-mouth disease (FMD) continue to emerge, causing tremendous loss in Chinese animal husbandry. These emerging FMD strains have urged for the innovation of new vaccines for disease control and prevention. Novel effective vaccine research led by Prof. CAI Xuepeng's team from the Lanzhou Veterinary Research Institute, Chinese Academy of Agricultural Sciences has made progress in this area. Using solid-phase peptide synthesis, several master virus seed stocks were used to create novel antigen and polypeptides for use in vaccination. New vaccine manufacturing procedures and standards were developed regarding the establishment of culture suspension, concentration and purification of virus antigens to guide efficient vaccine production for China's livestock and poultry industry. Six vaccine types have been employed across the county in addition to exports reaching Vietnam, Korea, Mongolia and other countries. Vaccine usage has played an integral role in quickly and effectively curbing the FMD epidemic in these countries. These vaccines have generated 7.538 billion mL in total sales and yielded 114.594 billion in indirect economic benefits, creating enormous economic, social and ecological benefits.

This project has awarded the Second Class Award for the National Science and Technology Progress of China.



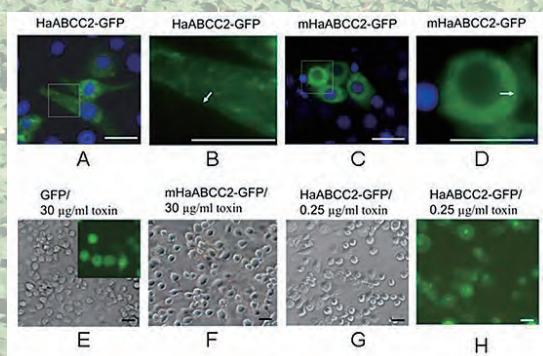
GRAPHENE OXIDES DECORATED WITH CARNOSINE AS AN ADJUVANT TO MODULATE INNATE IMMUNITY AND IMPROVE ADAPTIVE IMMUNITY IN VIVO. Traditional vaccine adjuvants tend to have side effects such as strong immune-related negative reactions and reduced vaccine performance. A research team led by LIU Guangqing from the Shanghai Veterinary Research Institute, Chinese Academy of Agricultural Sciences in collaboration with the Institute of Nano Biomedicine and Engineering of Shanghai Jiao Tong University, China have developed a novel vaccine adjuvant. A suspension of the model antigen OVA mixed with graphene oxide (GO) decorated with carnosine (Car), was injected into mice. The results show a robust and durable OVA-specific antibody response, increased lymphocyte proliferation efficiency, and enhance CD4⁺ T and CD8⁺ T cell activation. The presence of Car in GO appears to enhance the antigen-specific adaptive immune response through modulating the expression of cytokines, including IL-6, CXCL1, CCL2, and CSF3. This work indicates that the combination of GO with Car significantly enhances humoral and innate immune responses. The GO-Car adjuvant is an exemplary candidate for a safe alternative to current vaccine adjuvants.

DEVELOPMENT OF SWINE TRANSMISSIBLE GASTROENTERITIS, PORCINE EPIDEMIC DIARRHEA AND PORCINE ROTAVIRUS (G5 TYPE) TRIPARTITE LIVE VACCINE. Swine transmissible gastroenteritis virus (TGEV), porcine epidemic diarrhea virus (PEDV) and porcine rotavirus (PoRV) are three major agents responsible for severe diarrhea in pigs. These viruses tend to co-infect pigs in China resulting in high mortality rates in suckling piglets. To effectively prevent and control the infection of these viruses, a research team led by FENG Li from the Harbin Veterinary Research Institute of Chinese Academy of Agricultural Sciences has developed a safe and effective TGEV, PEDV, PoRV tripartite live vaccine for sows and piglets. In addition, a diagnostic and monitoring program has been developed for vaccine implementation. This vaccine can be used for both active immunization and passive immunity with protection rates of 88% and 96%, respectively. It is the first domestic live vaccine against PoRV infection and is also the first viral swine diarrhea tripartite live vaccine to achieve one immunization against three viral infections concurrently. The vaccine is licensed by seven biopharmaceutical companies with a total of 110 million RMB yuan contract. The direct sale of the vaccine has generated more than 130 million RMB yuan since being released on the market and has demonstrated significant economic and social benefits.



Agricultural Resources and Environment

A NOVEL MECHANISM OF COTTON BOLLWORM RESISTANCE TO BT CROPS. A research team led by Prof. WU Kongming from the Institute of Plant Protection, Chinese Academy of Agricultural Sciences found that the *ABCC2* protein aberrance led to high levels of *Bacillus thuringiensis* (Bt) resistance in the cotton bollworm. This *ABCC2* disruption also conferred an increased susceptibility to the insecticide abamectin as a result of reduced cellular discharge of this biotoxin. This research presents a molecular mechanism illustrating the negative cross-resistance phenomenon between two biotoxins in the cotton bollworm system. These findings provide important details regarding Bt resistance management and may be helpful in coevolution research on insect-microbe interactions. This research has been published online in the international journal *PLoS Pathogens* on Feb. 12, 2016.



