Research & Technology Driving Sustainable Grain Quality in Rice Supply

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Presentation to:

Rice Marketing and Technology Convention

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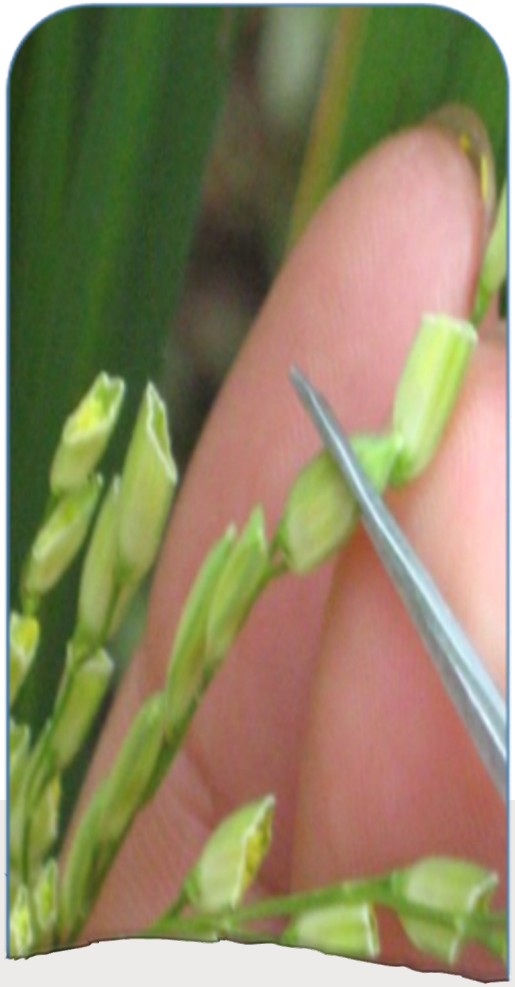

BREEDING

Courtesy:M.M. Chapala/RiceTec, Inc.

GOALS IN RICE BREEDING

Yield

Grain Quality

Sustainability

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THESE FACTORS IMPACT RICE QUALITY!

- Genetic
- Biotic and Abiotic Pressures
- Agronomic Practices
- Pre- and Post-Harvest Processing and Handling

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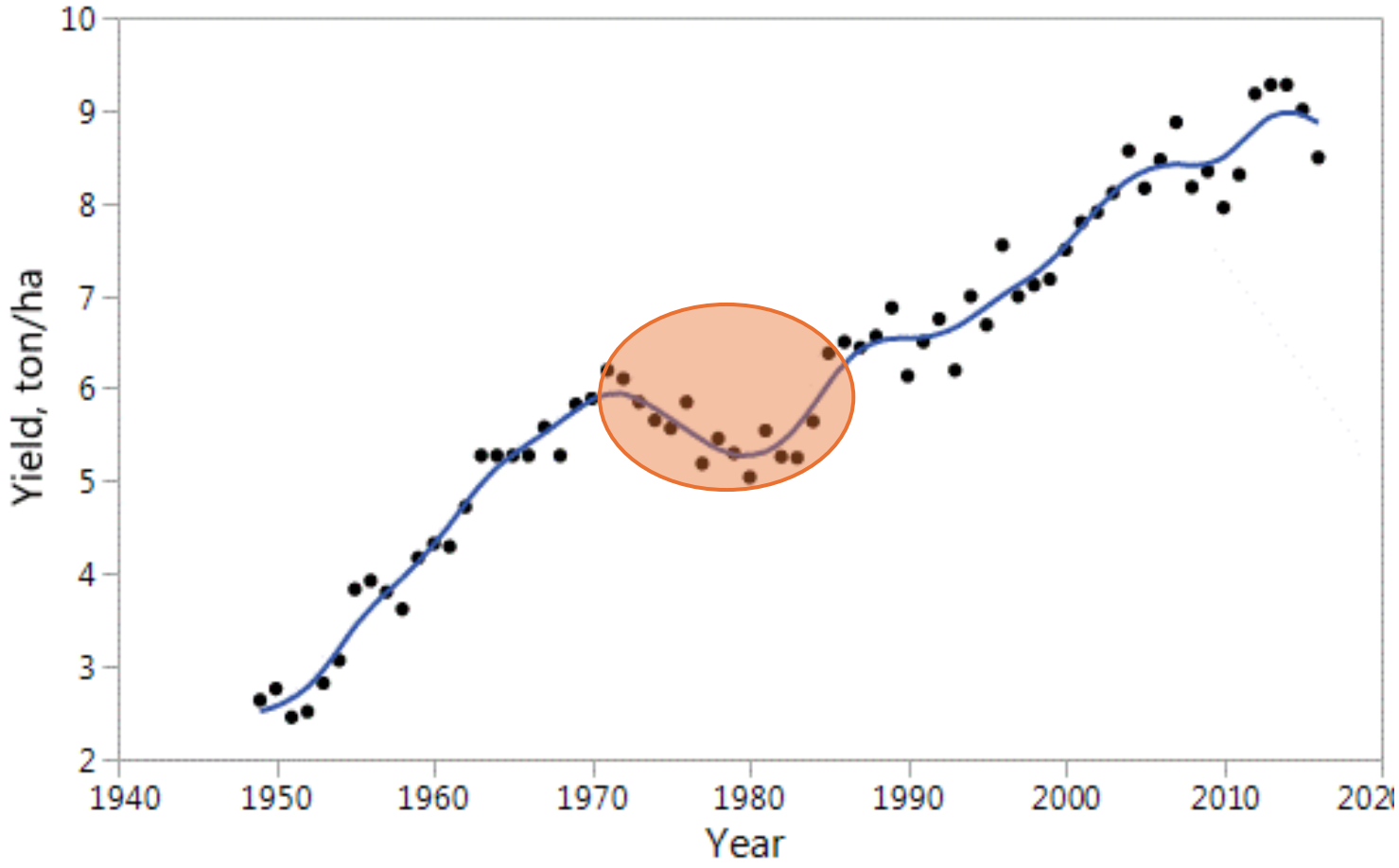
ANNUAL AVERAGE RICE YIELD, ARKANSAS



