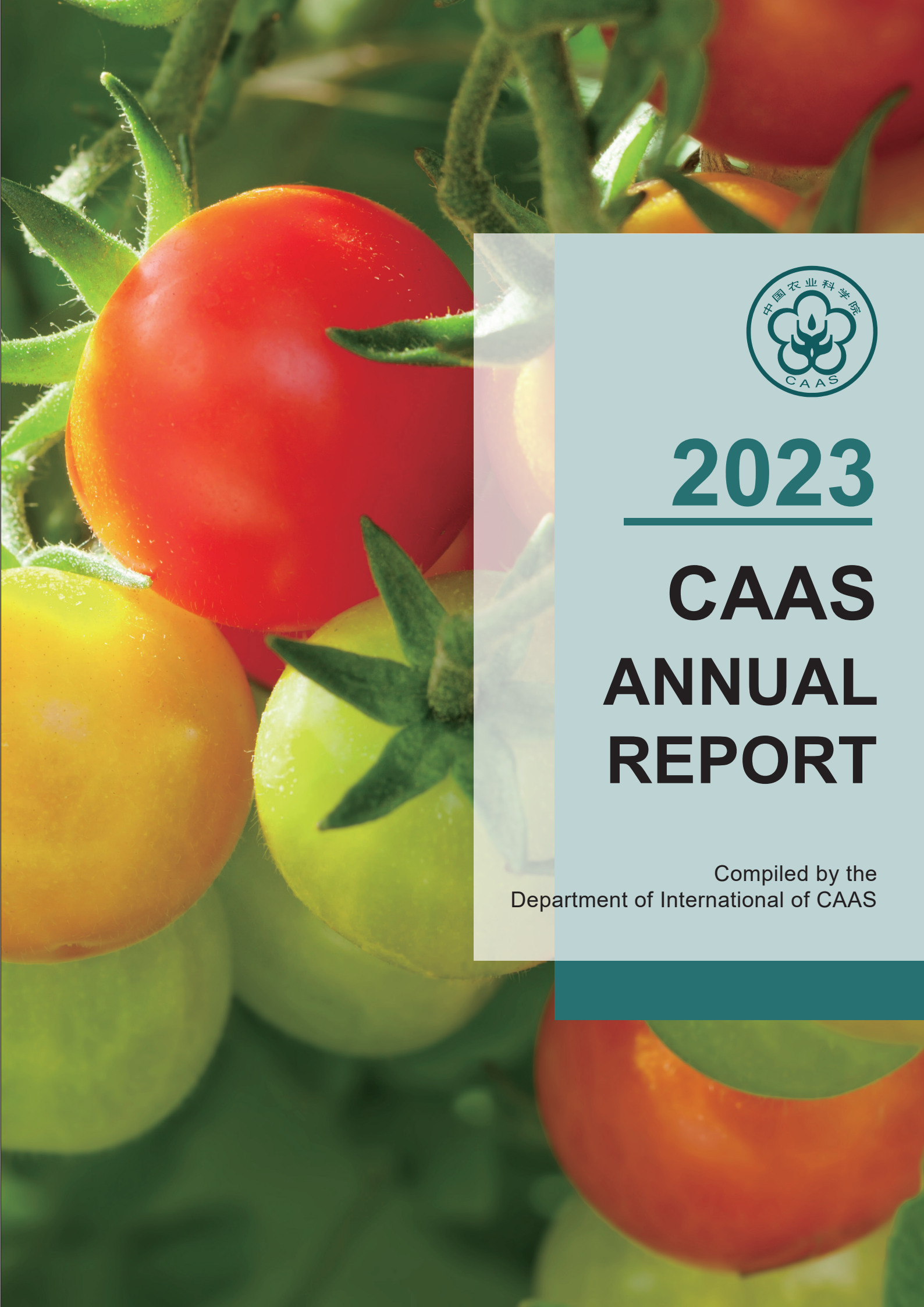

# 2023

# CAAS ANNUAL REPORT

Compiled by the
Department of International of CAAS

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Department of International Cooperation

Chinese Academy of Agricultural Sciences

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# 2023

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# Message from the President

The year of 2023 marks the beginning of China's path moving faster to build up its strength in agriculture. Following the guidance of President Xi Jinping on the works concerning agriculture, rural areas and farmers, and scientific and technological (S&T) innovation, as well as the spirit of his congratulatory letter to CAAS's 60th anniversary, the Chinese Academy of Agricultural Sciences (CAAS) vigorously promoted major issues in institutional restructuring, achieved new progress in S&T innovation, and made new contribution to the bumper harvest of the 20th consecutive year in grain production and comprehensive rural revitalization in China through concerted efforts all across the Academy.

Last year, the management structure of CAAS was reorganized to make sure more efforts would be made on priority issues, guided by the philosophy that success lies on the synergy between institutes, on the coordination across the Academy, not on any individual institutes or scientists. Significant breakthroughs were made in key S&T fields, several findings showed great originality, and a number of S&T achievements were rewarded with national or ministerial/provincial awards, leading to series of significant new products, technologies and equipment. CAAS was fully devoted to supporting the stable and safe supply of grain and major agricultural products, and the comprehensive and in-depth revitalization of rural areas. With higher basic capabilities of S&T innovation and improved quality and structure of the talent pool, CAAS was more proactive in S&T opening-up and cooperation, so as to further build up an open S&T innovation ecosystem.

Throughout the year, 86 new national key research and development (R&D) projects have been approved, seeing a year-on-year increase of 30%. 364 new projects were approved by the National Natural Science Foundation of China, including 39 national major projects, among which 3 Distinguished Young Scholars Projects and 9 joint fund projects were granted, all achieving the best record in history. A total of 4,681 articles were published in SCI/EI-indexed journals last year, and 3 articles were published in *Cell* or *Science* with CAAS scientists as the first author. Several discoveries are marked of strong originality, such as the first two-dimensional map of deleterious mutations in potatoes, the first pangenome construction of inbred line in maize breeding, and interpretation of the pathogenesis of avian influenza virus, etc.

Moreover, scientific findings of CAAS were also transformed into new products and new cultivars, and were greatly received by the market. The world's first trivalent DNA vaccine against avian influenza was developed; the independently cultivated new breed of beef cattle, the Huaxi cattle, accounted for 17.8% of the domestic market after three years of market promotion, and the total market share of Zhongxin and Zhongchu white-feathered meat ducks reached 40%, while that of domestic white-feathered meat chicken breeds increased to 25.1%. The fifteen expert groups of different disciplines provided emergency service in response to extreme weather conditions such as the widespread rainstorms during wheat ripening and harvest in the Yellow River Valley and the Huai River Valley, and played an important role in winning the bumper harvest of summer and autumn grain production last year.

With regard to international cooperation, the G2P mega science project initiated by CAAS attracted active responses from multiple parties, and received substantial pledge from the Beijing municipal government. The 7th Global Forum of Leaders for Agricultural Science and Technology (GLAST) was held, as the first of its kind, being a great gathering for agricultural scientists all around the world after the global pandemic. CAAS further strengthened its cooperation with international organizations, such as Food and Agriculture Organization of the United Nations (FAO), Consultative Group for International Agricultural Research (CGIAR) and the European Union (EU), and is deeply involved in negotiations on agricultural science and technology under the mechanisms of Group of 20 (G20), Asia-Pacific Economic Cooperation (APEC) and BRICS, making positive contribution to global food and agriculture governance.

For years to come, CAAS will forge ahead to accomplish its mission and responsibility as the national agricultural scientific institution, build up China's strength in agriculture, move faster towards self-reliance and self-improvement in agricultural S&T at higher levels, and support the comprehensive rural revitalization and agricultural modernization with concrete actions and achievements of high-quality development.

Prof. Wu Kongming
President of Chinese Academy of Agricultural Sciences

# COMMITMENT

As a national agricultural research institution, CAAS is the highest academic institution for comprehensive agricultural research in China, serving as a strategic consultancy for agricultural science and technology, and is a national strategic force in the field of agriculture, rural areas, and farmers.

CAAS consistently fulfills its mission, utilizing its position as a strategic scientific force, and fully implementing major works regarding agriculture, rural areas, and scientific innovation. It focuses on the forefront of global agricultural science and technology, addressing national needs, promoting modern agriculture, and contributing to public health.

CAAS is dedicated to solving major scientific and technological challenges in China's agricultural and rural economic development. CAAS aims to establish national centers for agricultural science and technology innovation, technology transfer, talent development, cooperation, and high-level think tanks. These efforts contribute significantly to ensuring national food security, advancing rural revitalization, and leading agricultural modernization.

# CONTENTS

# Annual Review

## 2023 in Numbers

**2.725 billion** yuan of total project funding, including:
**364** new projects under the National Natural Science Foundation of China with direct costs of **203 million** yuan,
**86** projects under the National Key R&D Program of Ministry of Science and Technology of China with funding of approximately **1.342 billion** yuan, and **1.18 billion** yuan for the Science and Technology Innovation Project.

**88** new crop varieties were approved at the national level; **82** new crop varieties and **1** new livestock breed were approved at the provincial level. **6** certificates were obtained for new pesticides, new feed, and new veterinary drugs.

**139,000** accessions of crop germplasm were collected, and the Chinese field gene-bank of wild rice was put into operation, preserving **13,000** gaccessions of germplasm

**4,681** articles were published in SCI/EI-indexed journals, including **67** articles with an impact factor above **20. 3** articles were published in *Cell* or *Science* with CAAS scientists as the first author.

**21** achievements applied for the National Science and Technology Awards;
**28** achievements received provincial and ministerial-level awards, among which **18** were first prizes.

The annual income from commercialization of scientific achievements reached **1.555 billion** yuan, seeing a **12%** increase compared with the previous year.

**980 million** yuan were implemented for facility construction, and **3** major construction projects were approved by local governments, with an approved investment of **1.2 billion** yuan.

**2** talents were newly promoted to the top-level, **67** individuals were selected for national talent programs, **1** person received the first "National Engineer Award," and **41** urgently needed high-level talents were introduced.

**169** experts from **18** research institutes joined the rural revitalization advisory groups, leading the scientific and technological assistance in **44** poverty-alleviated counties.

**106** new domestic and international cooperation projects were approved, with a contract amount of **162 million** yuan.

Advanced and practical technologies were integrated into over **200** technologies, which were easy to be applied; more than **50** sets of replicable and extendable comprehensive solutions were identified for regional agricultural development. Over **50** on-site observation meetings and training sessions were held, more than **8,000** technicians were trained.