A NOVEL NCRNA-MEDIATED MECHANISM GOVERNING REGULATION AND CO-EVOLUTION OF NITROGEN FIXATION. A research team led by Prof. LIN Min of the Biotechnology Research Institute, Chinese Academy of Agricultural Sciences, recently reported that a novel regulatory noncoding RNA (ncRNA), NfiS, responds to multiple environmental stress cues. This occurs through nitrogenase activity optimization and stress resistances via direct or indirect interactions with target mRNAs in the crop-associated, nitrogen-fixing bacterium *Pseudomonas stutzeri* A1501. This research on *P. stutzeri* revealed two significant findings including the horizontal transfer of a nitrogen-fixing genomic island and the recruitment of NfiS, by nifK mRNA, which is involved in the nitrogenase complex. The divergent

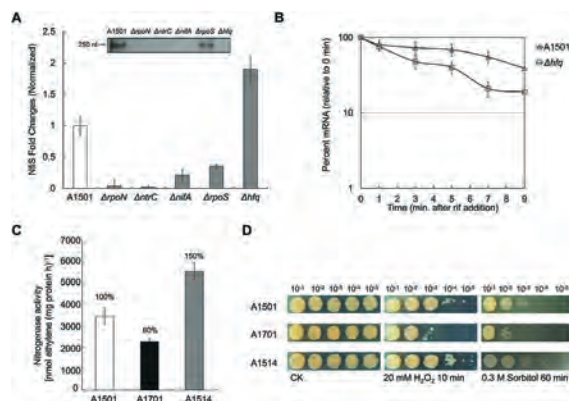
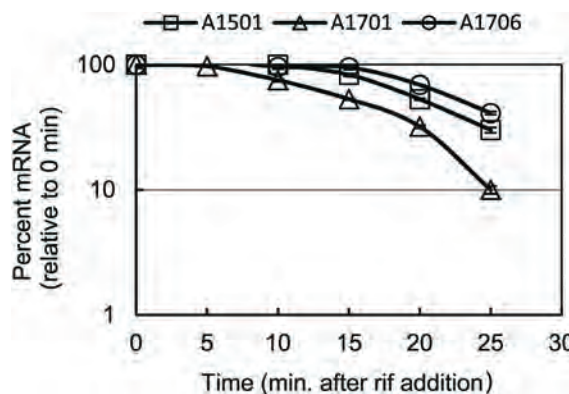
evolutionary history of bacterial nitrogen fixation conferred ancestral *P. stutzeri* the ability to fix nitrogen and these findings may reveal how this microorganism specifically regulates nitrogenase activity. Nitrogen fixation is a highly energy-demanding process that reduces N₂ gas to ammonium. Two key limiting factors, carbon source shortage and enzyme repression by fixed nitrogen, impose considerable constraints on crop-associated nitrogen fixation and its application in sustainable agriculture. Undoubtedly, this study will establish the theoretical basis for enhancing associative nitrogen fixation efficiency, lessening chemical fertilizer use and ultimately protecting the environment. Related work has been published in *Proceedings of the National Academy of Sciences* of the United States of America (*PNAS*).





PIVOTAL FERTILITY IMPROVEMENT AND AMELIORATION TECHNOLOGIES FOR LOW-YIELD PADDY SOILS IN SOUTHERN CHINA.

An ongoing study, headed by a research team led by Prof. ZHOU Wei of the Institute of Agricultural Resources and Regional Planning, Chinese Academy of Agricultural Sciences, regarding low-yield paddy soil amelioration in southern China has unveiled key technologies for production improvement. In the last ten years, five conventional low-yield paddy soils were investigated for soil quality characteristics and ways in which the soil profiles could be improved. The five soils include yellow clay, albic, gleyed, acid sulfate and water-logged soils. New products have been developed to enhance soil quality and their integrated formulations have resulted in soil fertility reclamations in many fields in China. In the last three years, the aforementioned technologies have been applied in 11 southern Chinese provinces, encompassing as many as 38.2 million hectares. Product application has increased the total value of socio-economic benefits and net income by 16.15 billion RMB yuan and 13.19 billion RMB yuan, respectively. This achievement was awarded the Second Class Award for the National Science and Technology Progress of China in 2016.





ESTABLISHMENT AND APPLICATION OF HIGH-EFFICIENCY AND LOW-RISK TECHNOLOGY SYSTEM FOR PESTICIDES.

A research team led by Prof. ZHENG Yongquan from the Institute of Plant Protection, Chinese Academy of Agricultural Sciences focuses on solving problems that exist in pesticide application, such as the invisible risks of new pesticide ingredients, loss of pesticide from plants, and residual pesticide contamination in the environment. A high-efficiency and low-risk pesticide system that considers safe active ingredients, optimal formulation design, ease of application and low risk management was designed. Studies on risk recognition in active ingredients revealed previously undetected risks of seven frequently used pesticides, such as difenoconazole, and put forward critical control points for how these pesticides affect agro-product safety. They also researched how double elements of the surface tension and contact angle affect pesticide sprays, and set up crop moisture index for improving target moisture. The team developed 10 pesticide products with high-efficiency and low-risk for industrialization. By scientifically formulating the pesticides using ingredients solicited for precision application, 26 insect-specific pesticide kits were created. Research trials found the precision rate reached more than 80%. To optimize field usage, an information tool card was created for farmers to monitor fluid distribution and choose proper formulation and tank-mix adjuvants. This reduced the amount of pesticides usage by 20-30%. A set of 12 standard cards for guiding the spraying drop density were invented, the farmers used this guide card and the quantity of pesticide application was reduced by 30-70%. This pesticide risk management guideline is now employed for risk monitoring, risk assessment and risk control. The use of above techniques and products has reached at least 12 million hectares in Chinese field sites. The resulting increase in agricultural output has a value of 14.99 billion RMB yuan and the resulting efficiency is worth 10.7 billion RMB yuan. This achievement has obtained remarkable economic, social and ecological benefits and was received the Second Class Award for the National Science and Technology Progress of China in 2016.