Source: nass/usda.gov/AR

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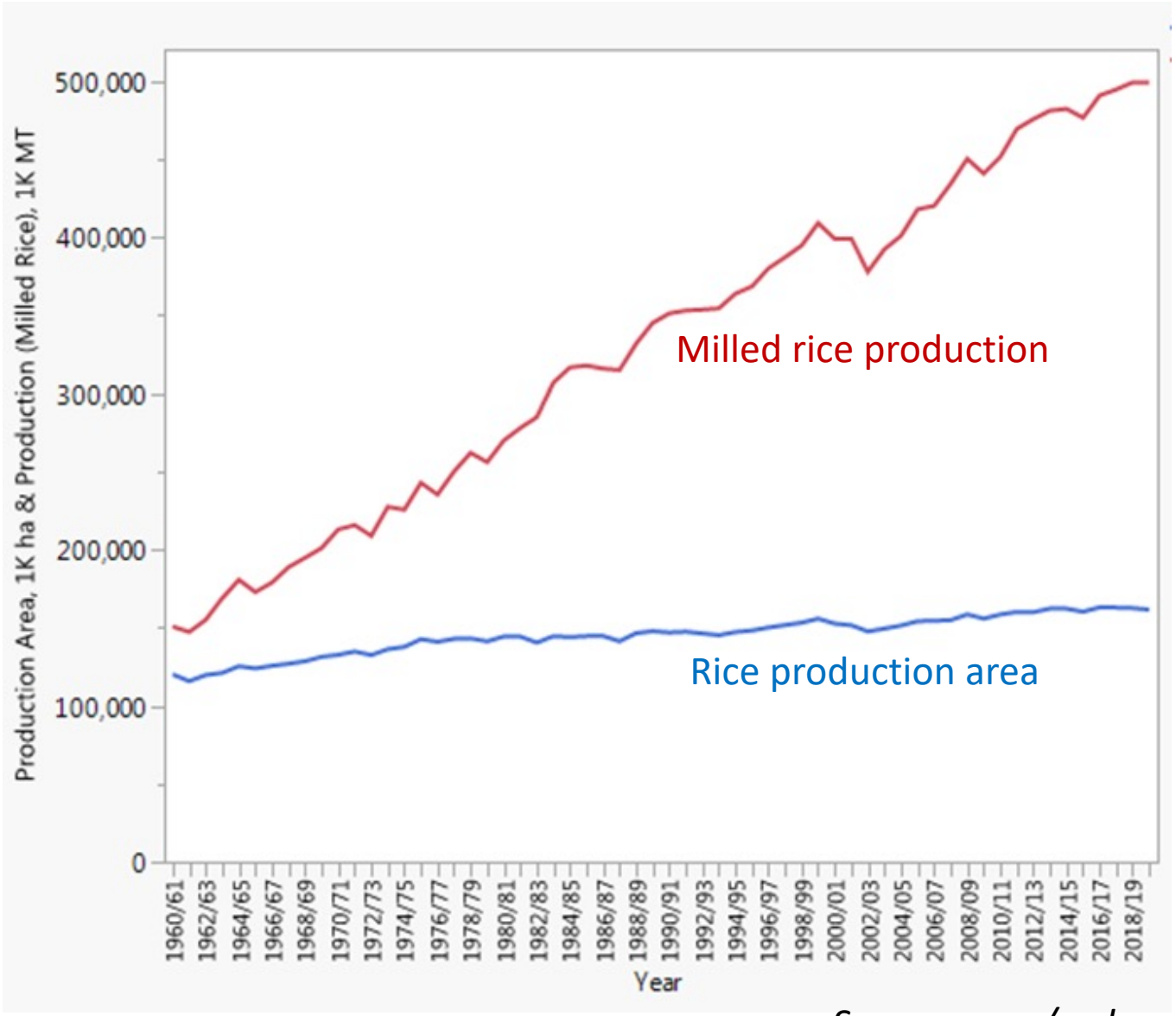
GLOBAL RICE ACREAGE AND PRODUCTION



