CNRRI’s Strategy for Development and International Cooperation

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Outline

◆ Brief Introduction
◆ Research Development in rice
◆ International Cooperation
◆ Future Cooperation Strategies
Basic Information

- Established in 1981 approved by the Chinese State Council.

- **Mission:** *To contribute to food security, nutrition improvement, environment protection, and poverty elimination in China through rice research.*

- About 400ha arable land, 411 staffs (205 senior and middle level scientists).
Organization Structure
June 2014

Administrative Branch
- General Affairs Division
- Human Resources Division
- Program Management & International Cooperation Division
- Finance Division
- Science & Technology Transfer Service Division
- Construction & Logistic Service Division

Director General
Deputy Director General

Research Branch
- China National Center for Rice Improvement
- State Key Laboratory of Rice Biology
- Research and Development Center of Rice Cropping Technology
- Rice Product Quality Inspection & Supervision Testing Center of MOA
- Rice Science & Technology Information Center

Other Branches
- Zhejiang Guodao Hi-tech Seeds Co. Ltd
- Experimental Farm
Major Responsibility

- Coordination of priority rice research programs throughout the country.
- Conducting national and international training and scientific & technical exchange.
- Compiling & publishing academic journals and books on rice.
Resistance breeding
Grain quality breeding
Heterosis utilization
Molecular breeding
Breeding technology

Functional genomics
Genetic engineering
Biological information
Resistance germplasm
Environmental biology

China National Center for Rice Improvement

National Key Laboratory for Rice Biology

Rice physiology
Rice ecology
Biodiversity
Crop protection

Rice Production Quality Inspection and Supervision Testing Center, MOA

R & D Center for Rice Cropping Technology
Rice S & T Information Center

- Rice library
- Rice website
- Publication
- Rice economics
Rice Germplasm Support

Largest rice gene bank in China

Storage entries: 70,000
Stress tolerance evaluation: 24,000,
Pest resistance evaluation: 56,000
Rice Technology Support
Facilities & Equipment Support

Largest phytotron in Asia— to simulating natural daylength and temperature
Rice information Support

http://www.chinariceinfo.com/

http://www.ricedata.cn/

http://www.shuidao.cn/

Library

Rice Science, Chinese Rice Science etc

Book
Major Rice-specific International Journal

Sponsor: CNRRI
Publisher: Elsevier
Editor-in-Chief: Dr. Shihua Cheng

Aim: To provide a forum for (1) Important advances in rice research, (2) Communication of the rice scientists, (3) Maintenance of food safety.

Type: Original articles, Reviews, Short communications

Indexed/Abstracted: ESCI, Scopus, CAB Abstracts, CSCD

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www.ricescience.org
Knowledge Transfer Support

Training Internship Ph.D/ Master
12 Countries 32 International students (2014-2017)
Science & Technology Service System
Testing Station of CNRRI

Provincial Testing Station

Testing Station of Zhejiang Province
Science & Technology Service System
100 experts 100 counties plan

16 provinces 110 counties or cities
Based on the development demand of the rice industry, gather quality resources, conduct generic & key technology research, integration, test and demonstration; Collect and analyze dynamics and information of the rice industry and its technology development, systematically deliver industrial technology development planning and industrial economic policy research, provide consultations for government decision making and information service for the society; Carry out technology demonstration and service.
National Rice Industrial Technology System

System Structure

- National Rice Research & Development Center, CARS
- Division of Rice Breeding and Seed Production
- Division of Disease, Pest and Weed Control
- Division of Soil, Fertilizer and Rice Cultivation
- Division of Rice Mechanization
- Division of Rice Processing
- Division of Rice Industrial Economy
- 35 Principal experts
- 46 comprehensive experiment stations
- 550 demonstration bases
- 700 plus supportive technical backbones

NRRDC, CARS Coordination Organization: China National Rice Research Institute
Achievements (until to 2016)

• 95 research achievements awarded by Chinese state (12) or provincial government (83)


• 208 rice varieties released
Research Development
11 Breeding Research Teams

- Molecular Breeding
- *Indica-Japonica* Hybrid Rice Breeding
- High-quality Rice Breeding
- Japonica Rice Breeding
- Three-line Hybrid Rice Breeding (2 Teams)
- Germplasm Preservation and Evaluation
- Gene Mapping and Cloning
- Germplasm Innovation and Utilization
- Two-line Hybrid Rice Breeding
- New Breeding Technology
- Early-season Rice Breeding
Varieties Released (2009-2016)

[Bar chart showing the release of conventional and hybrid rice varieties from 2009 to 2016. The chart indicates the number of varieties released each year, with a peak in 2015 with 17 varieties.]
## Series dominant Varieties (2005-)