NO-BASED PESTICIDES IMPROVING EFFICIENCY AND SAFETY OF PESTICIDES.

A research team led by Prof. CUI Haixin from the Institute of Environment and Sustainable Development in Agriculture, Chinese Academy of Agricultural Sciences has significantly contributed to the application to nanotechnology to improve efficiency and safety of pesticides. This group manufactured a plethora of high efficacy, environmentally friendly nano-based formulation of insecticides, fungicides and herbicides. Compared to conventional formulations, nano-based pesticides can significantly improve the efficacy and biological activity through a 30-50% application reduction. As a result, reduced pesticide residues minimize environmental pollution and improve food safety. These formulations also avoid the emission of harmful solvents and additives. Enviro-toxicology experiments demonstrated that no metabolic toxicity of nano-based pesticides exist in crop and environmental biological systems. These studies show that nano-based pesticides have wide prospects in assuaging the negative agriculture-associated chemical effects on the environment. This study was supported by the National Basic Research Program of China (973 Program).



Agricultural Mechanization and Engineering

KEY TECHNOLOGIES FOR IMPROVING ENERGY USE EFFICIENCY AND FOOD QUALITY IN PLANT FACTORIES. A research team led by Prof. YANG Qichang from the Institute of Environment and Sustainable Development in Agriculture, Chinese Academy of Agricultural Sciences has committed to address urgent technical demands regarding boosting energy savings, input resource efficiencies, and high quality food supply in plant factories for more than 12 years. Researches and applications of LED light programs for plant growth, automated control for LED lighting, light-temperature coupling with energy-saving environmental control, UV-nano TiO₂ nutrient solution disinfection, and remote control via web-based applications have significantly improved energy efficiency and plant quality of indoor grown vegetable crops in China. Thus, China has become one of the few countries in the world to solve technical barriers regarding indoor farming. In 2016, these researches on plant factories were selected to participate in the 12th Five-Year National Science and Technology Innovation Exhibition of China and were awarded with the “disruptive technologies in farming practices” title. To date, plant factories are employed in many regions of China, even the military on South China Sea Islands and aerospace system, Moon Palace 1. Plant factories have also been commercially used in the United States, the UK, Singapore and other countries, providing significant agricultural and economic benefits.





MECHANIZATION TECHNOLOGY AND EQUIPMENT FOR TEA PLANTATION.

A research team, led by XIAO Hongru from Nanjing Research Institute of Agricultural Mechanization, Ministry of Agriculture, China, created a mechanized standard for tea planting according to the typical Chinese tea garden classification based on geographical features. In accordance with the geographic environment, equipment was created and investigated for suitable power, tillage, pest control, planting and harvesting to specific tea garden locations. And they innovated series of tea garden machines which can be divided into three types: mobile, hand-driven and knapsack. They also created a novel type of green technology for pest controlling, a negative pressure insect-catching apparatus. Lastly, they innovated a sort of bionic tea plucking technology, a self-propelled tea plucking machine and intelligent tea picking device, providing high-quality tea picking.



NEWLY DEVELOPED INTELLIGENT RICE SEED PLANTER IN CHINA.

The first pneumatic seed discharging planter with 33-row width was domestically created in China, which was developed by a research team led by ZHANG Wenyi from Nanjing Research Institute for Agricultural Mechanization, Ministry of Agriculture of China. This machine took into consideration Chinese rice planting practices in conjunction with new methods supporting high efficiency, precision and intelligent seeding for large-scale farms. It distributes seeds quickly, evenly and efficiently while sowing 33 rows simultaneously, and works on 8 m width and can sow 5-7 ha h⁻¹. The seed planter possesses a real-time monitoring system for some key parameters such as moving speed, seed clogging, scoring leftover seeds, and rotating discharged seeds by a visual intelligent control panel. The equipment can be operated by a single person and meets for the high-efficiency requirements of big farm and other large-scale business bodies.



Agro-product Quality, Safety and Processing

DEVELOPMENT OF PRODUCTS AND KEY TECHNOLOGY FOR HIGH-EFFICIENCY UPGRADING OF FUNCTIONAL LIPIDS. To break the technical bottleneck existing in industrial development of natural functional lipids from oil seed, the research team led by Prof. HUANG Fenghong associated with the Oil Crops Research Institute, Chinese Academy of Agricultural Sciences has made many contributions. This team has created a technology of microwave modulating-pressing and physical refinement to prepare functional lipids, which more than doubles the content of concomitant in lipids. This team has invented a technology for wide-adaptability and high-efficiency modification of lipid molecules, which develops some novel functional lipids with stable structure and superior function. A system for evaluating functional lipids was created, including structure-effective relationship, dose-effective relationship and group-effective relationship. A series of products have been developed for the purpose of alleviating visual fatigue and lowering blood-borne fat. Above achievements have been applied in more than 30 enterprises in over 10 provinces, and products have been sold to more than 50 countries and regions. The social and economic benefits are very obviously. It has made outstanding contributions to supplement farmer incomes, increase sales for oil-bearing crop industries and improve human nutrition and health. This project has awarded the Second Class Award for the National Science and Technology Progress of China in 2016.