Source: nass/usda.gov

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GRAIN QUALITY

- What is it?
- It **impacts** consumer satisfaction, economic returns to producers and processors
- GQ **attributes:**
  - Grain shape, size and distribution
  - Amylose content
  - Gelatinization temperature
  - Protein content
  - Pasting properties
  - Millability
  - Appearance (translucency and chalkiness)

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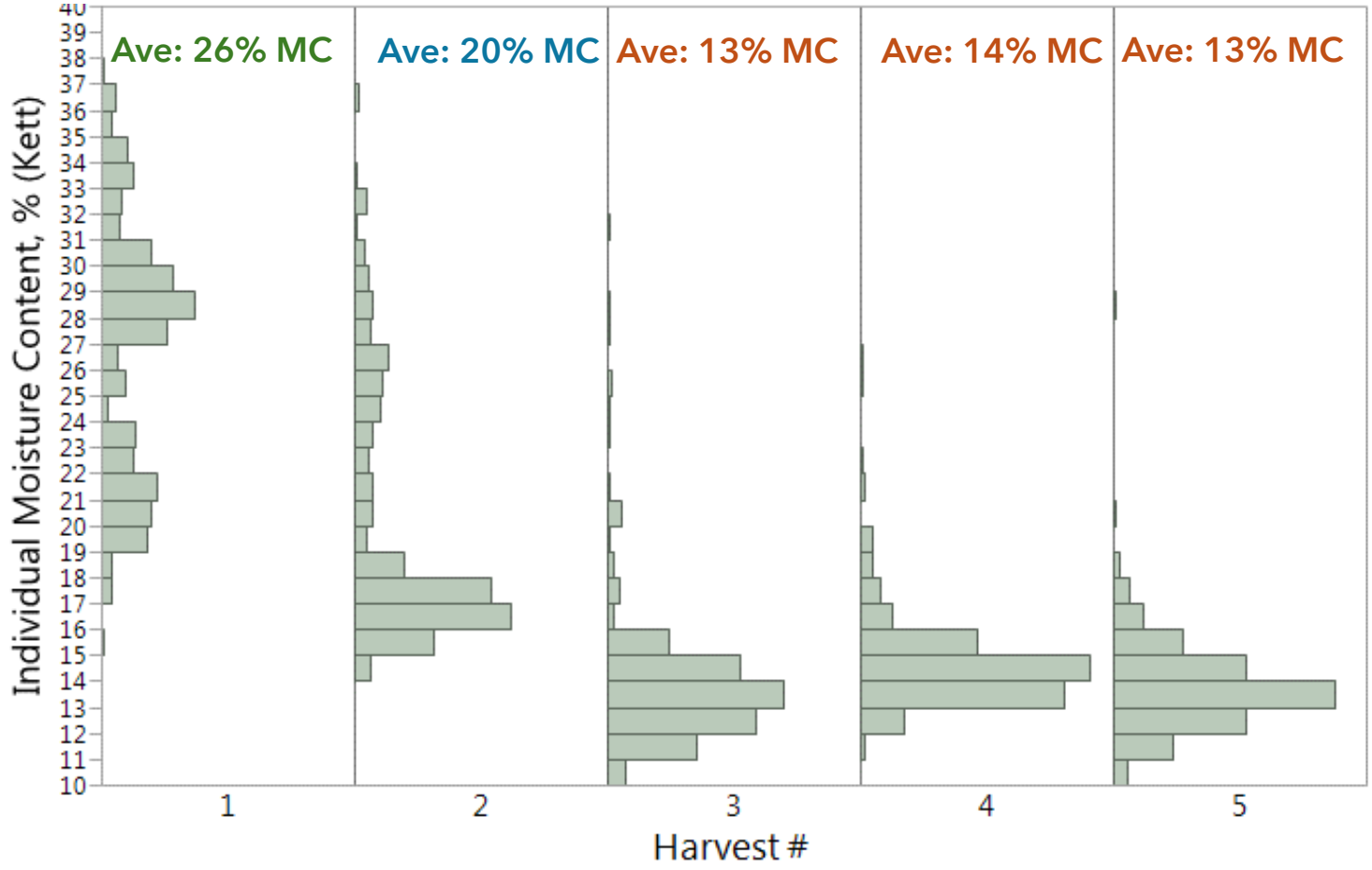
KERNEL RIPENING IN PANICLES