# SCIENCE AND TECHNOLOGY INNOVATION

- Major Scientific Discoveries in 2023
- Major Product Developments, Technological Breakthroughs, and Think Tank Reports in 2023
- Major Technological Tasks in 2023

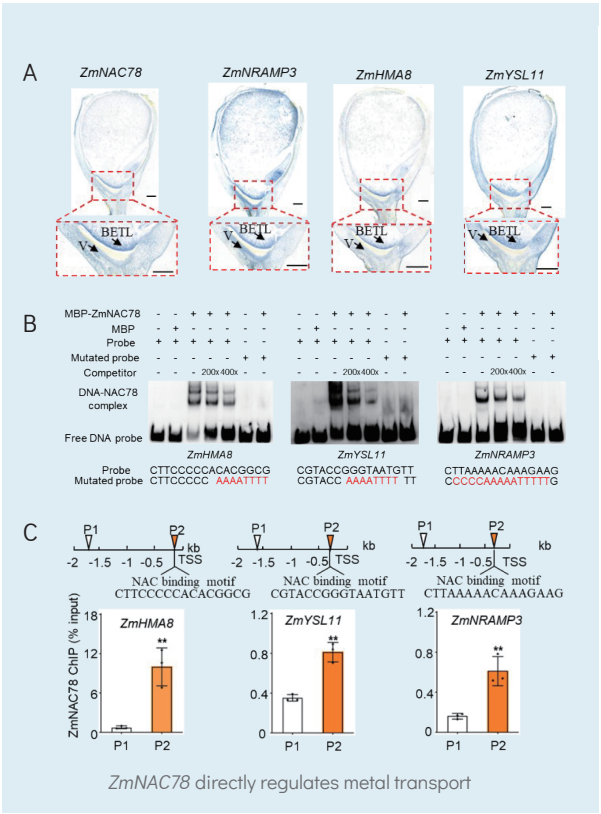
# 01. Major Scientific Discoveries in 2023

## The transcription factor *ZmNAC78* can achieve iron biofortification in maize (Biofortification of Iron content by regulating a NAC transcription factor in maize)

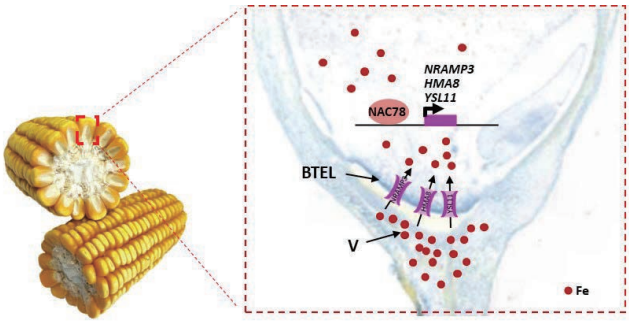
*Science* -https://www.science.org/doi/10.1126/science.adf3256

**Yan Pengshuai, first author; Li Wenxue, corresponding author, Institute of Crop Sciences, CAAS**

This study identified *ZmNAC78*, a key gene that regulates the entry of Iron into maize kernels, which together with metal transporter form a molecular switch to control the entry of iron into maize kernels. The use of this gene significantly increased the iron content of maize kernels to 70.5 mg per kilogram, which is more than twice the iron content of existing maize kernels for industrial use. The results of the study, while unraveling the biological pathways by which iron enters the maize kernel, also provide new insights into how the nutrient enters cereal crops, such as wheat, that have delivery cells. The research also developed molecular markers for breeding new iron-rich maize varieties and pioneered the application of these markers to select and breed new iron-rich maize combinations, which provided new materials for solving the problem of "hidden hunger" caused by the deficiency of iron and other micronutrients, as well as theoretical and technological support for the breeding of high-yield and high-quality synergistic crop varieties.




*ZmNAC78* directly regulates metal transport




*ZmNAC78* directly regulates metal transport proteins

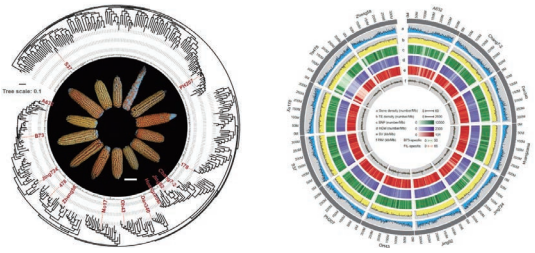
Professor Li Wenxue and his team observed the growth of maize

## Developing a core germplasm pan-genome: unraveling the genetic mechanisms underlying maize heterosis (De novo genome assembly and analyses of 12 founder inbred lines provide insights into maize heterosis)

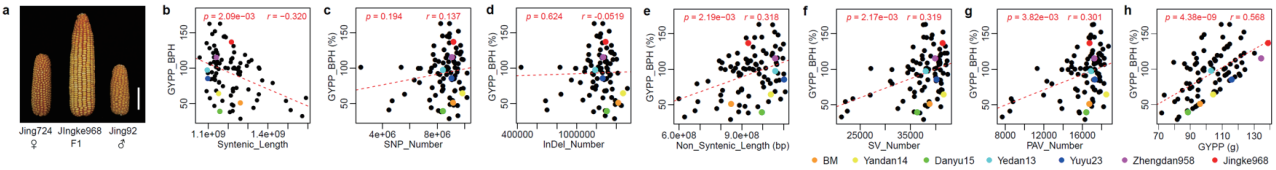
*Nature Genetics* -https://doi.org/10.1038/s41588-022-01283-w

**Wang Baobao, first author; Wang Haiyang, corresponding author, Biotechnology Research Institute, CAAS**

The utilization of heterosis is a key technical approach to increasing crop yields. This study conducted complete genome assembly of a representative core set of maize inbred lines, constructing the pan-genome of maize breeding inbred lines. It analyzed the effects of structural variations on gene expression changes and heterosis-related group differentiation, revealing the important genomic basis of genetic complementarity between parental genomes promoting heterosis formation in maize. Key heterosis genes related to yield were identified, laying a solid theoretical and resource foundation for maize functional genomics research and the breeding of highly dominant hybrid varieties.



Selecting representative maize inbred lines to develop the pan-genome of maize breeding germplasm

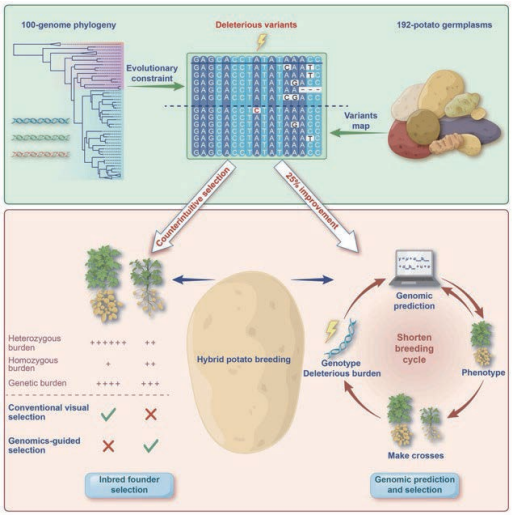



Revealing the genetic complementarity between parental genomes is an important genomic basis for the formation of maize heterosis

## "Evolutionary Lens" accelerates hybrid potato breeding

*Cell* -https://www.cell.com/cell/fulltext/S0092-8674(23)00405-1

**Wu Yaoyao, first author; Huang Sanwen, corresponding author, Agricultural Genomes Institute, CAAS**




The Evolutionary Lens accelerates hybridpotato breeding

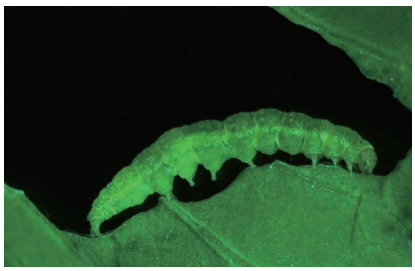
Potato is the most important tuber crop globally. The "U-Potato Plan" has revolutionized the breeding methods for potatoes, leading the potato industry towards a "green revolution". To accelerate hybrid potato breeding, this study analyzed 100 Solanaceae genomes, developed the "Evolutionary Lens" technology, generated the first two-dimensional map of functional genomic sites and deleterious mutations across the entire potato genome, proposed counterintuitive inbred line breeding methods, and developed a new genome-wide prediction model. This unprecedented accuracy in predicting potato yields has accelerated the process of hybrid potato breeding, placing China at the forefront of potato breeding theoretical foundations and technologies worldwide.

## Retrotransposon insertion mutations lead to the evolution of resistance in *Plutella xylostella* to Bt bioinsecticides

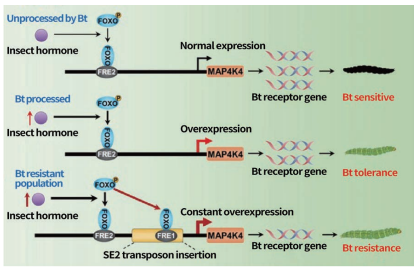
*PNAS* -https://doi.org/10.1073/pnas.2300439120

**Guo Zhaojiang, first author; Zhang Youjun, corresponding author, Institute of Vegetables and Flowers, CAAS**

*Plutella xylostella* is a globally significant agricultural pest and one of the most serious pests worldwide in terms of insecticide resistance. This study utilized a forward genetic approach to, for the first time, identify the critical genetic mutation associated with resistance to *Bacillus thuringiensis* (Bt) biopesticides in *Plutella xylostella* . The mutation identified was an SE2 retrotransposon insertion located within the promoter region of the *MAP4K4* gene, which is crucial upstream gene of the MAPK signaling cascade. This mutation introduces an additional binding site for the transcription factor FOXO, making it a "central signaling hub" for insect hormones to activate the MAPK signaling pathway. This discovery deciphers the genetic code linked with Bt resistance in *Plutella xylostella*, providing innovative strategies for monitoring, early warning and integrated pest management to Bt resistance in the field.



The larvae of *Plutella xylostella*




The genetic regulatory network of Bt resistance in *Plutella xylostella* mediated by the SE2 retrotransposon

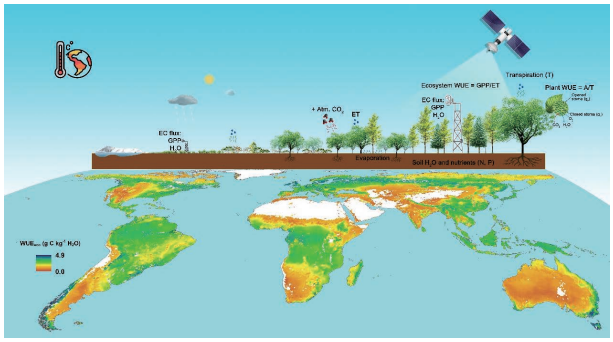

Professor Zhang Youjun and his team

## Increased atmospheric vapor pressure deficit leads to saturation of global terrestrial ecosystem water use efficiency

*Science* -https://www.science.org/doi/10.1126/science.adf5041

**Li Fei, first author; Li Fei, corresponding author, Institute of Grassland Research, CAAS**

The efficiency of carbon assimilation, described by the ratio of carbon assimilation to water vapor transpiration and known as ecosystem water use efficiency, is an essential metric for assessing the carbon sequestration potential and activity of ecosystems. Numerous studies suggest increased atmospheric carbon dioxide concentration enhances ecosystem water use efficiency. However, this study found an apparent stagnation in ecosystem water use efficiency growth over global terrestrial ecosystems since 2001. The rising atmospheric vapor pressure deficit is identified as the main driver for the stagnation in ecosystem water use efficiency development. The research indicates that the adverse effects of climate change will continue to weaken the carbon sink potential of terrestrial ecosystems, thereby affecting future global carbon neutrality and carbon peak goals.



Land ecosystem carbon-water exchange processes and three-dimensional monitoring techniques related to satellite remote sensing and eddy covariance

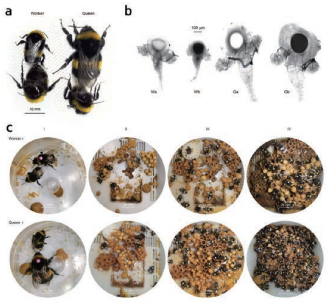
## Unveiling the ancient mystery of evolution, challenging the traditional view of lifetime unmatedness of developmentally-determined workers in superorganisms

*Nature Communications* -https://doi.org/10.1038/s41467-023-41198-6

**Zhuang Mingsheng, first author; Li Jilian, corresponding author, Institute of Apicultural Research, CAAS**

Social insects are defined as superorganisms, with their main characteristic being the lifetime unmatedness of developmentally-determined workers. However, the paradox of bumble bee workers, belonging to microorganisms, retaining intact spermathecae throughout their lives has long been a mystery in the scientific community. The team led by Li Jilian from the Institute of Apicultural Research, CAAS has verified that bumble bee workers retain the reproductive characteristics of queens: they are capable of mating and establishing colonies; and the mating of workers is inhibited by social factors. This study challenges the concept of lifetime unmatedness of developmentally-determined workers in superorganisms, providing a new perspective for a deeper and comprehensive understanding of the evolution of superorganisms, and also offering new ideas for the conservation of endangered bumble bee species.

