

Milestone of hybrid rice at IRRI

- 1972, IRRI started hybrid rice research
- 1979, IRRI revived hybrid rice research
- 1979, IRRI-China started collaboration on
- hybrid rice • Since 1980's, IRRI provided 90% of Chinese
- restorer lines directly or indirectly1982, Yield advantage of rice hybrids in the
- tropics confirmed 1990s, India & Vietnam started hybrid rice
- programs with IRRI
 Since 1994, commercial hybrids released in India, Philippines, Vietnam with IRRI parents





| Country | Bangladesh | India | Indonesia | Philippines | Vietnam | Total | China |
|--------------------------|------------------|------------|------------|---------------|-----------|--------|--------|
| Total Rice | 11,200 | 44,000 | 12,165 | 4,250 | 7,305 | 78,920 | 29,23 |
| Irrigated Rice * | 4,263 | 22,665 | 7,037 | 2,801 | 3,904 | 40,667 | 27,004 |
| Hybrid Rice ** | 300 | 1,100 | 130 | 341 | 650 | 2,521 | 19,00 |
| HR % of Irrigated Rice | 7.0 | 4.9 | 1.8 | 12.2 | 16.6 | 6.2 | 70.4 |
| * http://www.irri.org/su | cience/ricestat/ | /data/may/ | 2008/WRS20 | 108-Table30.p | <u>df</u> | | |

Mission of IRRI Hybrid Rice Program

- Development of germplasm, parents and hybrids as internationally public goods
- Research on technology for breeding and seed production
- Collaboration with NARES and private sector in hybrid rice research and production
- Promotion of exchange of information, technology, scientists and germplasm
- Training and Capacity building

Strategy of IRRI Hybrid Rice Program

- Focusing on conventional tools and integrate them with proven non-conventional methods to develop the technology
- Developing parental lines, especially female parents with high outcrossing to promote hybrid rice production
- Facilitating development of close partnership with public and private sectors
- Intensifying agronomic research to get maximized manifestation of heterosis in hybrids

Hybrid rice research priorities at IRRI

- Increase and stabilize yields of seed production
- Enhance yield heterosis in both dry and wet seasons to >20%
- Improve hybrid rice grain quality
 - Reduce chalk
 - Increase head rice recovery
- Improve resistance to biotic stresses
- Develop hybrids for unfavorable environments
- Improve breeding efficiency (biotech)

Utilization of IRRI hybrid rice germplasm

<u>1994-2005</u>

- 12 IRRI hybrids released in India, Indonesia, Philippines, Vietnam, and Bangladesh
- IRRI-bred CMS lines were used as hybrid parents and released by NARES (12) and the private sector (6)

| | | | | 1/10/02/14/03 | 1010 U COV P. | | 011000000000 |
|---------------|----------|-------------|------------------|---------------|---------------|-------------|--------------|
| IRRI Hybrid R | ice Germ | plasm Share | ed with NAF | RES and F | Private Sec | tors from 2 | 004 to 2007 |
| Arconting | 0 | C C | Peter struct the | TOTAL | rigonia | Contents | 16 |
| Australia | 13 | 13 | | | 7 | | 33 |
| Bandadesh | | | 11 | | 65 | | 192 |
| China | 17 | 30 | 54 | 3 | 14 | | (118) |
| Eavot | 3 | 3 | | | | 1 | \sim |
| India | 175 | 175 | 269 | 34 | 68 | 8 | (729) |
| Indonesia | 5 | 5 | | | 23 | 1.000 | 33 |
| tran | 16 | 16 | 27 | | 14 | | 73 |
| Japan | 6 | 8 | | | | | 12 |
| Kenva | 21 | 21 | 62 | 7 | | | 111 |
| Korea | | | | | 1 | | 1 |
| Laos | | | | | 4 | | - 4 |
| Malaysia | 5 | 5 | 10 | -4 | | | 24 |
| Myanmar | 7 | 7 | 21 | | 17 | | 52 |
| Nepal | 14 | 12 | 3 | | | | 29 |
| Nigeria | | | | | 29 | | 29 |
| Pakistan | 13 | 13 | 8 | 11 | | | 45 |
| Philippines | 72 | 64 | 107 | 14 | 153 | | (410) |
| Russia | 8 | 8 | 7 | | 17 | | 40 |
| Rwanda | | | | | 5 | | 5 |
| Sri Lanka | 10 | 10 | | | 16 | | 36 |
| Thailand | 19 | 19 | 22 | 10 | 13 | | 83 |
| USA | 13 | 13 | 6 | | 3 | | 35 |
| Venezuela | 27 | 27 | 43 | .5 | | | 102 |
| Vietnam | 10 | 10 | | 5 | 6 | | 31 |