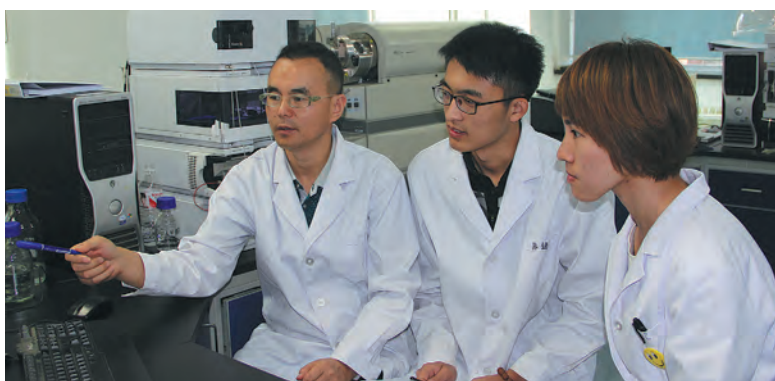




KEY TECHNOLOGIES OF PRECISE IDENTIFICATION AND CONFIRMATION TESTING FOR TYPICAL CHEMICAL POLLUTANTS IN AGRO-PRODUCTS.

A research team led by Prof. WANG Jing from the Institute of Quality Standards and Testing Technology for Agro-Products, Chinese Academy of Agricultural Sciences has developed a rapid multi-residue testing technology based on the enzyme inhibition of seven chemical pollutants. This test is based on molecularly imprinted biomimetic identification technology with

enhanced sensitivity and matrix-interference control. A total of 46 stable and accurate test kits/strips, including 28 enzyme linked immunoassay kits, 11 colloidal gold test strips and 7 chemiluminescent immunoassay kits were developed. The modular sample preparation units employ molecular imprinted solid phase extraction, mixed dispersion solid phase extraction, gel permeation chromatography to alleviate the issues regarding difficulties separating chemical pollutants with matrices in current agro-products. Based on the sample preparation methods, 25 tests with the ability to confirm the detection of pesticide residue, veterinary drug residue, prohibited additives and other typical chemical contaminants were established. These confirmatory testing methods could provide an important technical support to achieve full control on agro-product quality and safety. These products have been used in China's leading enterprises including risk assessment agencies, scientific research institutes and breeding companies, with more than 2600 units sourced in 31 provinces of China.



GREEN TECHNOLOGY AND APPLICATION OF AFLATOXIN CONTROL IN PEANUT PROCESSING. A research team led by Prof. LIU Yang from the Institute of Food Science and Technology, Chinese Academy of Agricultural Sciences has developed a system for aflatoxin prevention, control and detoxification. The team identified an essential oil composite inhibitor of peanut-derived aflatoxin which can effectively replace highly toxic and flammable phosphine. A peanut-reversing air-drying technology was developed, reducing 80-90% of the current processing cost and effectively inhibiting peanut aflatoxin contamination during post-harvest storage. The equipment uses the 'moldy peanut laser separation' technology which can exclude 99.2% of the moldy peanuts with an increase of 49% efficiency compared to the conventional 'color selection' technology. The composite peanut oil detoxification technology, including ozone treatments, alkali refinement, absorption modification, and ultraviolet irradiation, increased the detoxification rate of aflatoxin-contaminated peanuts from 42% to more than 95%.

Agricultural Information and Economics

MILESTONES IN CHINA'S AGRICULTURAL OUTLOOK RESEARCH. The Agricultural Information Institute at the Chinese Academy of Agricultural Sciences has made great efforts to strengthen the nation's agricultural monitoring and early warning systems. While addressing China's agricultural development demands and serving the supply-side structural reform in agriculture sector, the team has developed innovative theoretical methods and valuable technologies in the fields of agricultural information monitoring, early warning analysis models, and agricultural outlook. Specifically, a database for eight key commodities has been established for the aforementioned agricultural fields. The China Agriculture Monitoring and Early-warning System (CAMES) has been greatly improved as substantial progress has been made in core audits in agricultural information perception, big data analysis, intelligent simulation, agriculture production projection, consumption analysis, and short-term price forecast. In addition, the team organized the 2016 China Agricultural Outlook Conference, launched the "China Agricultural Outlook Report (2016-2025)" and created 18 commodity analysis reports. These efforts promote the role of market information in agricultural development and strength China's bargaining power in the world agriculture market.



THEORY AND PRACTICE OF AGRICULTURAL MODERNIZATION TAILORED TO CHINESE CHARACTERISTICS.