Bumble bee workers mate and breed colonies



Comparative graphs of bumblebee workers and queens before and after mating, fertilization of the seminal receptacles, and breeding colonies

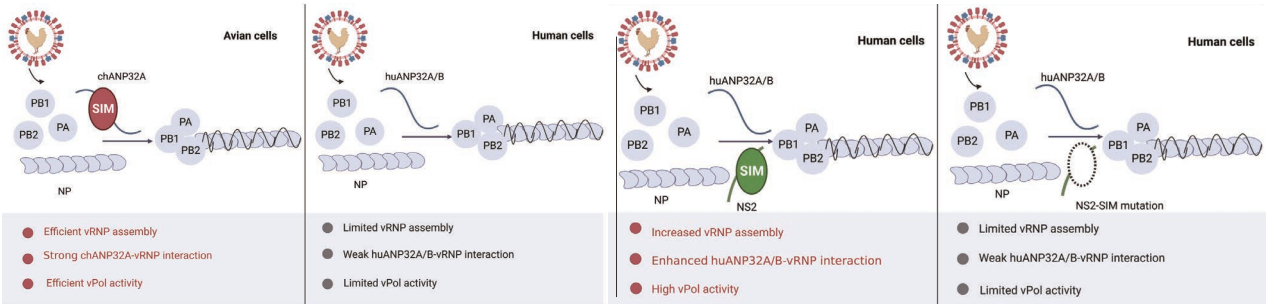
Bumble bee pollinating

## The SUMO-interacting motif (SIM) within the non-structural protein NS2 of the avian influenza virus facilitates its adaptation to mammalian hosts

*Science Advances* -https://www.science.org/doi/10.1126/sciadv.adg5175

**Sun Liuke, first author; Wang Xiaojun, corresponding author, Harbin Veterinary Research Institute, CAAS**

The potential molecular mechanisms underlying the cross-species transmission of avian influenza virus (AIV) to mammalian hosts remain unclear. For the first time, the research team has discovered a novel molecular mechanism whereby the non-structural protein NS2 of AIV specifically enhances viral adaptation to mammalian hosts through its SUMO-interacting motif (SIM). This finding elucidates why certain AIV strains can establish productive infections in mammalian hosts without acquiring adaptive mutations, thereby expanding our comprehension of the mechanisms by which AIV adapts to new host species during cross-species transmission.



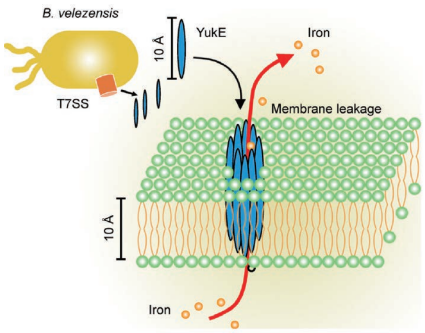

Schematic diagrams illustrating the working mechanism of NS2 protein promoting the polymerase activity of avian influenza virus in human cells

## Plant commensal type VII secretion system causes iron leakage from roots to promote colonization (Plant commensal type VII secretion system causes iron leakage from roots to promote colonization)

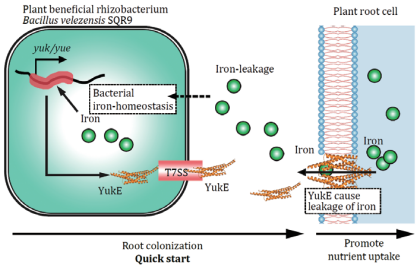
*Nature Microbiology* -https://www.nature.com/articles/s41564-023-01402-1

**Liu Yunpeng, first author; Liu Yunpeng, corresponding author, Institute of Agricultural Resources and Regional Planning, CAAS**

Focusing on key scientific questions in soil fertilization, the study utilized the widely used microbial fertilizer strains *Bacillus velezensis* as the research material, and discovered that the protein secreted by its type VII secretion system could directly insert into the root cell membrane during the early stages of plant-microbe interaction, leading to transient iron leakage from root cells, thereby rapidly acquiring iron to initiate root colonization. This "Borrow less and repay more" interaction between microbes and plants represents a novel mode of interaction between beneficial rhizobacteria and plants, providing theoretical guidance for the efficient utilization of microbial fertilizers. The related findings were published in the top-tier international journal *Nature Microbiology* (IF=28.3).




The protein secreted by the type VII secretion system inserts into the root cell membrane to cause iron leakage



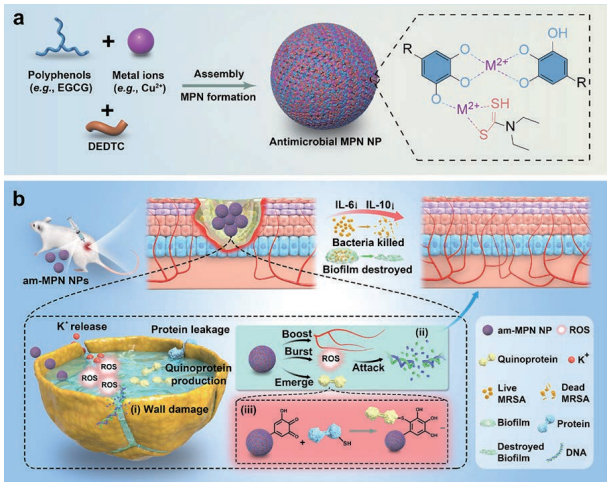

The model of interaction between Bacillus type VII secretion system and root

## Engineering Antimicrobial Metal–Phenolic Network Nanoparticles with High Biocompatibility for Wound Healing (Engineering Antimicrobial Metal–Phenolic Network Nanoparticles with High Biocompatibility for Wound Healing)

*Advanced Materials* -https://onlinelibrary.wiley.com/doi/10.1002/adma.202307680

**Yu Rongxin, first author; Zhang Xiangchun, corresponding author, Tea Research Institute, CAAS**

China's tea plantation area has exceeded 50 million mu, with abundant resources of tea polyphenols. Tea polyphenols possess various health benefits such as antioxidative and antibacterial properties. However, the instability of the structure of tea polyphenols limits their deep processing and utilization. This study developed, for the first time, an in-situ self-assembly technology for tea polyphenols, stabilizing their structure and constructing a new material library of tea polyphenols. Among them, it was found that tea polyphenol self-assembled nano-copper exhibits highly efficient synergistic antibacterial and anti-inflammatory activities, further proposing and demonstrating a new mechanism of quinone protein-mediated antibacterial activity. The research findings provide new insights into the design of novel steady-state polyphenol materials and expand the application of polyphenol resources in the field of life and health.



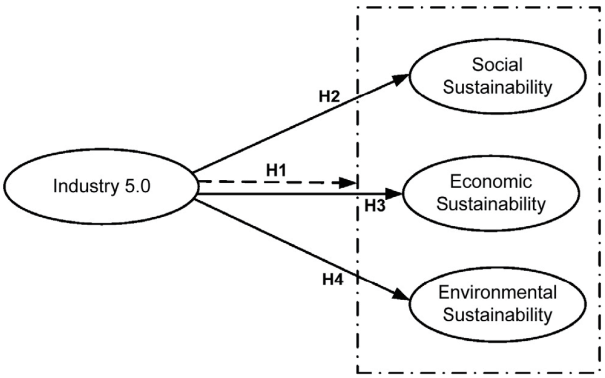

Schematic diagram of the construction and synergistic anti-infection mechanism of tea polyphe nols self-assembled biomaterials

## Does industry 5.0 model optimize sustainable performance of Agri-enterprises? Real-time investigation from the realm of stakeholder theory and domain

*Sustainable Development* -https://onlinelibrary.wiley.com/doi/10.1002/sd.2527

**Guo Long,first author**; **Sun Dongsheng,corresponding author,Institute of Agricultural Economics and Development, CAAS**

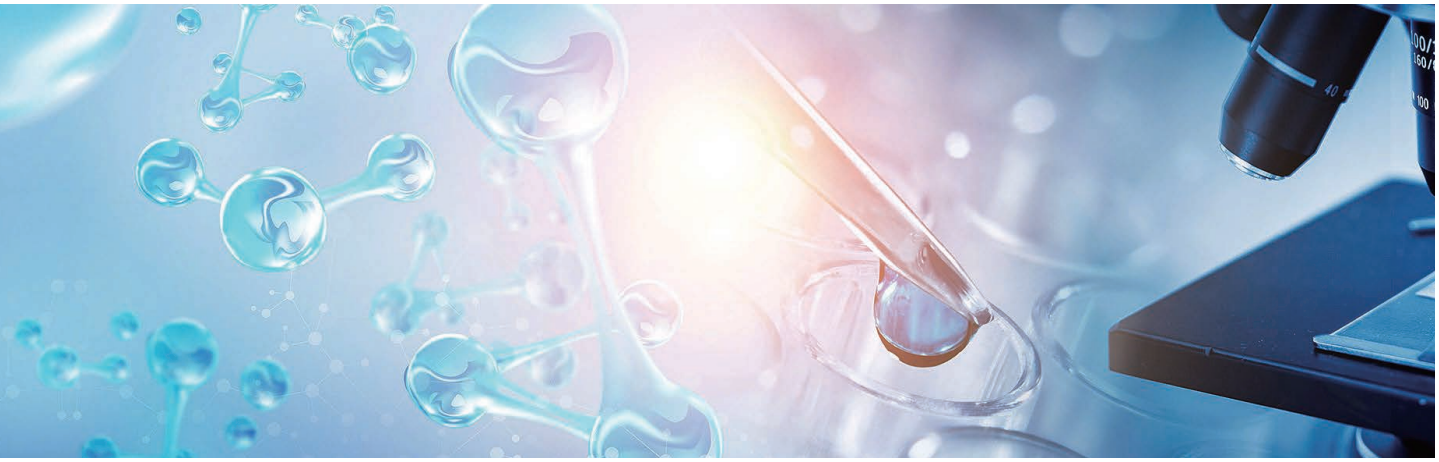
Currently, research on the Industry 5.0 model is just emerging, and as a result, the academic community is striving to reveal its impact on various industries worldwide. This article, after fully investigating the new formats and models of agricultural enterprise development under the Industrial 5.0 model, takes the perspective of stakeholder theory in China's agricultural economic field to understand how the Industrial 5.0 model can optimize the sustainable performance (STP) of the agricultural economy across three dimensions: economic, environmental, and social. This study provides theoretical support and new management ideas for achieving the personalized, ecological, and sustainable operation of agricultural enterprises. Additionally, it brings real-time evidence and actual cases to the layout of agricultural economic development under China's rural revitalization strategy.




How the Industrial 5.0 model affects the sustainable performance of agricultural enterprises across three dimensions

| Constructs | Male participants Freq. | % | Female participants Freq. | % |
|---|---|---|---|---|
| *Status of Gender:* | 250 | 65.7 | 130 | 34.2 |
| *Marital:* | | | | |
| Married | 205 | 82.00 | 040 | 30.77 |
| Single | 045 | 18.00 | 090 | 69.23 |
| *Education:* | | | | |
| Undergraduate | 110 | 44.00 | 015 | 11.54 |
| Master/MS/Mphil | 090 | 36.00 | 050 | 38.46 |
| Ph.D. | 050 | 20.00 | 065 | 50.00 |
| *Age:* | | | | |
| <21 | 025 | 10.00 | 020 | 15.38 |
| 21–25 | 070 | 28.00 | 035 | 26.92 |
| 26–30 | 080 | 32.00 | 050 | 38.46 |
| >31 | 075 | 30.00 | 025 | 19.23 |
| *Experience:* | | | | |
| <5 | 035 | 14.00 | 010 | 07.69 |
| 6–8 | 070 | 28.00 | 040 | 30.77 |
| 9–11 | 090 | 36.00 | 045 | 34.62 |
| >12 | 055 | 22.00 | 035 | 26.92 |

Agricultural enterprise data samples



# 02. Major Product Developments, Technological Breakthroughs, and Think Tank Reports in 2023

## The transformational strain BFL4-2 of insect-resistant and herbicide-tolerant maize lays the foundation for the industrial application of biological breeding

**【Wang Lei's Research Team, Biotechnology Research Institute, CAAS】**

The BFL4-2 maize transformation strain, created by Wang's team, incorporates the genes *cry1Ab, cry1F,* and *cp4epsps* . The maize varieties derived from this strain demonstrate over 95% efficacy against eight lepidopteran pests, including *Ostrinia nubilalis, Spodoptera frugiperda, Helicoverpa armigera, Bemisia tabaci, Grapholita* molesta, and can tolerate over four times the dosage of glyphosate, exhibiting excellent weed control. In January 2023, it was granted an agricultural genetically modified production safety certificate, marking the first such certificate issued by our institute for genetically modified maize. Patent transfers realized transformational revenue of 15 million yuan. The transformed varieties were included in the pilot planting for the industrial application of biological breeding in 2023, laying the foundation for the industrial application of biological breeding.

