Rice Industry Webinar: Hybrid Rice
Helping to Meet Global Demand for Food with Hybrid Rice Technology

(Brief Introduction of Mike Gumina and RiceTec)

What is hybrid rice?
- Genetics
- Challenges

Where is hybrid rice grown today?
- Countries/market share
- Global Developers

What are the advantages of growing hybrid rice?
- Yield
- Economics
- Sustainability

How does hybrid rice play a part in meeting global demand for rice?
- Rice consumption in 2035
- Global rice preference segmentation
- Projected hybrid rice adoption to fill the consumption verse supply gap.

Future developments in hybrid rice?
- Grower attributes
- Miller attributes
- Consumer attributes
RiceTec was started as an off-shoot of the Farms of Texas.

RiceTec develops, produces and distributes rice seed products combined with the information needed to use them successfully.

First hybrid was released in 2000 (XL6).
RiceTec is a Global Resource
Mission

RiceTec will drive food production sustainability through rice seed technologies and make a positive impact on farmers, employees and stakeholders.
What is Hybrid Rice?
Hybrid Seed results from cross-pollination of two distinct pure lines, one as a pollinator and one as a seed parent.

Female (Male-sterile seed) parent

Pollen from anthers on the male parent fall on the stigma of the female parent where hybrid seed is produced.

Male (Male-fertile pollinator) supplies pollen

HYBRID SEED HARVESTED
Heterosis: Depends upon Diversity in Sources of Lines
Hybrid Rice was first developed in China during the 1960s

Yuan Longping

- The “Father of Hybrid Rice”

- Recipient of World Food Prize in 2004

- Has an asteroid named after him 😊
Hybrid Rice History

Hank Beachell

- IRRI
- U.S. Department of Agriculture (Texas)
- USDA/ARS Rice Research Unit
- 1996 World Food Prize
Rice is a Self-Pollinating Crop
As Such Need to develop male sterility

Aborted Typical

Anther

Pollen
Challenges to Developing Hybrid Rice

Heterosis

Male Sterility
- TGMS (Thermo-sensitive Genic)
- PGMS (Photoperiod-sensitive)
- CMS (Cytoplasmic)

Seed Production
- Pollination
- Flowering Synchronization
- Seed Quality (Purity)
- Economic yield
Mechanical Methods Needed to Create Pollen Movement
Global Developers

[Image with logos of various global developers]
Hybrid Rice Technology is a Solution to Meet Increasing Worldwide Demand for Rice

Source: RiceTec
Advantages of Growing Hybrid Rice

- Yield
- Economics
- Sustainability
Yield Increases in US since 2002 are due to Hybrids and CLEARFIELD Technology

Yield Impacting Events
1. Release of Magnolia cultivar
2. Release of Saturn cultivar and registration of propanil herbicide
3. Release of Lemont semidwarf cultivar
4. Release of Cocodrie variety
5. Adoption of Clearfield technology/cultivars and hybrids

History of Louisiana statewide rice yields (3-year moving average) and major yield impacting events. Source: NASS, 2012

Source: B. Leonards (LA Farm & Ranch)
Average Yield Advantage of Hybrid Vs. Inbred Rice in China (~2MT/Ha)

Source: IRRI.org
Yield Advantage of Hybrid Rice is Evident Regardless of Planting Date

Figure 1. Effect of planting date on main crop grain yield of different types of rice, Crowley, LA, 2001-04.

Source: LSU
# Independent Yield Trial Results

## Texas A&M Yield Trials

(2013-2014 Average)

<table>
<thead>
<tr>
<th>Hybrid</th>
<th>Inbred</th>
<th>Hybrid Yield Advantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>XL753</td>
<td>PRESIDIO</td>
<td>23%</td>
</tr>
<tr>
<td>XL753</td>
<td>CL152</td>
<td>26%</td>
</tr>
<tr>
<td>CLEARFIELD Products</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CL745</td>
<td>CL152</td>
<td>12%</td>
</tr>
<tr>
<td>CL745*</td>
<td>CL111*</td>
<td>24%</td>
</tr>
</tbody>
</table>

*2014 only

## University of Arkansas Yields

(2014-2015)

<table>
<thead>
<tr>
<th>Hybrid</th>
<th>Inbred</th>
<th>Hybrid Yield Advantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>XL753</td>
<td>Roy J</td>
<td>27%</td>
</tr>
<tr>
<td>XL753</td>
<td>LaKast</td>
<td>28%</td>
</tr>
<tr>
<td>CLEARFIELD Products</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CL745</td>
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<td>24%</td>
</tr>
<tr>
<td>CL745</td>
<td>CL111</td>
<td>23%</td>
</tr>
</tbody>
</table>

## Mississippi State University Yield Trials

(2015)

<table>
<thead>
<tr>
<th>Hybrid</th>
<th>Inbred</th>
<th>Hybrid Yield Advantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>XL753</td>
<td>LAKAST</td>
<td>10%</td>
</tr>
<tr>
<td>XL753</td>
<td>Rex</td>
<td>14%</td>
</tr>
<tr>
<td>CLEARFIELD Products</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CL729</td>
<td>CL151</td>
<td>15%</td>
</tr>
<tr>
<td>CL745</td>
<td>CL152</td>
<td>17%</td>
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</table>
Advantages of Growing Hybrid Rice

New combinations and developments through plant breeding have driven genetic gain across the years:

- New heterosis
- Blast resistance
- Bacterial panicle blight resistance
- Agronomic improvements
- Higher profits
## Economic Advantages of Growing Hybrid Rice

Total Revenue Gain in 2014 USD for Arkansas, Louisiana, and Mississippi from RiceTec® Adoption: 2003-2013