A research team led by Prof. JIANG Heping of the Institute of Agricultural Economics and Development, Chinese Academy of Agricultural Sciences, looked into the macro-ordination and micro-practices of modern agriculture using information from the world's agricultural development trends and China's current national conditions. The theory and practice of agricultural development in China was then systematically explored. This research uncovered agricultural practices that could be implemented in modern day China to urge efficient agricultural progress. First, they actualized the agricultural development principle of "taking advantage of local conditions and developing crop-associated comparative advantages" to create an agricultural development goal that would guarantee food security and the supply of basic agricultural products. A summarized plan of action was formulated to facilitate agricultural modernization in China. Second, a network information system for agricultural modernization development and evaluation was innovated. It was designed to be a comprehensive evaluation index system to track the development level of China's agricultural modernization. Last, they proposed the pyramid theory in which a new-type of modern farmer would be cultivated. This entailed setting the first agricultural science and technology park construction standard which was awarded by the Ministry of Agriculture of the People's Republic of China. They established the theory and execution of valley economic development. These studies have made positive contributions to the theoretical system regarding agricultural modernization and practical exploration for Chinese farming practices.



Domestic Cooperation

32

Deepening Pragmatic Cooperation with Local Governments

Following the approach of planning in advance, targeted solutions, clear responsibility, timely project follow-ups, achievements transferring, and talent exchanges, CAAS strengthened cooperation with local governments in staple grain producing areas, typical ecological areas, special-function regions and impoverished or remote regions, as those in the Tibet Autonomous Region and the Xinjiang Uygur Autonomous Region. It also contributed to the targeted poverty alleviation in these regions.

In 2016, CAAS co-founded the Institute of Selenium- Rich Products with the local government of Ankang in Shaanxi province. Five cooperation projects were carried out and CAAS experts were sent to offer training and consultancy services in Ankang. A number of programs were carried out in Beijing's Daxing, including the targeted breeding of new rose varieties, the demonstration of urban-type watermelon production technology and technology for highly-efficient and safe use of feed additives, and joint construction of an international cooperation base. CAAS also sent an expert to work as a deputy township head in charge of scientific work in Daxing.

CAAS convened the Meeting on National Agricultural S&T Assistance in Tibet Autonomous Region in Lhasa, to set the priorities for technical assistance to the region. CAAS provided strong technical support to the development of the region's advantageous industries, including cattle and sheep husbandry, fruit and vegetable plantations, forage grass and highland barley. 11 technicians from Tibet Autonomous Region attended a three-month training program at CAAS and improved their capability in research and management. A total of 79 agricultural technicians and officials from the Inner Mongolia Autonomous Region's Hinggan League, located in the south of Greater Khingan Mountains, participated in a five-day training session at CAAS and systematically learned about facilities vegetable, horticulture and the development of modern agriculture among other things.



CAAS signed S&T MoU with Ningxia Academy of Agricultural and Forestry Sciences



Prof. Li Jiayang, then president of CAAS doing research on modern agriculture development in Tibet

International Cooperation

33



Mr. Han Changfu, the Agricultural Minister of China inspected the work in CAAS CIAR

In 2016, CAAS continuously enhanced international cooperation, carried out the “going global” strategy of CAAS matured products and technologies, established a more beneficial bilateral, multilateral and regional cooperation patterns, and steadily increased CAAS voice and influence in international food and agricultural affairs.

1. Advancing the construction of the CAAS Center for International Agricultural Research (CIAR)

The CIAR was established on Jan 21, 2016, marking a new stage in CAAS’ “going global” strategy and international cooperation. The establishment of the center was also a symbol achievement from the inter-ministerial joint conference system for international agricultural cooperation since the system was headed by the Ministry of Agriculture. To date, the center has established contacts and conducted cooperation with the members of the joint conference system, provincial research institutes, domestic and international agricultural enterprises as well as international organizations. The center has made progress in overseas agricultural research, implementing the going global of agricultural science and technology, providing overseas agricultural information service, training international professionals and coordinating national international cooperation work.



Phase II of project launch for Green Super Rice for the Resources-Poor of Africa and Asia



International students of GSCAAS got degree

2. Expanding strategic partnership

CAAS signed or renewed 82 agreements, including joint laboratory agreements and other multilateral and bilateral agreements (among which, 15 are at academy level), with the Russian Academy of Sciences, the Israeli Ministry of Agriculture and Rural Development, the Ministry of Agriculture of Laos, Uruguay's National Agricultural and Animal Husbandry Institute, the Rural Development Administration of the Republic of Korea, the International Rice Research Institute, and Wageningen University of the Netherlands, among others. CAAS deepened its partnerships with world's top institutions and expanded its international cooperation.



Prof. Li Jiayang, then president of CAAS signed MoU with Tajik Agrarian University



Prof. Chen Mengshan, Secretary of the Leading Party Group of CAAS, witnessed signing of agricultural S&T cooperation agreement together with Minister of Uruguayan Ministry of Agriculture and Fisheries



Vice president of CAAS, Prof. Wu Kongming signed MoU with IRRI



Prof. Li Jinxiang, Vice president of CAAS visited Ethiopian Academy of Agricultural Sciences

3. Establishing international cooperation platform

CAAS built 18 new joint international laboratories, including Ministry of Agriculture - CIMMYT Joint Laboratory; CAAS-Wageningen University Livestock and Poultry Waste Resource Center; CAAS-JIRCAS Agricultural Development Research Joint Laboratories; and Sino-Germany Tea Processing Chemistry Joint Laboratory. Two bases to bring in experts from overseas of CAAS have also been approved by the State Bureau of Foreign Experts Affairs.