## The early-maturing, high-quality, and high-yield new variety Zhongmian 113 ensures stable supply of high-quality raw cotton in China

**【Ma Xiongfeng's Research Team, Institute of Cotton Research, CAAS】**

Zhongmian 113 overcame the bottleneck of negative correlation between growth period and yield, quality, and other traits, achieving early maturity, high quality, and high yield. It promoted the demonstration and promotion of "Eastward to Westward (Gansu-Northern Xinjiang- Yili)" and "Northward to Southward (Northern Xinjiang-Southern Xinjiang) promotion and applications", preventing the risk of cotton planting in the northwest inland cotton area. It met the needs of different entities in the cotton production chain, forming a market promotion model of "one factory, one product". In 2022, it ranked third in the country in terms of promotion area, was selected as a major agricultural and rural technology achievement in China, and was continuously selected as a key variety promoted by the Ministry of Agriculture and Rural Affairs from 2022 to 2023. It has been listed as a key promoted variety or demonstration variety in Xinjiang, Gansu, and other places, with a cumulative promotion of 8 million mu, achieving significant economic and social benefits.

Seed of Zhongmian 113

Field of Zhongmian 113

Plant of Zhongmian 113

## The high-quality and multi-resistant field cucumber variety Zhongnong 48 becomes the main cultivated variety for a new generation of vegetable production bases, transporting vegetables from South to North

**【Zhang Shengping's research team, Institute of Vegetables and Flowers, CAAS】**

Utilizing internationally leading molecular breeding technology, the team has cultivated Zhongnong 48, a glossy and densely spined cucumber variety, ideal for field cultivation, boasting high yields, and demonstrating superior disease resistance. This variety has greatly addressed issues related to poor disease resistance, poor resistance to adverse conditions, and inadequate commercial quality of field varieties. Zhongnong 48 demonstrates significant cost-effectiveness advantages and has become the main cultivated variety for a new generation of vegetable production bases. It is widely planted in China's main cucumber production areas, bringing enormous economic and social benefits. In 2023, it was selected as the only dominant cucumber variety by the Ministry of Agriculture and Rural Affairs, and the same year it was selected as a major new agricultural technology, product, and equipment in rural areas in China.

Zhongnong 48 cucumber

Field growth status of Zhongnong 48 cucumber


Certificate of Selection for Major Agricultural and Rural Scientific and Technological Achievements in China in 2023

## The "Zhongyoupan 7" becomes the new benchmark for flat nectarine, addressing issues such as fruit cracking, small fruit size, and low yield.

**【Wang Lirong's Research Team, Zhengzhou Fruit Research Institute, CAAS】**

Flat nectarine combines the characteristics of flat peach and nectarine, offering better flavor and convenience. However, due to its heavier fruit cracking, smaller fruit size, and lower yield, it was first cultivated only sporadically. Over the past 30 years, Zhengzhou Fruit Research Institute has explored excellent germplasm domestically and internationally, undergone four generations of hybridization, and utilized embryo rescue technology. By aggregating 17 excellent germplasm traits, they have solved the worldwide challenge of heavy fruit cracking, small fruit size, and low yield in flat nectarines. They cultivated "Zhongyoupan 7", a mid-ripening, large, yellow-fleshed, high-yielding variety. It boasts good appearance, high quality, and high yield, achieving synergistic improvement in fruit appearance and flavor quality. This breakthrough in flat nectarine breeding, hailed as "Divine 7" by farmers, is one of China's iconic varieties. It has been extensively planted in Shandong, Henan, Shanxi, and other regions, generating significant socio-economic benefits.

The high-yielding Zhongyoupan 7

Zhongyoupan 7

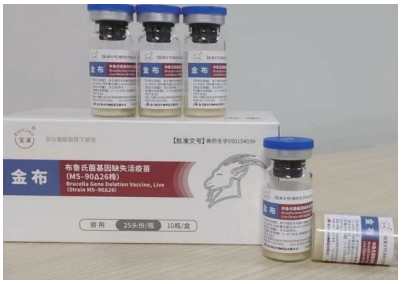
## Brucella Gene Deletion Vaccine, Live (Strain M5-90Δ26) ensures the sound development of the sheep industry

**【Bu Zhigao's Research Team, Harbin Veterinary Research Institute, CAAS】**

Brucella Gene Deletion Vaccine, Live, developed by Bu's team can distinguish between vaccine immunity and natural infection antibodies, effectively removing naturally infected animals, and breaking through the key bottlenecks in brucellosis vaccine production and application. This marked vaccine has been used in a cumulative total of 68 million doses, reducing the individual and herd positivity rates of sheep in immune regions, as well as the incidence rate of human brucellosis. It provides important technological support for the smooth implementation of the "Five- Year Action Plan for the Prevention and Control of Brucellosis among Livestock (2022—2026)".


中华人民共和国
新兽药注册证书

The new veterinary drug certificate for Brucella Gene Deletion Vaccine, Live(Strain M5-90Δ26) new veterinary drug certificate




Brucella Gene Deletion Vaccine, Live (Strain M5-90Δ26)

Researchers immunizing sheep with the Brucella Gene Deletion Vaccine, Live (Strain M5-90Δ26)

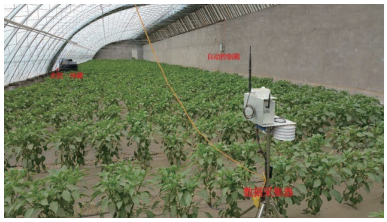
## Protected Vegetable High-Efficiency Soilless Cultivation Technology" facilites the development of protected agriculture on non-arable lands such as the Gobi Desert

**【Jiang Weijie's Research Team, Institute of Vegetables and Flowers, CAAS】**

Addressing the high substrate costs and lack of practical water-saving cultivation and efficient use of water and fertilizer technologies in non-arable areas such as the Gobi and deserts in northwest China, key technologies for high-efficiency soilless cultivation of vegetables in desert and Gobi environments have been developed. This technology reduces substrate costs by 35% compared to traditional peat substrates, reduces fertilizer costs by 40%, saves over 25% water, and reduces fertilizer usage by over 35%. The highest annual yield of tomatoes can reach 30,000 kilograms per hectare. It has realized efficient production of soil-less-cultivated vegetables in the Gobi Desert, solving the problems of low agricultural production efficiency and difficult sustainable development in Gobi and desert areas. This fundamentally promotes the development, transformation, and upgrading of the facility vegetable industry in Gobi regions in China. The technology was selected as a significant new agricultural technology in China in 2023.

Protected tomato soilless cultivation in desert, Zhangye City, Gansu Province

Protected tomato soilless cultivation in Gobi desert, Jiuquan City, Gansu Province

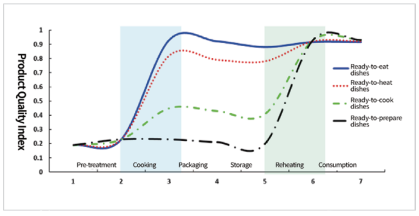


Protected pepper cultivation in desert, Wuhai, Inner Mongolia

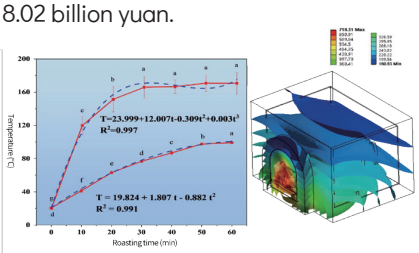
## Industrialized green processing technology leads the sound development of meat prepared dishes industry

**【Zhang Dequan's Research Team, Institute of Food Science and Technology, CAAS】**

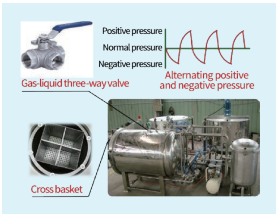
Aiming at the three major problems in the industrialization of traditional meat dishes in China, such as the difficulty of maintaining their appearance and quality, the lack of key processing technologies, the lack of core equipment and the backwardness of complete sets of production lines, Zhang's team has made breakthroughs in the key technologies of new type of targeted bacterial reduction, flavor development and preservation, and industrialized green maturation for precooked meat dishes, and created key complete sets of equipment and control systems such as pulse-pressure marinating, integrated quantitative braising and "superheated steam+" integrated stir frying and roasting. Additionally, they have introduced four categories of new products -- ready-to-eat, ready-to-heat, ready-to-cook, and ready-to-distribute -- establishing a theoretical, technical, and equipment system for the industrial processing of traditional meat dishes, promoting the transformation and upgrading of the precooked dish industry from "traditional small pot production" to "digital industrialization", and achieving the goals of quality maintenance, industrialized processing, and quality improvement. Since 2020, 11 representative application enterprises of this technology have cumulatively added sales revenue of 11.318 billion yuan and profits of 8.02 billion yuan.




Quality formation and preservation of meat prepared dishes




Heat transfer laws between surface and center during roasting duck process



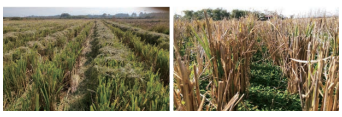

Digital pulse pressure marinating equipment

## Simplified, efficient, fertilizer-saving, and yield-increasing green manure technology in Southern paddy fields promotes the modernization of green manure production

**【Cao Weidong's Research Team, Institute of Agricultural Resources and Regional Planning, CAAS】**

In response to the inadequate organic nutrient input and cultivation methods, as well as various ecological environmental issues in Chinese paddy fields, Cao's team has cultivated and selected new varieties of green manure tailored for paddy fields. They have optimized high-yield cultivation and regulation methods for green manure, developed equipment for the simplified production process of green manure, and researched technologies such as the combined utilization of green manure and rice straw, nitrogen reduction, potassium reduction, phosphorus regulation, and reduction of losses and emissions. These have been integrated into the "Simplified, efficient, fertilizer-saving, and yield-increasing green manure technology in Southern paddy fields". This technology effectively achieves a reduction of 40% in nitrogen and potassium use in rice, significant carbon sequestration and emission reduction, reduction of nitrogen and phosphorus losses, and improvement in soil quality. Over the past decade, this technology has been demonstrated and promoted on tens of millions of acres, with its core techniques repeatedly selected as national agricultural and rural recommended technologies and among the top ten new agricultural and rural technologies.


Green manure: high-quality rice base



High stubble retention technique for rice straw

Green manure dry farming and stubble retention technique for emission reduction

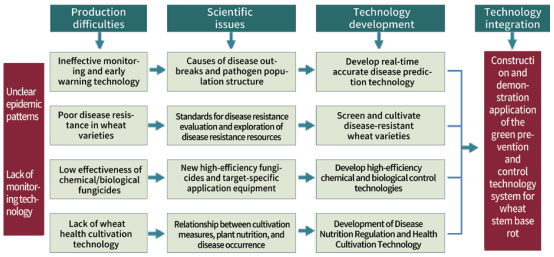
Large-scale demonstration site

## Enhancing research on wheat crown rot to support scientific prevention and control strategies for wheat crown rot in government decision-making

**【Chen Wanquan's Research Team, Institute of Plant Protection, CAAS】**

Wheat crown rot is a newly emerging and rapidly spreading plant epidemic. Over the past five years, continuous large-scale surveys have revealed that the disease is spreading continuously in the major wheat-growing areas of China. The annual affected area has exceeded 100 million mu, with a yield loss of over 3.5 billion kilograms, severely impacting the steady development of China's wheat industry. This study identified areas of severe, moderate, and sporadic occurrences of wheat crown rot in China, as well as predominant pathogen species, toxin contamination characteristics, and the disease resistance status of wheat varieties. It proposed industrial technical challenges caused by the disease and urgently needed scientific issues for research resolution, developed a major scientific research task map, and assisted the Ministry of Agriculture and Rural Affairs in formulating emergency prevention and control strategies and technical plans for wheat crown rot.

Symptoms of wheat crown rot during seedling stage (Xingtai, Hebei Province) and adult stage (Pingdingshan, Henan Province)




Industrial technical challenges and scientific issues of wheat crown rot

## Exploring the roots of rural income disparities and solutions on the path to common prosperity

**【Xie Linghong's Research Team, Institute of Agricultural Economics and Development, CAAS】**

Narrowing the income gap among different groups within rural areas is a crucial aspect of achieving common prosperity, carrying significant importance and posing formidable challenges. This achievement entails estimating the level and evolution trends of income disparities within rural areas, summarizing typical characteristics of various disparities, analyzing the structural sources of disparities from both regional and income source perspectives, assessing and looking ahead at the external environment, opportunities, and challenges of narrowing income disparities within rural areas. It particularly delves into the pressure faced by traditional small-scale farmers to increase income, leading to challenges in agricultural succession and the construction of a strong agricultural nation. It systematically outlines new issues and phenomena regarding income disparities within rural areas. Finally, it proposes a comprehensive approach, implementation paths, and complementary policies for narrowing income disparities within rural areas, providing forward-looking decision-making support for enhancing farmers' income and achieving common prosperity in the face of new circumstances.

