Status and Perspective of Crop Science Research in CAAS

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Outline

- **1.** General crop production in China
- **2.** Crop science research in ICS-CAAS
- **3.** Recent progresses in ICS-CAAS
- 4. Major challenges to be tackled

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China: providing sufficient food for 1.3 billion people is always a big task ...

7% farmland; 22% world population

Major staple food crops in China

Crops	Area (Mha)	Yield (kg/ha)	Production (Mt)	% World
Maize	38	5891	224	23
Rice	30	6892	208	27
Wheat	24	5392	130	17

Wheat: yield and total production in China in the last 65 years



Maize: Yield and total production in China in the last 65 years



Comparison of crop yields between USA and China



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Core research areas in ICS-CAAS



700 researchers + 400 graduate students

Major funding sources

- Ministry of Science and Technology
- Ministry of Agriculture and Countryside
- National Natural Science Foundation
- Industry projects and returns
- Others (International Corporation Program, etc.)

Rolling budget: 80 million US\$/year

National Crop Gerplasm Bank hosted by ICS-CAAS





- 480,000 accessions in 350 crops including staples, oil, vegetables, fibers, and flowers
- 80% are from China
- 18,000 maize and wheat lines from CIMMYT
- 1000 lines donated to CIMMYT

Greenhouse faculties







Field experimental stations

- Changping,Beijing
- Shunyi, Beijing
- Langfang, Hebei
- Xinxiang, Henan
- Gongzhuling,Jilin

Hainan Station



- Nanbin, Hainan
- Yuanmou, Yunnan
- Guyuan, Hebei

Changping Station

The state of the

+ over 1000 field trial locations

Xinxiang Station

Scientific achievements: patents



Scientific achievements: new varieties



Scientific achievements: research papers



2017: 396 research papers, 261 in SCI journals

High-profile articles published by ICS-CAAS in the last 5 years

Journal types	Journals	Papers
	Nature	2
	Science Nature Biotechnology	1 3
	Nature Genetics	3
General	Nature Communications	3
	Developmental Cell	1
	PNAS	4
	Plant Cell	10
	Plant Physiology	9
	New Phytologists	9
	Plant Journal	10
Plant & crop sciences	Genome Biology	1
	Current Opinion Plant Biology	1

Nationally

- We collaborate with almost every provisional and regional agricultural research institutes and agricultural universities
- Provide fundamental and technical supports to their breeding and crop management
- Varieties developed by ICS-CAAS are licensed to over 100 seed companies
- We provide trainings to many farmers, to penetrate with optimal crop management skills

Internationally

- We have strong collaboration ties with CIMMYT, JIC, IRRI, Wageningen University, UC Davis, CSIRO
- With supports from Gates Foundation, we provide supports to many developing countries for developing "green super-hybrid rice"
- We have collaborations with international seed companies such as Monsanto, DOW, Syngenta, Dupont

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Recent progresses-1: Utilization of *Agropyron gaertn* to improve wheat

- A. gaertn: a close relative of wheat that carries the P genome.
- A good trait donor for wheat: large number of grains per spikes, broad-spectrum resistance, strong abiotic stress tolerance



A natural habitant in Gobi Desert

>300grains/panicle



increased grain number



high fertilizer use efficiency

91 new materials are developed by using remote hybridization
Important traits: increased grain numbers, high quality, disease and drought resistances, and high fertilizer use efficiency



Mianmai 367

Chuanmai 93

Chuanmai 93:

- Average grain number per spike was 54.2, which is 6.3 grains more than the control "Mianmai 367".
- Yield increase is 16.7%

Recent progresses-2:

Wheat genomics and gene discoveries



Genome-wide wheat variation map and characterization of genetic network regulating flowering time

Nature, 2013; Plant Cell, 2014; Nat Commun, 2016

Recent progresses-3: Stragalectone-sensing gene P53 in rice architecture



Nature, 2013

Recent progresses-4: Cloning of a brown planthopper resistance gene from rice





Nature Biotech, 2015

Recent progresses-5: Deep-sequencing of 3,010 Asian cultivated rice genomes



Nature (Article), 2018

Recent progresses-6: Construction of soybean pan-genome and analysis transition from vegetative to reproductive growth



Nature Biotechnology, 2014; Mol Plant, 2016

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Recent progresses-7: identification of rice cultivars with higheryield & lower methane output



Increasing biomass by 10%, reduced annual CH₄ emissions by 7.1%.

Jiang et al., Global Change Biology, 2017.



Wheat Zhongmai 175:

- High yield and good quality, high water use efficiency, wide adaptability
- National release right is granted
- Total growing in 2017 409,000 hectares





Maize Zhongdan 808/909

- Two varieties suitable for south-west China
- Planted over 2,300,000 ha so far
- Zhongdan 909of is one of the top-ten varieties in the country.



Zhonghuang13

Zhonghuang35

Zhonghuang13: the most cultivated soya variety in China

- Reached 400, 000 ha in 2017, accumulated cultivation areas over 5.3 million ha
- Zhonghuang35 has the national highest yield: 421.37kg/mu



Jianggeng 1 rice:

- Early maturity, good quality, high yield potential
- Resistant to cold, lodging and major diseases, fast in grain filling, high seed-setting rate

Mung bean Zhonglv 14



Millet Zhonggu 2 and Zhonggu 5



Barley Zhongsi 1



Recent progresses-9: Development of GM crops



Non-GM Corn

Bt Corn

Recent progresses-9: Development of GM crops



Herbicide-resistant soybean

increased yield: 5%; increased fat: 21%, lower weeding cost: 70%.

Recent progresses-9: Development of GM crops



Drought-resistant transgenic wheat

Increase water use efficiency by 16% and yield by 15%.

Recent progresses-10: Optimization of production technology



 Integration of dense planting, selection of high-yield and lodging-resistant cultivars, all-machine handling and green production technology
National yield record: 22.76 tons/ha (Hybrid MC670)

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Major challenges-1: Commercial application of clean production technology with herbicide and insect resistant crops



Major challenges-2: Development of multi-location, field-based phenotyping facility for trait characterization, gene discovery, precise breeding and optimized crop management



Major challenges-3: Development of hybrid varieties for wheat and soybean



Major challenges-4: Development of resilience crop varieties with stable yield and healthy features (higher nutrition and dietary fibers, less toxins, PHS-resistant)



Thank you!