Inauguration ceremony of Sino-Dutch Joint Research Center for Greenhouse Horticulture (Beijing)



Official opening of the Joint Laboratory for Soil Molecular Ecology

4. Serving for world agricultural development

Based on its advantageous resources in agricultural research, CAAS formulated a year plan to promote agricultural technologies and products going abroad, facilitated the establishment of its overseas integrated agricultural production technology platform and the National Technology Innovation Alliance for Agriculture Going Global. CAAS took the lead in making and implementing the Sino-Africa Agricultural Research Institutes 10+10 Cooperation Mechanism and drafted the implementation actions. CAAS pragmatically promoted the going abroad of its mature agricultural technologies and products and increased the overseas influence of the technologies related to avian influenza vaccine, foot-and-mouth disease vaccine, high-quality crop seeds, vegetable seeds, plant protection, biogas, cotton production, animal husbandry and veterinary, etc.



Experts from Institute of Cotton Research, CAAS investigated fields in Kenya



Experts from IPP, CAAS guiding in Rwanda for soil insect investigation



Overseas Training Course on Biogas Utilization Technology for Mauritania

5. Striving for international cooperation projects

CAAS has actively applied for bilateral and multilateral international cooperation projects initiated by the Ministry of Agriculture, the Ministry of Science and Technology, the Ministry of Commerce, the National Science Foundation Committee, and the State Bureau of Foreign Experts Affairs, as well as the European Union, Asia-Pacific Economic Cooperation, and International Atomic Energy Agency, among others, to focus on joint research in key fields. CAAS applied for 131 projects in 2016, of which 66 were approved, with total research funds of 61.44 million yuan.

6. Organizing international academic events

CAAS hosted or organized 43 international academic conferences and offered 12 international training sessions, attracting 7,306 participants, 2,076 of them from abroad. These events included the Fifth Global Forum of Leaders of Agricultural Science and Technology, the Fifth Meeting of G20 Agricultural Chief Scientists, the Fourth CAAS International Advisory Board Meeting, International Symposium on Agroecology for Sustainable Agricultural Food Systems, and the Seventh International Crop Science Congress, which have comprehensively improved CAAS' international influence.



5th Global Forum of Leaders of Agricultural S&T (GLAST)



The 7th International Crop Science Congress



5th Meeting of G20 Agricultural Chief Scientists

7. Strengthening agricultural capacity building

In 2016, 46 CAAS staffs received training overseas through recommendations from the China Scholarship Council, 39 via the State Bureau of Foreign Experts Affairs, 6 sponsored by international organizations' donations, and 21 through other channels, which greatly enhanced the internationalization of the CAAS researchers and management personnel.

Besides, CAAS also organized the 21st Workshop on National Network of Agricultural S&T International Cooperation and the 2016 CAAS Foreign Affairs Management and Training Session, as well as the other training and exchange activities, to continuously strengthen its capacity building.



2016 CAAS Traing Workshop for Liaison Officer of International Cooperation



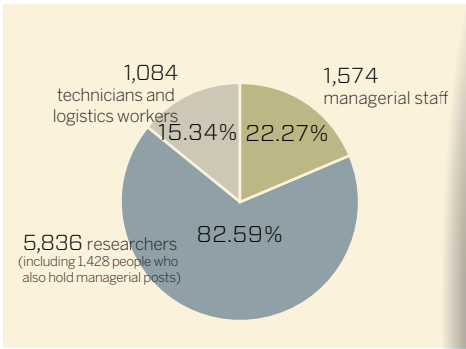
21st Workshop on National Network of Agricultural S&T International Cooperation



Experts from IPP CAAS gave training in Laos

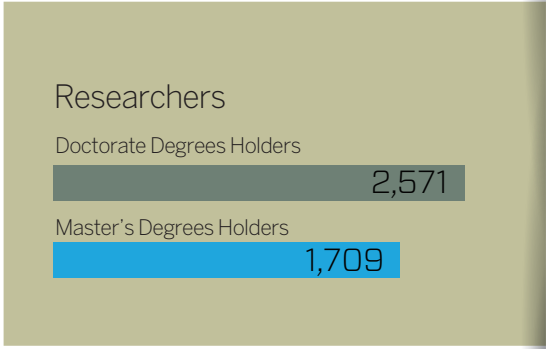
Staff

01 CAAS had **7,066** members of staff by the end of 2016.



02 3,049 hold research assistant title or below, accounting for 52.24 percent. **5,836** researchers. Of all the researchers at CAAS, 1,073 are professors. 1,714 are associate professors, accounting for 29.37 percent.

Category	Count	Percentage
Research assistant title or below	3,049	52.24%
Associate professors	1,714	29.37%
Professors	1,073	18.39%



03 Postgraduate degree holders account for 49.36 percent of the total managerial staff at CAAS. Of them, 486 have doctorate and 396 have master degree. A total of 665 managerial staff members are 45 years old or younger, accounting for 42.25 percent of the CAAS management group.

Among the technicians and logistics workers at CAAS, three received special government allowances from the State Council, 16 are in the first-class technical posts, 199 in the second-class technical posts. 201 technicians have college degrees and above, accounting for 18.54 percent of the total number of this group. There are 150 technicians and logistics workers aged 45 or below at CAAS, accounting for 13.84 percent of the total.