# 03. Major Technological Tasks in 2023

## Task 1 Soybean Variety Enhancement

In response to the national strategic demand for increasing soybean yield per unit area and ensuring the security of national soybean and oilseed supply, we accelerated the release of a batch of high-yielding, dense-resistant, high-oil, and multi-resistant soybean varieties, cultivated a group of new strains, and reserved a batch of new germplasms.

Cultivar Certificate of Zhongdou 66


Zhongdou 66 in the field


Zhonghuang 212 (kernels and beans)


Zhonghuang 212 in the field

## Task 2 Green and Efficient Production Technology Integration and Demonstration Project for Protected Agriculture

Eleven green and efficient production demonstration bases were established in major protected vegetable production areas such as the Huang-Huai-Hai region, the Bohai Rim, Northeast China, the middle and lower reaches of the Yangtze River, and the northwest Gobi Desert. Additionally, one low-carbon and energy-saving plant factory demonstration base was constructed in Beijing. A core production technology system for Gobi ecological agriculture, labeled as "1 + 6", was formed. In Jiuquan, Gansu Province, these technologies were applied and promoted to across 85000 mu of farmland. Key technologies for efficient soil-less cultivation of vegetables in desert Gobi areas were selected as "Major New Technologies, Products, and Equipment in China's Agriculture and Rural Areas in 2023". Through the assembly maturity, demonstration, and promotion of these technologies, comprehensive improvement in the quality and efficiency of protected agriculture was achieved nationwide.


Vertical unmanned plant factory

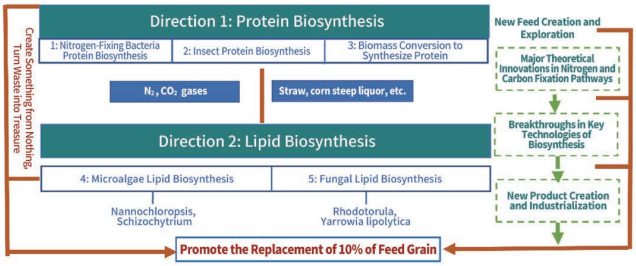

Soil-less cultivation of tomatoes in the desert of Zhangye City, Gansu Province


Large-Span insulated and mechanized plastic arched greenhouses in the Huang-Huai-Hai region and the Bohai Rim

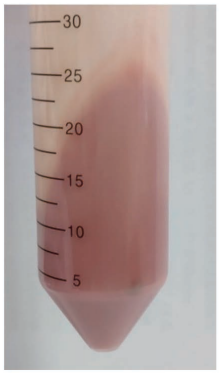

Aerial view of Gobi Protected Agriculture Park in Suzhou District, Jiuquan City, Gansu Province

## Task 3 Protein and Energy Feed Biosynthesis

Focusing on the issue of the scarcity of high-quality protein and energy resources in China's feed industry, this project aims to tackle the technology of biosynthesizing protein and energy feed. It involves utilizing nitrogen-fixing bacteria, insects, and biomass to produce biological protein, as well as using microalgae and fungi to synthesize fats. The goal is to develop new types of non-grain feed resources and industrialize their applications, laying a solid foundation for ensuring the sustain-able development of China's livestock industry and food security.

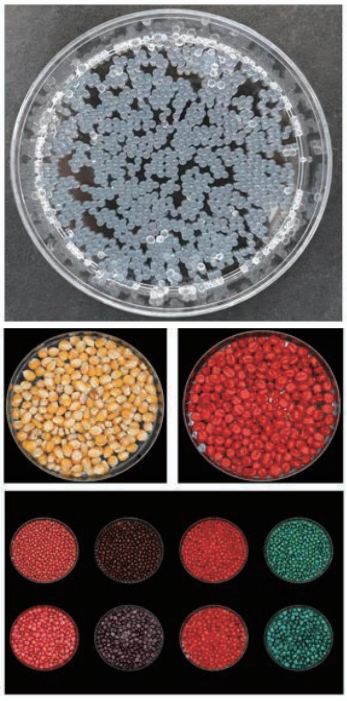



Research and commercialization roadmap of Pprotein and energy feed biosynthesis key research routes



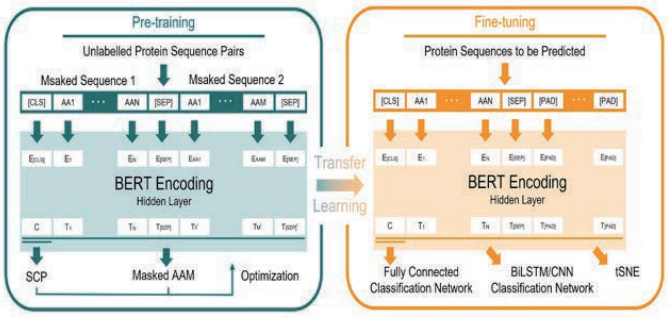

Pilot-scale system for feed protein microorganisms fermentation

## Task 4 Agricultural Synthetic Biology Technology Platform Establishment and New Major Product Development



Microcapsules and seed coating agents prepared from synthetic materials

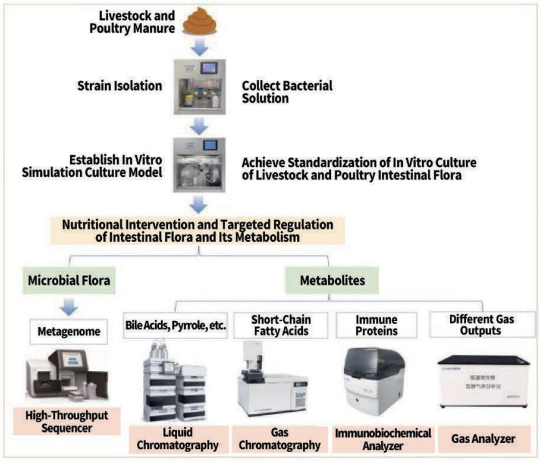
Focusing on significant bottlenecks in the application and industrial development of agricultural synthetic biology products in China, this initiative aims to establish an agricultural synthetic biology technology platform and construct microbial cell factories. It seeks to develop a series of novel synthesized products such as feed enzymes and pesticides, accelerating the industrialization of agricultural synthetic biology technology, and providing theoretical and technical support for achieving green development and quality improvement in agriculture and animal husbandry.




Development of basic models for intelligent design

## Task 5 Innovation and Application of Microbial Germplasm in Animal Farming

Addressing the issue of low digestibility in poultry and aquaculture feed, as well as the lack of strains promoting digestion and efficient feed products, this initiative focuses on creating a repository of typical animal gut microbiota, identifying functional bacterial strains and their active components, and developing green feed products for industrialization. These efforts aim to promote the healthy development of poultry and aquaculture farming in China.





Development of techniques for the extracellular cultivation and analysis of gut microbiota

## Task 6 Key Technology Research and Application for Improving the Rural Living Environment in Typical Regions

Adopting the research approach of "zone-based management and diversified collaboration", with "local, nearby, and rural" as the path, and "reducing pollution, lowering carbon emissions, and increasing efficiency" as the overall goal, this initiative focuses on different application scenarios in typical regions. The key breakthroughs include addressing technological bottlenecks such as low-cost on-site and harmless treatment of waste in arid areas, insulation, temperature and efficiency increase for diverse organic waste in cold regions, and collaborative low-carbon and safe utilization of rural sewage in water network areas. In three major typical regions, models for collaborative waste treatment in rural living environments are being established to achieve comprehensive improvement in the rural living environment across the region.

Agricultural land use

Courtyard waste disposal and utilization

Passive compliant emissions

## Task 7 Research and Demonstration of Key Technologies for Green Integrated Pest Management of Major Vegetable Diseases and Pests in Hainan Province

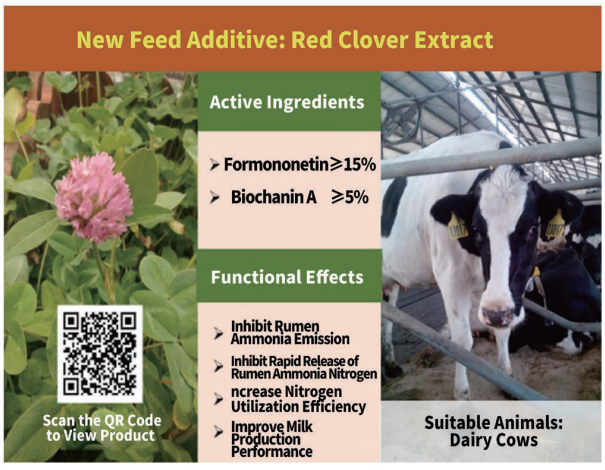
The focus is on the development of rapid detection technology and products for pesticide residues in cowpeas, as well as research and demonstration of key technologies for the green control of thrips and melon flies in cowpeas. This includes integrating/establishing a green pest control technology system and pesticide residue detection technical regulations to strengthen full-process control over pesticide use safety and cowpea production safety.


*Symptoms* and *Damage* caused by thrips and melon flies to cowpeas

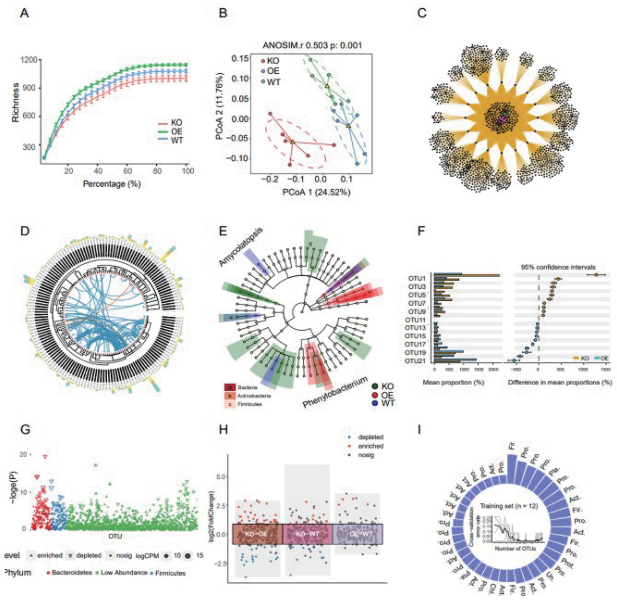
Cowpea thrips green prevention and control demonstration area in Lingshui, Hainan Province

## Task 8 Agricultural Microbiome Research Program

Aligned with the pressing demand for efficient utilization of agricultural resources in China, this project aims to establish a world-class agricultural microbiome strain library and gene bank by benchmarking against the forefront of microbiome research. It seeks to unravel the interactions among microbiomes, hosts, and environments, and develop novel green inputs such as fertilizers and plant growth regulators. The goal is to achieve breakthroughs in both theoretical innovation and product development in the field of agricultural microbiome research.