<table>
<thead>
<tr>
<th></th>
<th>Varieties</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Guodao</strong></td>
<td>Guodao 1, Guodao 3, Guodao 6, <strong>Guodao 7</strong>, Guodao 8, Guodao 9 ……</td>
</tr>
<tr>
<td><strong>Zhongjiazao</strong></td>
<td>Zhongjiazao 32, <strong>Zhongjiazao 17</strong>, Zhongjiazao 66, ……</td>
</tr>
<tr>
<td><strong>Zhongzao</strong></td>
<td>Zhongzao 22, Zhongzao 25, Zhongzao 27, Zhongzao 31, Zhongzao 35, Zhongzao 38, <strong>Zhongzao 39</strong> ……</td>
</tr>
<tr>
<td><strong>Zhongzheyou</strong></td>
<td><strong>Zhongzheyou 1</strong>, Zhongzheyou 2838, Zhongzheyou 634, Zhongzheyou 8, Zhongzheyou 86, Zhongzheyou 10……</td>
</tr>
<tr>
<td><strong>Huazhan</strong></td>
<td>TianyouHuazhan, ZhongpuyouHuazhan, ChuanyouHuazhan, YueyouHuazhan, BoyouHuazhan, YiyouHuazhan, XinyongyouHuazhan, BinyouHuazhan, ZhongbaiyouHuazhan, ZaofengyouHuazhan, BollyouHuazhan, RongyouHuazhan, ZhongguyouHuazhan……</td>
</tr>
<tr>
<td><strong>Chunjiang</strong></td>
<td>Chunyou 2, ChuanJiang026, ChuanJiang063, Chunyou58, Chunyou59, Chunyou172, Chunyou 658, <strong>Chunyou 84</strong>, Chunyou927……</td>
</tr>
</tbody>
</table>
Super Early-season Rice: Zhongjiazao 17

- Largest extension area in the south of China
- Second-Largest extension area in China
- Dominant Variety Named by MOA, China (2009-2017)
Quality rice breeding

- Widely used in the Yangtze river region in China (545 million ha)
- Good quality / short duration
  High yielding
Aromatic rice breeding

- High quality
- Good yielding
- Aromatic
- 70% market in the southern of China
Conventional rice breeding

- Zhongjiazao 17
- Zhongjiazao 32
- Zhongzao 22
- Zhongzao 35
- Zhongzao 39
- ......

High yield, short duration, Super conventional rice
Hybrid rice breeding

- Hybrid rice breeding
- Super hybrid rice breeding

Wild rice  

Hybrid rice
Utilization of international germplasm for restorer resource in hybrid rice breeding

Milyang46-Korea

Shanyou10
(ZS97A /Milyang46)
Xieyou46
(XQZ A/Milyang46)

Shanyou10 and Xieyou46, two popular hybrid rice varieties in southern China, 10 mha of total planting area
## Direct or indirect use of international germplasm in CNRRI’s hybrid rice breeding

<table>
<thead>
<tr>
<th>Hybrid/parents</th>
<th>Germplasm</th>
<th>Use</th>
<th>Origin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shanyou 10</td>
<td>Milyang 46</td>
<td>R-line</td>
<td>Korea</td>
</tr>
<tr>
<td>Xieyou 10</td>
<td>Milyang 46</td>
<td>R-line</td>
<td>Korea</td>
</tr>
<tr>
<td>Zhongzhe A</td>
<td>PS-21</td>
<td>B-line</td>
<td>India</td>
</tr>
<tr>
<td>ID-CMS line</td>
<td>Indonesia 6</td>
<td>Parent of B-line</td>
<td>Indonesia</td>
</tr>
<tr>
<td>R9308</td>
<td>IR26</td>
<td>Parent of R line</td>
<td>IRRI</td>
</tr>
<tr>
<td>R8006</td>
<td>IRBB60</td>
<td>Parent of R-line</td>
<td>IRRI</td>
</tr>
</tbody>
</table>
Development of ID-CMS type used in hybrid rice breeding

![Graph showing area (% in hybrid rice) over years from 1996 to 2006 for WA-CMS, G&D-CMS, and ID-CMS.]
High grain quality in ID-CMS line comparing to WA-CMS line

<table>
<thead>
<tr>
<th>Trait</th>
<th>1st generation CMS line</th>
<th>2nd generation CMS line</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Zhenshan97 A</td>
<td>Zhong 9A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Chuangxiang29A</td>
</tr>
<tr>
<td>B line</td>
<td>Zhenshan97</td>
<td>Zhong9B</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Chuanxiang29B</td>
</tr>
<tr>
<td></td>
<td>(You1B/L301B/FeigaiB)</td>
<td>(II32A/Xiangsimiao)</td>
</tr>
<tr>
<td>Grain length/width ratio</td>
<td>2.3</td>
<td>3.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.4</td>
</tr>
<tr>
<td>Chalky grain percentage</td>
<td>84.0</td>
<td>8.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>48.0</td>
</tr>
<tr>
<td>Chalkiness (%)</td>
<td>16.6</td>
<td>0.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10.8</td>
</tr>
<tr>
<td>Translucency</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>
High outcrossing in ID-CMS line comparing to WA-CMS line