04 Currently, 13 academicians of the Chinese Academy of Sciences and the Chinese Academy of Engineering work in CAAS. Of the CAAS staff, 28 scientists have been listed in the National Ten Thousand Talents Program; 21 have been honored as national young and middle-aged scientists in science, technology and management with outstanding contributions to China; 133 have received special government allowances from the State Council; 60 have been listed in the National Hundred, Thousand and Ten Thousand Talents Program; 23 individuals and 7 teams have been ranked in the Innovative Talents Growth Program initiated by the Ministry of Science and Technology; 11 have won the China Agricultural Elite Award presented by the Ministry of Agriculture, and 82 have been included in the Outstanding Talents for Agricultural Scientific Research.

Graduate Education

Based on CAAS high level research advantage and education resources, the Graduate School of the Chinese Academy of Agricultural Sciences (GSCAAS) has formed multi-levels and multi-types training system. The GSCAAS currently holds 53 PhD degree disciplines, 65 master's degree disciplines, and 2 specialized master's degrees in agriculture and veterinary medicine.

At present, GSCAAS holds 1,652 supervisors, including 13 academicians of the Chinese Academy of Sciences and the Chinese Academy of Engineering, 572 supervisors for doctoral programs and 550 teachers. A total of 4,515 students are studying at the school. In 2016, GSCAAS enrolled 1,440 students (291 for doctorates, 720 for master's degrees, 261 for specialized master's degrees, 132 international students and 36 for doctorates under international cooperation programs). A total of 1,085 students, including 211 PhD holders and 874 master's degree holders, graduated last year.

Last year, GSCAAS promoted international students programs that catered to the Belt and Road Initiative and the agricultural "going global" strategy. For the first time, the graduate school was open to applications from international students throughout the year and the enrollment was in the spring or autumn. In 2016, GSCAAS enrolled 132 international students. Of the new students, 114 are PhD candidates and 67 were awarded Chinese Government Scholarships. GSCAAS currently has a total of 245 international students, including 216 doctorate candidates. The students hail from 47 countries and are studying in 36 disciplines among 29 CAAS institutes. A total of 40 international students, including 29 PhD holders and 11 master's degree holders, graduated from GSCAAS last year.

In 2016, GSCAAS enrolled the first 19 doctorate candidates for joint PhD programs with Wageningen University in the Netherlands, and enrolled 17 doctorate candidates for joint PhD programs with the University of Liege in Belgium, increasing the number of its PhD seekers under its Sino-foreign educational programs to 92.



Budget

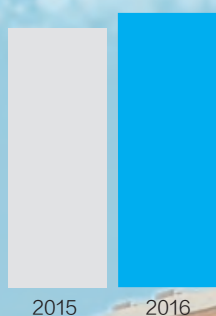
The annual revenue of CAAS is 7.33 billion Chinese Yuan, up 8.27 percent on the year before. It included government grant of 3.69 billion Chinese Yuan, up 7.89 percent from 2015. Both are the highest record in the academy's history.



3.69 billion Chinese Yuan in government grant

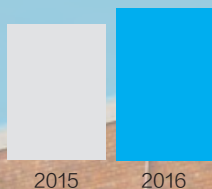
Annual revenue

8.27% growth



Government grants

7.89% growth



Field Stations

Deepening operating mechanism reforms for CAAS' field stations: In 2016, CAAS advanced reforms of its comprehensive bases, strengthened its field stations management and improved the overall support to the development of modern agriculture. With the requirements of unified coordination, separation of management and operation, and the parity of authority and responsibility, CAAS has undertaken reforms to its 3 academic level comprehensive stations, which are Beijing Nankou base, Hebei Langfang park and Henan Xinxiang base. The reform led to an initial “double-good” situation of good comprehensive bases operating mechanism and good management services to all the CAAS field stations. The reform has created a funding model that combines government financial support and paid technological service, shares the running costs of the comprehensive base or stations by CAAS academic level and the related research institutes. The Langfang park and the Xinxiang station strengthened cooperation with local governments, and conducted demonstrations, training and technical demonstration activities.

Improving CAAS management level of field stations: In 2016, CAAS Field Stations Development Plan for the 13th Five-Year Plan (2016-2020) was compiled, preliminarily established a performance assessment system and designed an improved management information system for the field stations. CAAS also cleared its field stations development path and improved its IT-based management and supervision capabilities.

At present, CAAS holds 106 field stations at institute level which cover 27 provinces with the total area of 97,900 mu (about 6,527 ha).

Research Facilities

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Major S&T Facilities: CAAS has 2 major national key scientific facilities — the National Key Facility for Crop Gene Resources and Genetic Improvement and the National Center for Agricultural Biosafety Sciences; 6 state key laboratories, 5 national engineering laboratories, and 3 national veterinary reference laboratories. CAAS also boasts 11 national crops gene banks and 12 national germplasm nurseries, which have long-term preserved 440,000 accessions of crop germplasm resources, ranking the second in the world. CAAS owns the National Agricultural Library, in which the collection of agricultural books and journals ranks top in Asia and the third in the world. Also, the academy has 2 FAO reference centers and 7 OIE reference centers.