Development of new feed additives



Establishment of a High-Throughput microbiome analysis platform

# SCIENCE AND TECHNOLOGY SUPPORT

- Expert Groups
- Demonstration of Integrated Technologies of High-Yield and High-Efficiency
- Rural Revitalization
- Cooperation with Enterprises
- Intellectual Property
- Research Layout

# 01. Expert Groups

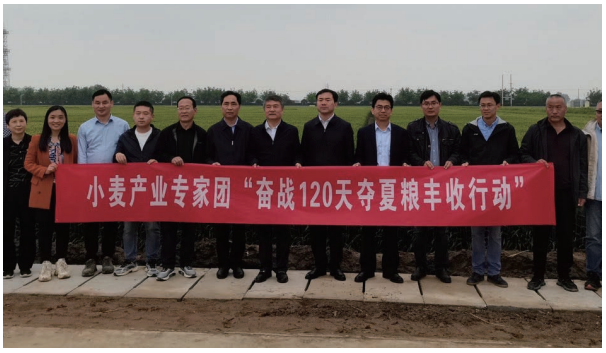
Focusing on the stable production and supply of grain and important agricultural products, 15 expert groups covering grain, cotton, oil, meat, eggs, milk, fruits, vegetables, tea, and other sectors were established. A working mechanism of "efficient operation of expert groups, full support from research institutes, and overall coordination and provision from the academy" has been basically formed. Combining the service pattern of "expert group - expert station - field class-room," the scientific and technological forces of the entire industrial chain are integrated to carry out research and consultation services on industrial policies, demonstration and application of integrated new varieties and technologies, emergency technical support services for industries, and technical training and guidance services. The groups are fully committed to providing "four services" -- serving the government, serving enterprises, serving farmers, and serving scientific research. Scientific and technological task forces visited more than 20 provinces to carry out a series of major actions for stable production and supply, including large-scale yield improvement; winning bumper harvests of summer grain and oil; autumn grain harvest actions; deploying to the front line to take charge of provinces and regions; emergency services for extreme weather; pest monitoring; etc. Minister of the Ministry of Agriculture and Rural Affairs, has repeatedly made affirmative comments on scientific and technological support for stable production and supply by CAAS. "Scientific and Technological Services for Stable Production and Supply" was award-ed the title of "Best Volunteer Service Project", selected by 18 national departments, including the Publicity Department of the CPC Central Committee.

Prof. Yang Zhenhai, Secretary of the Leading Party Group of CAAS, went to Zhouqu County, Gansu Province, to investigate the development of rural industries


Issuing appointment letters to the heads of the expert groups

## 02. Demonstration of Integrated Technologies of High-Yield and High-Efficiency

In the main producing areas, the integration, demonstration, and promotion of key technologies across the entire industrial chain were comprehensively deployed for 20 industries, including planting industries such as rapeseed, cotton, vegetables, and fruits, as well as breeding industries such as pig and beef cattle, and rural living environment management. More than 200 advanced practical technologies were integrated, and over 50 sets of replicable and scalable comprehensive regional agricultural solutions were found. More than 50 on-site observation meetings and training sessions were held, training more than 8,000 new business entities, providing comprehensive technical model reserve for scientific and technological support in stable production and supply.




Prof. Wu Kongming, President of CAAS, conducting research to guide the work of winning a bumper summer grain harvest in Henan Province

The launching meeting of demonstration of integrated technologies of high-yield and high-efficiency in 2023

## 03. Rural Revitalization

Continuous scientific and technological assistance was provided to the 11 rural revitalization demonstration counties of CAAS and key assisted counties listed by relevant national ministries. 169 experts from 18 research institutes were organized to join the rural revitalization industry advisory group, leading the scientific and technological assistance in 44 poverty-alleviated counties. Meetings on scientific and technological assistance to Xinjiang was held, focusing on scientific and technological research in six major industries, including grain and cotton in Xinjiang. CAAS led 19 provincial and ministerial-level agricultural research institutions to jointly establish a plateau agricultural innovation center, creating a platform for scientific and technological assistance to Xizang.

CAAS scientists supporting the tea industry in Ziyang County, Shaanxi Province, a rural revitalization demonstration county

## 04. Cooperation with Enterprises

All-round efforts were made to deepen the integrated development between enterprises and academy. The role of the joint body of enterprise-academy integrated development was brought into play. Through holding a series of regional and industry-specific matchmaking activities, the progress of major scientific and technological achievements of CAAS was widely publicized, various resources were gathered, and the commercialization of CAAS's scientific and technological achievements was promoted. In-depth strategic cooperation with leading enterprises such as CNADC (Zhongnongfa) and Dabeinong was further promoted, focusing on joint research and development in crop breeding, animal vaccines, feed microorganisms, nutritious foods, and other areas. The 2023 (the 3rd) China Agricultural Transfer Fair was successfully held, showcasing and releasing 100 major agricultural scientific and technological achievements and 1,000 outstanding scientific and technological achievements, effectively gathering resources from all parties, including government, industry, academia, research, and finance, also promoting the commercialization and implementation of scientific and technological achievements.


China Agricultural Technology Transfer Fair 2023

## 05. Intellectual Property

The 3rd China Agricultural Technology Transfer Fair was held, releasing 100 major scientific and technological achievements of CAAS, and signing contracts for 24 major projects on-site. The annual income from achievement commercialization reached 1.555 billion yuan, seeing a 12% increase compared with the previous year. The intellectual property management work of CAAS focused on the high-quality development of intellectual property. With the implementation of national standards and the cultivation of professional talents as the starting points, the standardization of intellectual property management was continuously strengthened, and intellectual property service guidance was enhanced. Through holding activities combining both specific and general aspects, such as the "Intellectual Property Service Tour", CAAS provided service to scientific and technological innovation in the agricultural field, intellectual property forums, and training for intellectual property specialists, and helped improving the overall level of intellectual property creation, utilization, protection, management, and service. In 2023, CAAS was granted 1,946 domestic patents, with invention patents accounting for more than 85%; and 308 new plant varieties were approved.


The campaign of "Intellectual Property Service Tour"

# 06. Research Layout

**Construction of major scientific research platforms:** The major scientific research platform was put into operation systematically. Throughout the year, construction funds of various types totaling 980 million yuan were implemented, and 8 national key laboratories led by CAAS were officially put into operation. Focusing on key areas such as seeds and biosecurity, the resource preservation conditions for oil crops, forage, northern medicinal plants, sika deer, Mongolian cattle, and other resources were improved. The major platform for phenotypic identification research facility was put into trial operation, and the system for crop and livestock resource preservation and innovative utilization was further improved. The vertical agricultural industry demonstration base in Chengdu Center was fully completed, and the experimental capabilities of bases and stations in Dezhou, Shunyi, Shaerqin, and other locations were continuously enhanced, efficiently supporting the implementation of scientific research projects and the integration of technological innovation. Facilities such as the Changdao migratory insect laboratory and the isolation and quarantine facility for the introduction of agricultural crops from abroad were completed, providing platform support for high-quality biosecurity prevention and control.

Collaboration and cooperation between CAAS, local institutions, and universities were deepened. The Mulberry and Silkworm Research Center was jointly established with Jiangsu University of Science and Technology, exploring a new model of academy-university cooperation. Innovation alliances were formed around areas such as feed grain saving. All 77 alliances about innovation and development are also boosted.

**Layout of major scientific research facilities:** The systematic construction of major scientific and technological platforms was promoted to comprehensively enhance the core supporting capabilities for scientific and technological self-reliance. The national phenotypic identification research facility and the Northern Rice Research Center were completed and put into operation. The National Seed Industry Innovation Center was basically completed. The Agricultural Genomics Research Center and the Northwest Center of the National Agricultural Biosecurity Science Center were topped out. The construction of the Anyang Innovation Base and the National Livestock and Poultry Germplasm Resource Bank commenced. The Nanfan International Cooperation and Exchange Center was about to start construction. The National Agricultural Microbial Bank, the National Major Scientific Research Facility for Plant Biosecurity Resource Preservation and Utilization, and the National Digital Agriculture and Rural Scientific Research Collaborative Innovation Platform were submitted to the ministry for review and approval, forming a pattern of "completing a batch, constructing a batch, and approving a batch" for step-by-step advancement.

The national phenotypic identification research facility is a pilot project of CAAS to support the construction of the Nanfan Silicon Valley. The project focuses on rice, maize, and cotton, and concentrates on major scientific issues of crop phenotypic interaction mechanisms and theories in field and controlled environments. It aims to construct a multi-environment, multi-dimensional, and full-growth-period phenotypic and genotypic large-scale precise identification platform, greatly enhancing China's independent innovation capabilities in the creation of excellent germplasm, mining of important genes, and breeding of major varieties. With a total construction area of 46 thousand square meters, it is equipped with field environment phenotypic identification facilities and a large-scale verification area. The construction site is located in Sanya, Hainan Province.


The national phenotypic identification research facility in Sanya

The Northern Rice Research Center is an important national-level scientific and technological innovation platform deployed in the Northeast China. It is also a major deployment of CAAS in the overall layout of national agricultural scientific research and the promotion of the development of the rice industry in the northern region. Focusing on the major strategy of national food security, the project concentrates on scientific research in 6 major areas: innovation of rice germplasm resources in northern China, breeding of new varieties, physiological and ecological research, cultivation technology innovation, soil fertilization and remediation research, as well as the research of common and key technologies in the development of the northern rice industry, helping to promote industrial upgrading, improve quality and efficiency. The total land area is approximately 274,000 square meters. The construction site is in Baoqing, Heilongjiang Province.

Northern Rice Research Center

The sketch of Seed Industry Innovation Center

The Seed Industry Innovation Center focuses on crops, livestock, and agricultural microorganisms. It undertakes the achievements of major upstream platforms such as germplasm resources, theoretical foundations, and phenotypic research. It concentrates on the middle and downstream of seed industry innovation, including breeding technology innovation, variety creation, improved variety reproduction and processing, and industrial incubation. It deeply integrates the two major resource elements of germplasm and information and builds a highland for applied basic research in biological breeding and strategic variety research and development, contributing to the construction of the "Nanfan Silicon Valley," a national tropical agricultural science center, and the Hainan Free Trade Port. The total construction area is 50,000 square meters. The construction site is in Sanya, Hainan Province.

The Agricultural Genomics Research Center is a concrete measure of CAAS to implement the development strategy of the Guangdong-Hong Kong-Macao Greater Bay Area. Aiming at major national needs such as food security, biosecurity, and ecological security, the project focuses on basic research such as genomics-led big data biology and synthetic biology, breaking through major scientific and cutting-edge technological issues in agriculture such as complex genome analysis, whole-genome design breeding, synthetic genomes, and artificial chromosomes. It promotes the interdisciplinary integration of genomics with agriculture, food, and other disciplines, becoming "the pillar of a great power" in the field of genomics research in China. The total construction area is 35,000 square meters. The construction site is in Shenzhen, Guangdong Province.

The sketch of Agricultural Genomics Research Center

The Northwest Center of the National Agricultural Biosecurity Science Center is an important fulcrum for CAAS to implement the strategy of "mobilizing the entire academy to aid Xinjiang." The project aims to find the resolution of major scientific and technological problems in the characteristic oasis agriculture of the western region, serve the major needs of agricultural production and industrial development in the western region, and build a pioneering zone for innovation-driven development with high-end resources and obvious innovation advantages. It forms a key common technology research and innovation support system that comprehensively covers four major agricultural industry clusters: grain and oil, cotton and textile clothing, green organic fruits and vegetables, and high-quality livestock products, and establishes a safety barrier in northwest China to prevent and control the invasion of alien species. The total construction area is 12,000 square meters. The construction site is located in Changji Hui Autonomous Prefecture, Xinjiang Uygur Autonomous Region.

The sketch of Northwest Center of National Agricultural Biosecurity Science Center

The Anyang Innovation Base is a major facility cluster and comprehensive scientific research platform deployed by CAAS outside Beijing, focusing on creating a collaborative development pattern for the Greater Beijing Area. The base undertakes the extension and expansion of disciplinary strengths in the fields of crops, plant protection, animal husbandry, and other areas in the Beijing region. At the same time, it deploys research and development platforms covering the entire industrial chain for regional key industries such as wheat, maize, oil crops, pigs, and broiler chickens. Following the overall layout of "one body, two wings, and multiple elements," it aims to build a first-class highland for agricultural science and technology innovation, a highland for rural revitalization demonstration, and a highland for the dissemination of agricultural civilization, comprehensively serving the high-quality development of agriculture and rural areas in the region and even the whole country. The first phase of the project has a total construction area of 80,000 square meters. The construction site is in Anyang, Henan Province.

The sketch of Anyang Innovation Base Phase I

The sketch of National Livestock and Poultry Gene Bank

The National Livestock and Poultry Gene Bank is an important project to promote the strategic preservation of livestock and poultry germplasm resources in China. Through innovations in ultra-low temperature preservation and breed monitoring with early warning technologies, it orderly connects introduction bases, regional gene banks, livestock and poultry conservation farms and reserves, and other live resource protection institutions, achieving an efficient protection system where live protection and genetic material preservation of livestock and poultry germplasm resources complement each other. It serves as both the foundation and the core of the national livestock and poultry germplasm resource protection system, promoting the rapid improvement of livestock and poultry breeding, basic research, industrialization development, and international competitiveness, becoming a world-leading and internationally first-class innovation center for livestock and poultry germplasm resources. The total construction area is 14,000 square meters. The construction site is located in Beijing.