Possible cause for declining heterosis

Narrow genetic diversity in hybrid rice parents

- All hybrid rice germplasm were directly derived from inbred breeding
- Less understanding of heterotic pools for tropic rice germaplsm
- Are there any heterotic gene/gene blocks?

Strategies to enhance heterosis

- Increase genetic diversity in hybrid germplasm (heterotic pools)
 - Molecular markers
- Traditional grouping methodsBiotechnology application
- Parental selection
- Heterotic gene/gene block
- Exploiting sub-species heterosis
 - Among indicas
- Indica x New Plant Type
- Application of 2-line hybrids to expand germplasm pools



| | | | | Yield Adva | ntage (%) |
|------|--------|----------|------------------|-------------|------------|
| Year | Season | Hybrid | Yield (kg/ha) | > PSB Rc 82 | > IR75217H |
| 2007 | ws | IR81950H | 6429 | 24.8 | 5.7 |
| 2007 | ws | IR82363H | 6413 | 24.5 | 5.4 |
| 2007 | ws | IR85466H | 6478 | 25.8 | 6.5 |
| 2007 | DS | IR82372H | 9119 | 21.1 | 8.1 |
| 2007 | DS | IR84711H | 9101 | 20.9 | 7.9 |
| 2006 | DS | IR82386H | 8895 | 23.2 | 6.7 |

| | | Yield Ad | vantage (%) |
|----------|------------------|-------------|--------------|
| Hybrid | Yield (kg/ha) | > PSB Rc 82 | > II You 128 |
| IR82363H | 8578 | 29.9 | 8.2 |
| IR75217H | 8556 | 29.6 | 7.9 |
| IR80228H | 8505 | 28.8 | 7.3 |
| IIYou128 | 7928 | 20.1 | - |









| Country Bangladesh India Indonesia Philippines Vietnam Total Chin na 4,476 13,961 2,963 1,203 2,873 25,476 1,455 of Total Rice Area 42.0 32.4 25.3 29.2 39.0 33.6 5.0 |
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| of Total Rice Area 42.0 32.4 25.3 29.2 39.0 33.6 5.0 |
| |
| |









| Average he | ead rice yield and o | chalk performanc | e of hybrid rice |) |
|------------|----------------------|------------------|------------------|-----|
| Season | | Head Rice (%) | Chalk (%) | n |
| | Inbred | 47.9 | 10.9 | 39 |
| Dry | Hybrid | 41.1 | 16.8 | 240 |
| | Hybrid vs Inbred | - 6.7 | 5.8 | |
| | Inbred | 51.7 | 15.0 | 33 |
| Wet | Hybrid | 46.7 | 19.9 | 223 |
| | Hybrid vs Inbred | - 5.0 | 4.9 | |

| | Amylose | Chalk | Head Rice | Total Rice | GEL TEMP | GEL CON | YIELD | Remarks |
|------------------------------|---------|-------|-----------|------------|----------|---------|-------|--------------|
| SBRc 64 | 24 | 5 | 56.4 | 69.0 | HVL | soft | 6771 | inbred check |
| SBRC 82 | 25 | 5 | 60.8 | 70.0 | НИ | soft | 7226 | inbred check |
| R68284H (Mestizo) | 21 | 9 | 61.7 | 69.3 | L | soft | 5435 | hybrid check |
| R73834S/IR69726-29-1-2-2-2 | 24 | 1 | 56.2 | 69.9 | ١L | soft | 7842 | two-line |
| R73328A/PR26208-17-1-1R | 23 | 1 | 62.5 | 71.0 | HWL | soft | 7391 | three-line |
| R68897A/IR69712-154-2-3-1-3F | R 27 | 5 | 54.8 | 69.8 | ٧L | soft | 7546 | three-line |
| R70369A/PR25458-8-1-3-1R | 27 | 5 | 60.6 | 69.8 | ٧L | soft | 7978 | three-line |