Instrument and Equipment for Open Sharing: CAAS has launched an online platform to share its 904 large research instruments and equipment for more than 500 research institutions, universities and companies home and abroad. The shared facilities include an automatic high-throughput optical 3D imaging system and an ultra-high-throughput sequencer.

Germplasm Resources for Open Sharing: CAAS has established 3 open sharing platforms to crops, livestock and microorganisms resources. CAAS provided crop germplasm resources accession for 31,000 times, domestic animal resources accession for 18,000 times, and agricultural microbe resources accession for 1,572 times to more than 1,000 research institutions, colleges, enterprises and producers home and abroad in 2016.

Research Data for Open Sharing: With 520 TB databases in a variety of sectors including crop science, animal science and animal medicine, practaculture science, agricultural resources and environmental science, and agricultural biotechnology and biosafety, CAAS offered regular data services of 270TB for more than 1,300 times last year.

CAAS offers online data and services via the following websites:

CAAS website for scientific research facilities: <http://111.203.21.19>

Chinese Crop Germplasm Resources Information System: www.cgris.net

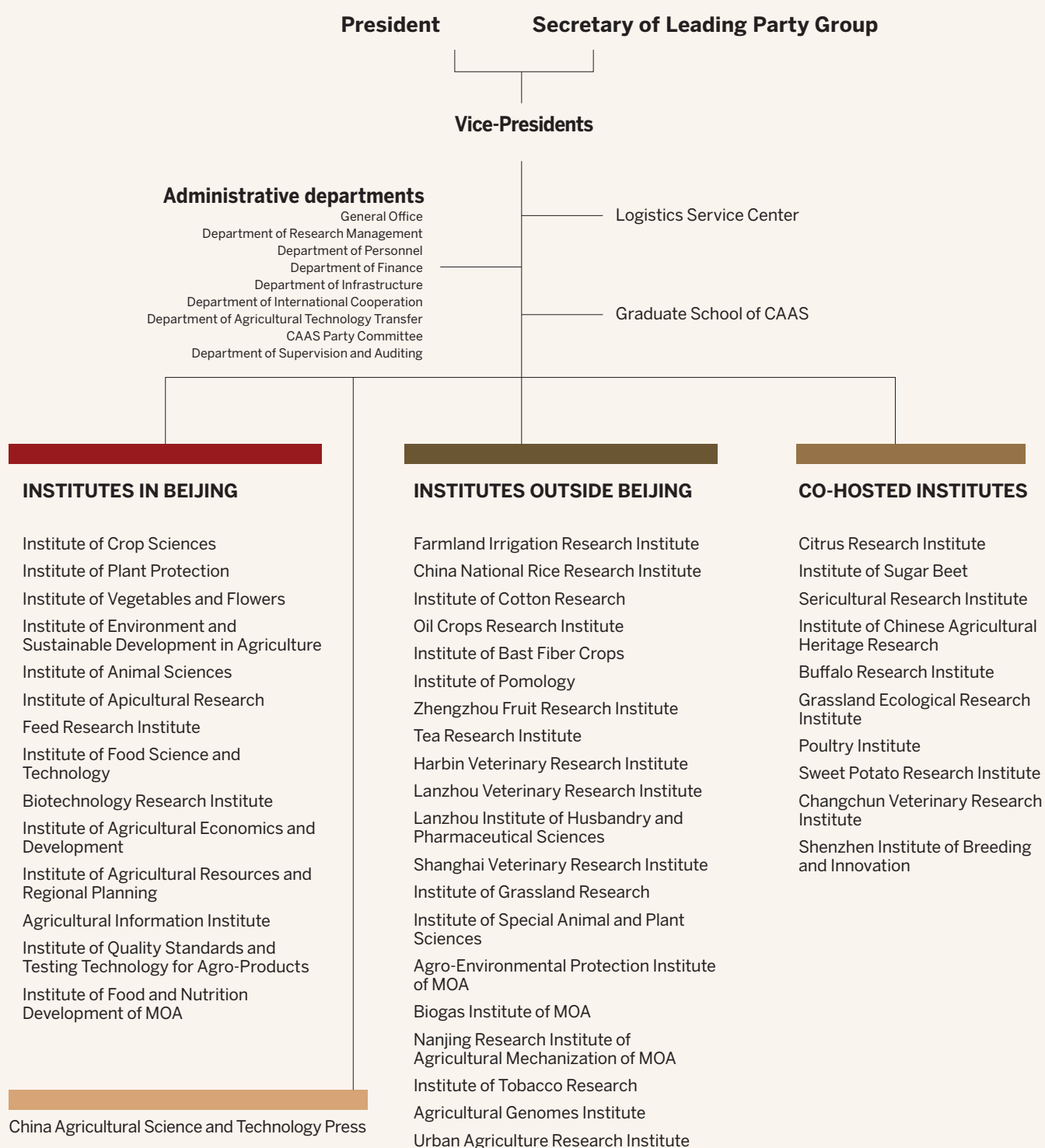
National Infrastructure of Domestic Animal Resources: www.cdad-is.org.cn

Agricultural Culture Collection of China: www.acc.org.cn

AgriData: www.agridata.cn



Organizational Structure



Research Institutes Distribution



Key Laboratories and Centers

1 Major national facilities

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

2 Key national laboratories

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

3 International reference laboratories

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

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2016



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