<table>
<thead>
<tr>
<th>Year</th>
<th>Arkansas</th>
<th>Mississippi</th>
<th>Louisiana</th>
<th>Total (2014 USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td>$1,619,585</td>
<td>$0</td>
<td>$43,546</td>
<td>$1,663,131</td>
</tr>
<tr>
<td>2004</td>
<td>$11,698,323</td>
<td>$0</td>
<td>$1,458,524</td>
<td>$13,156,847</td>
</tr>
<tr>
<td>2005</td>
<td>$6,904,232</td>
<td>$0</td>
<td>$917,962</td>
<td>$7,822,194</td>
</tr>
<tr>
<td>2006</td>
<td>$18,003,523</td>
<td>$804,508</td>
<td>$1,142,958</td>
<td>$19,950,989</td>
</tr>
<tr>
<td>2008</td>
<td>$72,515,743</td>
<td>$823,114</td>
<td>$7,133,599</td>
<td>$80,472,455</td>
</tr>
<tr>
<td>2009</td>
<td>$105,004,392</td>
<td>$6,321,137</td>
<td>$19,019,253</td>
<td>$130,344,782</td>
</tr>
<tr>
<td>2010</td>
<td>$133,988,586</td>
<td>$16,989,992</td>
<td>$28,226,938</td>
<td>$179,205,516</td>
</tr>
<tr>
<td>2011</td>
<td>$152,328,127</td>
<td>$23,065,639</td>
<td>$32,377,211</td>
<td>$207,770,977</td>
</tr>
<tr>
<td>2012</td>
<td>$106,262,046</td>
<td>$10,541,162</td>
<td>$12,138,443</td>
<td>$128,941,651</td>
</tr>
<tr>
<td>2013</td>
<td>$75,373,409</td>
<td>$7,866,539</td>
<td>$15,512,174</td>
<td>$98,752,122</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td></td>
<td>$915,337,828</td>
</tr>
</tbody>
</table>

Source: Nalley et al. U of A, 2014
Hybrid technology is showing the same advantages in both direct seeded and transplanted farming systems.
Hybrid addresses issues in both mechanical and manual systems
Sustainability Advantages of Hybrid Rice

- Environmental
- Social
- Economic
Economic and Environmental Benefits of Sustainability with Hybrid Rice

“...in short it appears that hybrids are 35.9% more efficient users of water and emit 29% less GHG per unit of output” (Nalley et al. 2014).

Variety

Nitrogen-use efficiency

Blast resistance

Sprinkler-irrigated rice

Easier milling

Greater Disease tolerance

Sources: Nalley et. al., (water, CO2); Walker & Norman (N use); Lanning & Siebenmorgen (milling)
Environmental Benefit of Hybrid Rice: Lower Carbon Emissions

Source: Lyman and Nalley
### Desired Consumer Attributes in an “Environmentally Friendly” Rice

<table>
<thead>
<tr>
<th>Desired Attributes</th>
<th>Likely to Purchase</th>
<th>Less Likely to Purchase</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Good for Environment</td>
<td>19%</td>
<td>10%</td>
</tr>
<tr>
<td>2. Non-GMO</td>
<td>18%</td>
<td>8%</td>
</tr>
<tr>
<td>3. Local/Produced in USA</td>
<td>15%</td>
<td>8%</td>
</tr>
<tr>
<td>4. Natural/No Chemicals</td>
<td>12%</td>
<td>8%</td>
</tr>
<tr>
<td>5. Healthy/Good for You</td>
<td>11%</td>
<td>7%</td>
</tr>
<tr>
<td>6. Good Price</td>
<td>9%</td>
<td>5%</td>
</tr>
<tr>
<td>7. Like the Packaging</td>
<td>6%</td>
<td>3%</td>
</tr>
<tr>
<td>8. Everything/Like It</td>
<td>5%</td>
<td>3%</td>
</tr>
<tr>
<td>9. Would Taste Good</td>
<td>5%</td>
<td>4%</td>
</tr>
<tr>
<td>10. Fewer Pesticides</td>
<td>5%</td>
<td>2%</td>
</tr>
</tbody>
</table>

<5% not shown

Source: IRI Market Research Study, July 2014
Future Developments in Hybrid Rice

- Growers
- Millers
- Consumers
Global demand for milled rice is estimated to increase from 439 million to 555 million tons in 2035*

Additional rice needed: 116 million tons by 2035

Source: IRRI, 2010
Different Seeds Required for the Different Grain Quality Parameters
Types of Rice Preferences Around the World
Hybrid rice penetration should increase significantly over the next 20 years, foremost in Mercosur, India and SE Asia.

- **MERCOSUR**
  - **2015**: Penetration: 4%
  - **2035**: Penetration: 34%

- **INDIA**
  - **2015**: Penetration: 7%
  - **2035**: Penetration: 28%

- **SE ASIA**
  - **2015**: Penetration: 4%
  - **2035**: Penetration: 35%

Source: RiceTec
Future Developments in Hybrid Rice

Growers
- Yield Increase
- Reduction of risk (Diseases tolerance, Lodging, Shattering, Abiotic Stress)
- Decrease in Input Cost (Water, Fertilizer, Ag Chemical, Weed Control)
- Maturity

Millers
- Preferences (Grain size, Amylose, Chalk, Translucency)
- Whole milling yield
- Segmented Grain Quality According to Consumer

Consumers
- Uniformity of cooking
- Texture and aroma
- Sustainable food production solutions
Information and Knowledge for Success

• Crop Planning/Market Planning
• Financial Planning
• Risk Management
• Field by Field/Acre by Acre Yield Analysis
• Drying, Storage, Delivery, Marketing
• Supply Chain Coordination with Buyers
• Flexibility to Adjust to Changing Global Circumstances
Q&A