The Nanfan International Cooperation and Exchange Center is an important project of CAAS to support the construction of the Nanfan Silicon Valley and build up an international cooperation and exchange platform. Focusing on major scientific and technological issues in national food security and seed industry innovation, it leverages the policy, resource, and location advantages of the Hainan Free Trade Port. With the "Belt and Road" international cooperation as a link, it carries out collaborative research in fields such as germplasm resource exploration and utilization, and biological breeding. It also promotes a new pattern of Nanfan breeding network with China's agricultural science and technology as the innovation core and the international agricultural production community of shared future in unity. The total construction area is 6,300 square meters. The construction site is in Sanya, Hainan Province.

The sketch of Nanfan International Cooperation and Exchange Center

The National Agricultural Microbial Gene Bank is committed to building a "Noah's Ark" for the protection and utilization of agricultural microbial germplasm resources in China, achieving diversified collection, large-scale preservation, systematic preservation methods, modernized preservation facilities, and intelligent resource management of germplasm resources. It will have the capacity to preserve 200,000 strains and 5 million copies of agricultural microbial strains, DNA, and microbial samples, and will be able to carry out precise identification and systematic evaluation of the stored resources, meeting the major needs of China's strategic reserve, basic research, production application, and international competition of agricultural microbial germplasm resources in the next 50 years. The total construction area is 12,000 square meters, and the construction site is in Tongzhou District, Beijing.

The national major scientific research facility for plant biosecurity resource preservation and utilization is committed to building a large-scale national-level resource preservation and utilization scientific research facility that integrates plant biosecurity resource collection and preservation, major theoretical innovation, tackling of "bottleneck" technologies, and high-quality talent cultivation. It will achieve systematic collection, diversified preservation, and intelligent management of plant biosecurity resources. It will have the capacity to preserve 245,000 living organisms, specimens, seeds, and 1 million copies of DNA/RNA genetic resources and other plant biosecurity resources, meeting the needs of China's basic research, technology research and development, and strategic resource reserve in plant biosecurity in the next 50 years. The total construction area is 18,900 square meters, and the construction site is in Changping District, Beijing.

The National Digital Collaborative Innovation Platform for Agricultural and Rural Development is committed to building a new data-intensive innovation platform that serves the fourth paradigm of agricultural scientific research, featuring open scientific research, independent security and control, and ubiquitous sustainability. It will construct a resource-intensive, flexibly scalable, and high-computing cluster computing system with a storage capacity of 10PB and a computing power of 20PFlops, develop general algorithms for agricultural scientific research and collaborate on scenario-based applications. It will help building intelligent and professional agricultural academic search engines, and provide strong support for agricultural scientific research in terms of "data + algorithms + computing power." The main construction content includes the purchase of software and hardware, as well as system development and integration. The construction site is in Haidian District, Beijing.

# KEY INITIATIVES

- **The Agricultural Science and Technology Innovation Program**
- **Strategy for International Cooperation and Development**
- **Talent Pool**

# 01 The Agricultural Science and Technology Innovation Program

The implementation of the Agricultural S&T Innovation Program (ASTIP) was further promoted. The construction of science centers was accelerated, focusing on the source theories in the field of agricultural and rural science and technology. 19 key tasks were selected and deployed to support young leading talents in conducting basic research. An annual reporting mechanism was established, and the "2022 Annual Report for the CAAS ASTIP" and the ten-year work summary were highly recognized by the Ministry of Finance. The research teams were optimized and adjusted, and research institutes were urged to strictly implement the chief succession mechanism. The average age of the chiefs of the research teams in CAAS was maintained at 48.7 years old, with young chiefs under the age of 45 accounting for nearly one-third of the total number of chiefs. Publicity for the ten years of the innovation project was carried out, and a press conference was held to release the themed promotional video and brochure titled “Progress and Impact of the ASTIP over the Past Decade”, which received widespread attention from competent departments, academy staff, and all sectors of society. Nearly 20 central media outlets reported it, significantly enhancing the social influence of the Program.

# 02. Strategy for International Cooperation and Development

## G2P International Mega Science Project

Promoting the Initiation of the G2P international mega science project, which was initiated and led by CAAS, has received widespread response and support from the "International Seed Industry Joint Center Construction" task of Beijing. The program has also garnered high attention and intended support from the Bill & Melinda Gates Foundation.


Ceremony of Scientists Initiating International Mega Science Project

## The 7th GLAST

With the theme of "Science and Technology Leading the Transformation of the Global Food System," the 7th Global Forum of Leaders for Agricultural Science and Technology (GLAST) was co-hosted by CAAS, the People's Government of Hainan Province, the Food and Agriculture Organization of the United Nations (FAO), the Consultative Group for International Agricultural Research (CGIAR), and the International Atomic Energy Agency (IAEA). The *Sanya Declaration* was released at the conference, with 49 countries and 13 international organizations actively responded, providing scientific and technological solutions to the transformation of agrifood systems and global challenges.


Hosting the 7th Global Forum of Leaders for Agricultural Science and Technology (GLAST)

## Active Participation in Global Food Security Governance

CAAS continues to strengthen cooperation with international organizations such as FAO, CGIAR, and the EU, participate in agricultural science and technology cooperative negotiations within mechanisms such as G20, APEC, and BRICS, and engage in international conventional negotiations and standard formulation or revision in areas such as climate change, pesticides, veterinary drugs, and food safety.


CAAS's experts attended the Meeting of Agricultural Chief Scientists of G20 States, as the representatives of China

## Steady Progess in South-South Cooperation

In collaboration with the African Academy of Sciences, CAAS initiated the China-Africa Agricultural Science and Technology Innovation Alliance, which has been incorporated into the "Plan for China Supporting Africa's Agricultural Modernization ; and released the initiative at the 2nd Forum on China-Africa Cooperation in Agriculture. CAAS is building an international cooperation system for agricultural science and technology along the borders and deepening agricultural science and technology cooperation with neighboring countries.


Announcement of the China-Africa Agricultural Science and Technology Innovation Alliance (CAASTIA) Initiative at the 2nd China-Africa Agricultural Cooperation Forum

Diplomats from 20 countries in Latin America and the Caribbean visited CAAS to experience China's agricultural science and technology achievements

## Greater International Influence

In 2023, CAAS hosted a total of 61 international conferences, with approximately 12,000 participants from all over the world attending through online and offline channels. Among them, conferences such as the "International Symposium on Sustainable Management of Fall Armyworm," the "International Symposium on Plant Biosecurity," and the "International Symposium on Dryland Agriculture" highlighted the characteristics of large scale, high level, and remarkable achievements, generating extensive influence in their respective disciplines.


2023 International Conference on Dryland Agriculture

International Symposium on Plant Biosafety


Global Symposium on Sustainable Fall Armyworm Management

CAAS successfully hosted 34 high-level delegations, continuously expanding its international influence.


Qu Dongyu, Director General of the Food and Agriculture Organization (FAO) of the United Nations, visited CAAS

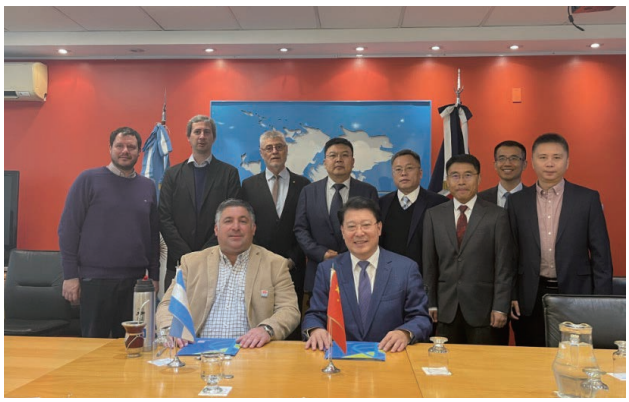

Bill Gates, Co-Chair of the Bill & Melinda Gates Foundation, visited CAAS


President of Maldives visited CAAS


Sisay Leudetmounsone, Politburo Member of the Central Committee, Secretary of the Secretariat, and Minister of Organization Department of the Lao People's Revolutionary Party, visited CAAS

## Partnership Building

Through various forms of agricultural science and technology innovation cooperation with major agricultural countries in Europe and Latin America, CAAS has deepened "Belt and Road" agricultural science and technology cooperation, reaching consensus in multiple areas including cutting-edge technology research, technology demonstration, industrial cooperation, and talent training.



CAAS Signed an MoU with the National Agricultural Technology Institute of Argentina

A CAAS delegation visited German research institutes

# 03. Talent Pool

## Talent Program

The high-level talent group continues to grow. Two talents were newly promoted to the top-level, 66 individuals were selected for national-level talent programs, one person received the first "National Engineer Award" ,and 41 urgently needed high-level talents were introduced. 182 individuals were newly promoted to professors, and 279 to assistant professors. 42 individuals were newly appointed to the position of level-two professional technics, and 108 to level-three professional technics.

The "Agricultural Science Talent" brand program was optimized and upgraded. The "Management Measures for the 'Agricultural Science Talent' Program of the Chinese Academy of Agricultural Sciences (Trial)" was issued, further optimizing the talent development system, resource allocation structure, and assessment and selection methods. The new round of academy-level selection for agricultural science talents was completed, with the total number exceeding 460; 12 individuals who completed the second batch of the program were rated as excellent, and 17 individuals were withdrawn or adjusted for support, achieving dynamic talent management.

Comprehensive support was provided for the cultivation of young talents. The "Youth Far-Reaching Plan" was implemented, sending 27 outstanding talents to world-class universities and colleges for collaborative research.

## Graduate Education

CAAS has 5 A+ disciplines, including Crop Science, Horticulture, Plant Protection, Animal Science, and Veterinary Medicine; 2 A disciplines, including Biology and Agricultural Resources and Environment; and 2 A- disciplines, including Ecology and Food Science and Engineering. B+ and above disciplines account for 75% of all first-level disciplines. In addition, the Agricultural Professional Degree is rated A. There are currently 2,781 graduate supervisors, including 1,079 doctoral supervisors.

CAAS holds a graduate education management work conference

The enrollment scale has steadily expanded, and the structure of student sources has continued to optimize. The enrollment quotas for master's and doctoral students have increased by 55 and 38, respectively,

compared to the previous year. CAAS is creating high-quality textbooks with agricultural science characteristics, and 30 textbook construction projects, such as "Crop Germplasm Resources," have been approved in the first batch. Seizing major opportunities for education reform, CAAS actively seeks support from the Ministry of Education, the Ministry of Agriculture and Rural Affairs, and the Henan Provincial Party Committee and Provincial Government. It has taken the lead in collaborating with 25 high-level agricultural universities to initiate the construction of the China Modern Agriculture Joint Graduate School, promoting the integration of industry and education, as well as science and education, and creating a new highland for the education and training of high-level agricultural talents.

International students visited the National Agricultural Science and Technology Innovation Park

In last year, 1,370 degrees were awarded (including 342 doctoral degrees and 1,028 master's degrees). In the 2020—2021 academic year, all CAAS sample dissertation met requirements of the national doctoral dissertation sampling inspection, maintaining a record of passing all sampling inspections for six consecutive years. Three doctoral dissertations were awarded the 2023 Beijing Outstanding Doctoral Dissertation Award. CAAS organized and guided students to participate in national-level graduate practical innovation competitions, such as the First Rural Revitalization Volunteer Service Skills Competition, the Second China Graduate "carbon peak and neutrality targets" Innovation and Creativity Competition, the 20th Graduate Mathematical Modeling Competition, and the Second China Graduate Cybersecurity Innovation Competition with excellent results.

CAAS cultivates high-level internationalized talents who are knowledgeable and friendly to China. There are 319 international students on campus, covering 41 majors and coming from 51 countries worldwide. The scale of doctoral international students ranks among the top domestic universities. In 2023, 77 international students were admitted, with the number of Chinese Government Scholarship recipients increasing by 36.9% compared to 2022, and the number of Beijing Government Scholarship for International Students increasing by 18.5%. The National Nanfan Research Institute (Sanya) and the Western Research Institute enrolled international students for the first time. One Ethiopian alumnus was promoted to the position of university president. The third phase (2022-2026) of the China-Belgium project was approved by the Ministry of Education. In 2023, 40 doctoral students were admitted to the China-foreign cooperative doctoral degree education project, with high-quality students from domestic and foreign universities accounting for 77.5%. A 2022 China-Belgium project doctoral student, as a team leader, won the grand prize of the "Transformative Research Challenge (TRC)" of the Food and Agriculture Organization of the United Nations, marking the first time a Chinese team entered the finals and won an award. CAAS signed 6 cooperation agreements and memorandums with foreign universities and research institutions.