<table>
<thead>
<tr>
<th>Trait</th>
<th>1st generation CMS line</th>
<th>2nd generation CMS line</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Zhenshan 97A</td>
<td>Zhong 9A</td>
</tr>
<tr>
<td>CMS resource</td>
<td>WA</td>
<td>ID</td>
</tr>
<tr>
<td>Exserted stigma (%)</td>
<td>39.6</td>
<td>82.3</td>
</tr>
<tr>
<td>Outcrossing seed setting (%)</td>
<td>35.7</td>
<td>75.6</td>
</tr>
<tr>
<td>Seed yield (t/ha)</td>
<td>2.2-3</td>
<td>3.0 - 4.5</td>
</tr>
<tr>
<td>No. of hybrids released</td>
<td></td>
<td>112</td>
</tr>
</tbody>
</table>
More than 200 hybrids released, 27 mha
Super hybrid rice breeding

- Enhancing the genetic diversity of parents-----hybridization between *indica* and *japonica*

- Selecting plant type for increasing photosynthesis efficiency

- Molecular-assisted selection on disease resistance
Xieyou9308, 12.2 t/ha
Zhejiang, 2000
Farmers’ words:
Ideo-plant type, good quality and high yielding

Top 5 planting area of rice in China
Root system selection

Selecting plant type for increasing photosynthesis efficiency----synchronously considering both above-ground and under-ground traits.
Guodao 6, 13t/ha, Zhejiang, 2006
Pyramid of disease resistant genes using MAS

xa5

Xa7

xa1

Xa21

Xa23
R8006

Xa21+Pi25
Released hybrid:
Guodao 1

R8012

Xa25+Xa21
Released hybrid:
Guodao 9
Molecular basis research on high yield in rice

Mono-tillering gene

(moc1, chr.6)

Nature 2003, 422: 618-621
National Second Award for Natural Science (2005)

Molecular Basis on Plant Type Formation
National Second Award for S&T Progress (2010)

Development of important germplasm in rice
Direct seeding

Throwing-seedling

Machine direct seeding technology
Rice mechanical transplanting technology of pot-mat seedling

It obtained 9 national invention patents and 13 utility model patents and applied for over 3 million hectares in 2016.
Water saving technology

Wheat-like Cultivation Technology

Development of Water saving Technology
Rice-duck farming technology
CNRRI’s varieties and techniques covered annually 10 mha of rice field in China
For more information

International Cooperation
30 MOA /MOU
(2009-2017, 12 countries)
Major Cooperation Area

- Collection, evaluation and utilization of rice germplasm
- Screening and Breeding of rice varieties (including hybrid rice) for abroad
- Rice molecular biology technology such as new gene detecting, mapping, genomics, MAS breeding system, etc
- Rice cultivation technology including high yield cultivation technology, machinery planting technology, etc
- Testing or certification services for agri-product including pesticide, bio-fertilizer, etc.
Cooperation Platform

• China-IRRI Joint Research Center on Rice Quality and Nutrition (2005, China)
• Asia Agricultural Technology Transfer Center (2015, Indonesia)
• CNRRI-Biogene Joint Research Center (2016, Indonesia)
• Sino-Pakistan Hybrid Rice Research Center (2017, Pakistan)
• China National Rice Research Institute Rice Test Center in Cambodia (2017 or 2018, Cambodia)
• More……
Cooperation Platform

International S&T Cooperation Base (2009, MOST)

National Demonstration Base for introduction of Intelligence (2002-2017, State Administration for Foreign Affairs)

National Demonstration Organization for introduction of Intelligence (2012-2017, SAFA)
Future Cooperation Strategies
Priorities for Collaboration

1. Abroad application of hybrid rice technology

- Hybrid rice breeding
- Seed production technology of hybrid rice
- Cultivation technology for hybrid rice

2. Functional genomics of important agronomic traits

- Genetic and molecular mechanisms of important agronomic traits of rice
- Design molecular modules for breeding of these traits
- Establish high-performance rice molecular breeding gene chip;

3. Development of new breeding technology such as whole genome designing breeding of rice for creating backbone breeding parents
Cooperation Pattern

1. Information Exchange

- Mutual visiting (leaders, administration Officials, experts)
- Joint academic activities (discussion, seminar, workshop, conference)
- Joint initiatives
- Publication exchange

2. Joint Research

- Joint project or program (bilateral, multi-lateral) from domestics, two countries, international organizations
- Joint research center or the other platform
- Entity enterprise
Cooperation Pattern

3. Technology Transfer & Education

- Abroad adaptation test (varieties & technology)
- Training (Researchers, technicians, farmers)
- Education such as PhD/MS

4. Network for research, technology sharing & information exchange (high-level)

- Country X Country (Specific Areas)
- Country X Country (General Areas)
- Country X International Organization
- Country X Private Sector/NGO

5. Other Possible Pattern……
Thank you!