International students experienced traditional Chinese Spring Festival culture

## Postdoctoral Work

Last year, 244 postdoctoral researchers were admitted, and the number of postdoctoral researchers on campus exceeded 820. In 2023, postdoctoral researchers in the academy received 154 fund grants of various types, with a total funding amount of 32.73 million yuan. Postdoctoral researchers, accounting for 26.2% of the young scientific research personnel in CAAS, obtained 47.2% of the academy's youth projects. The Lanzhou Veterinary Research Institute was approved to establish a postdoctoral research station, and the Institute of Urban Agriculture was approved to establish a Sichuan provincial postdoctoral innovation and practice base.

## International Talent Team

CAAS has 105 experts holding senior management positions in international organizations, and 414 experts serving as editors-in-chief or in other editorial roles for internationally renowned journals. CAAS has stationed seven diplomats in overseas institutions and international organizations, playing crucial roles in multilateral agricultural negotiations, "Belt and Road" initiatives, major bilateral project implementations, and high-level visits, providing strong support for bilateral and multilateral diplomacy and scientific cooperation.

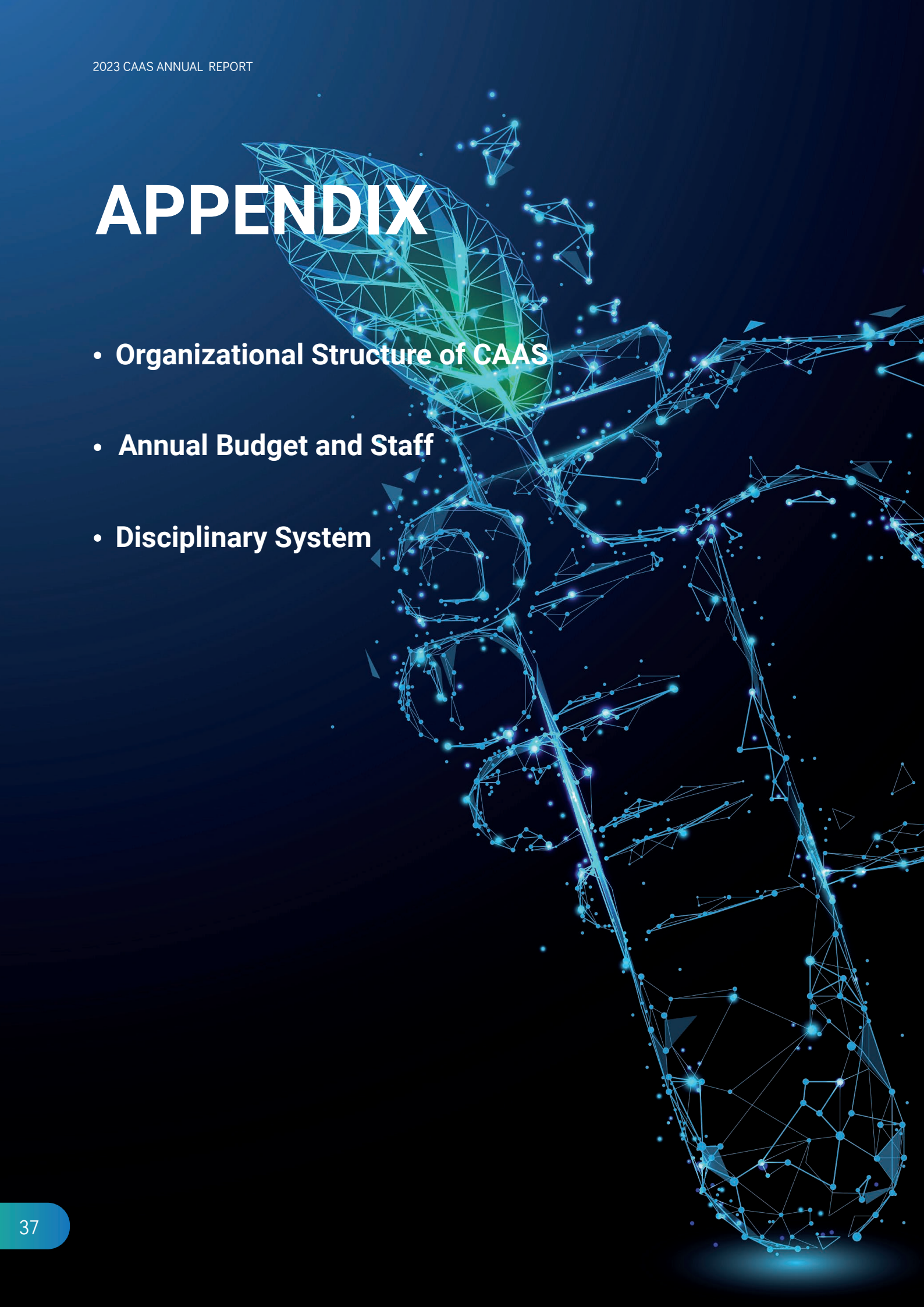
CAAS appointed prominent international experts, including former President of the African Academy of Sciences, Dr. Felix Dakora, as a visiting researcher, among others. CAAS successfully obtained approval for 16 projects related to foreign experts.

CAAS achieved new breakthroughs in international talent training and dispatch, launching our "Young Voyager Program," which funded 27 individuals with a total amount of 24.18 million yuan. CAAS organized the selection of candidates for the 2023 Innovative Talent International Cooperation Training Program in animal husbandry and plant protection disciplines, with 20 people receiving funding and 85 projects approved under the national government-sponsored overseas study program.

Throughout the year, CAAS organized 331 official overseas (including Hong Kong, Macao, and Taiwan) delegations, involving 717 participants, and invited 464 foreign guests, totaling 606 visits.

# APPENDIX

- Organizational Structure of CAAS
- Annual Budget and Staff
- Disciplinary System



# Organizational Structure of CAAS

## President

## Secretary of Leading Party Group

## Vice-Presidents

### Administrative Departments

- General Office
- Department of Research Management
- Department of Personnel
- Department of Finance
- Department of Development and Construction
- Department of International Cooperation
- Department of Technology Transfer
- Department of Major R&D Programs
- CAAS Party Committee
- Department of Supervision

- Graduate School of CAAS

### Research Institutes in Beijing

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

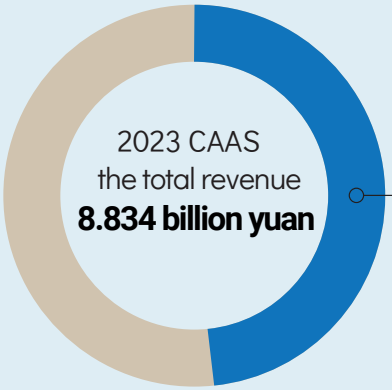
- China Agricultural Science and Technology Press Ltd.

### Research Institutes outside Beijing

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

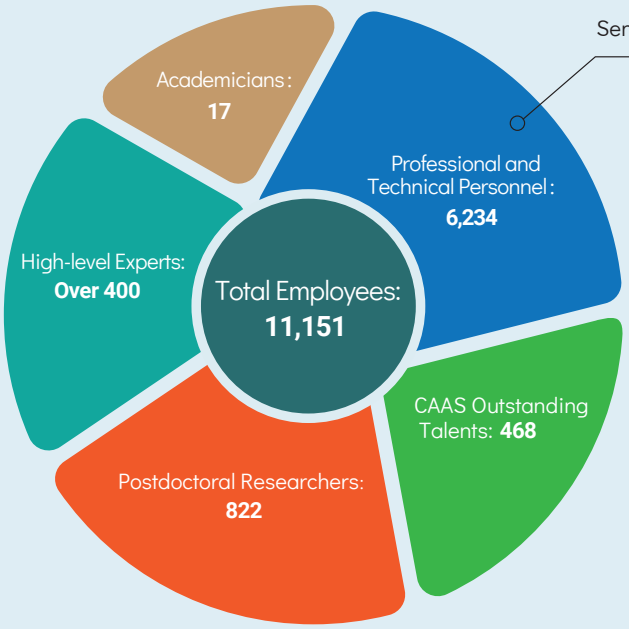
# Annual Budget and Staff

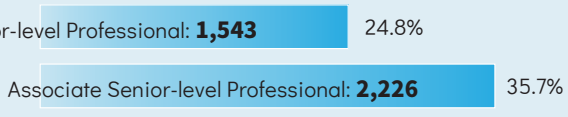
In 2023, the total revenue of CAAS reached RMB 8.834 billion yuan, among which 3.925 billion yuan was allocated from fiscal budget.

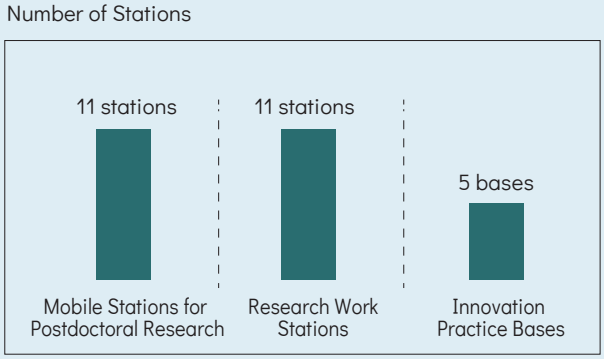



Among which 3.925 billion yuan was allocated from fiscal budget.

There are a total of 11,151 employees in CAAS, among which 6,234 are professional and technical personnel,including 1,543 senior-level professionals and 2,226 associate senior-level professionals, accounting for 24.8% and 35.7% of the total professionals respectively. CAAS also has 17 academicians, over 400 high-level experts, and 468 CAAS Outstanding Talents. There are 11 mobile stations for postdoctoral research and 11 research work stations, together with 5 innovation practice bases.



# Disciplinary System

The disciplinary system is more and more robust. By focusing on basic research, key areas and rural studies, the entire disciplinary system was rebuilt, prioritizing disciplines that are of strategic importance, such as Agricultural Microbiology, Biosecurity, Rural Development, and Rural Energy. A new disciplinary system comprising 283 research directions out of 58 academic fields of 11 major clusters of disciplines was established.

## Brief table of disciplinary setting of CAAS (2023)

| Cluster of Disciplines (11) | Academic Field (58) | Major Direction (283) |
|---|---|---|
| **Agricultural Basic and Frontier Research** | 4 Academic Fields including basic theoretical research | 26 Major Directions including basic research on agricultural biological classification |
| **Crop Science** | 5 Academic Fields including crop germplasm resources | 47 Major Directions including the collection and conservation of crop germplasm resources |
| **Horticulture** | 4 Academic Fields including horticultural crop germplasm resources | 20 Major Directions including collection, conservation, identification and assessment of vegetable germplasm resources |
| **Plant Protection** | 6 Academic Fields including plant diseases and insect pests | 19 Major Directions including epidemic detection and control of grain crop diseases |
| **Agricultural Resources and Environment** | 6 Academic Fields including farmland and soil | 22 Major Directions including soil fertilization and improvement |
| **Animal Sciencet** | 5 Academic Fields including animal germplasm resources | 27 Major Directions including collection, conservation, identification and assessment of livestock germplasm resources |
| **Veterinary Medicine** | 6 Academic Fields including animal diseases | 21 Major Directions including avian diseases |
| **Agricultural Microbiology** | 4 Academic Fields including agricultural microbial germplasm resources | 16 Major Directions including collection, conservation, identification and assessment of agricultural microbial germplasm resources |
| **Agro-product Quality and Processing** | 5 Academic Fields including agricultural quality standards and testing | 25 Major Directions including agricultural quality standards and standard substances |
| **Agricultural Equipment, Engineering and Information** | 6 Academic Fields including agricultural machinery and equipment | 25 Major Directions including planting machinary |
| **Agricultural Economics and Rural Development** | 7 Academic Fields including Agricultural Economics | 35 Major Directions including Agricultural Technology Economic Theory |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