Uniform kernel maturity

Less uniform kernel maturity

INDIVIDUAL KERNEL DEVELOPMENT AND MATURATION



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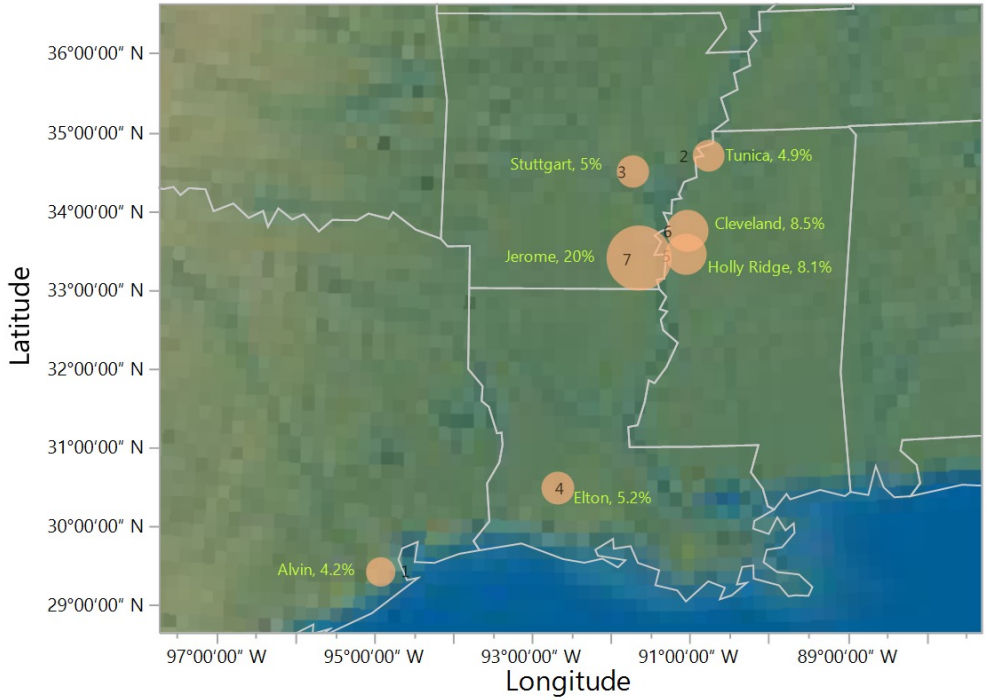
COMMON QUALITY ISSUES: KERNEL CHALK

Kernel Chalk



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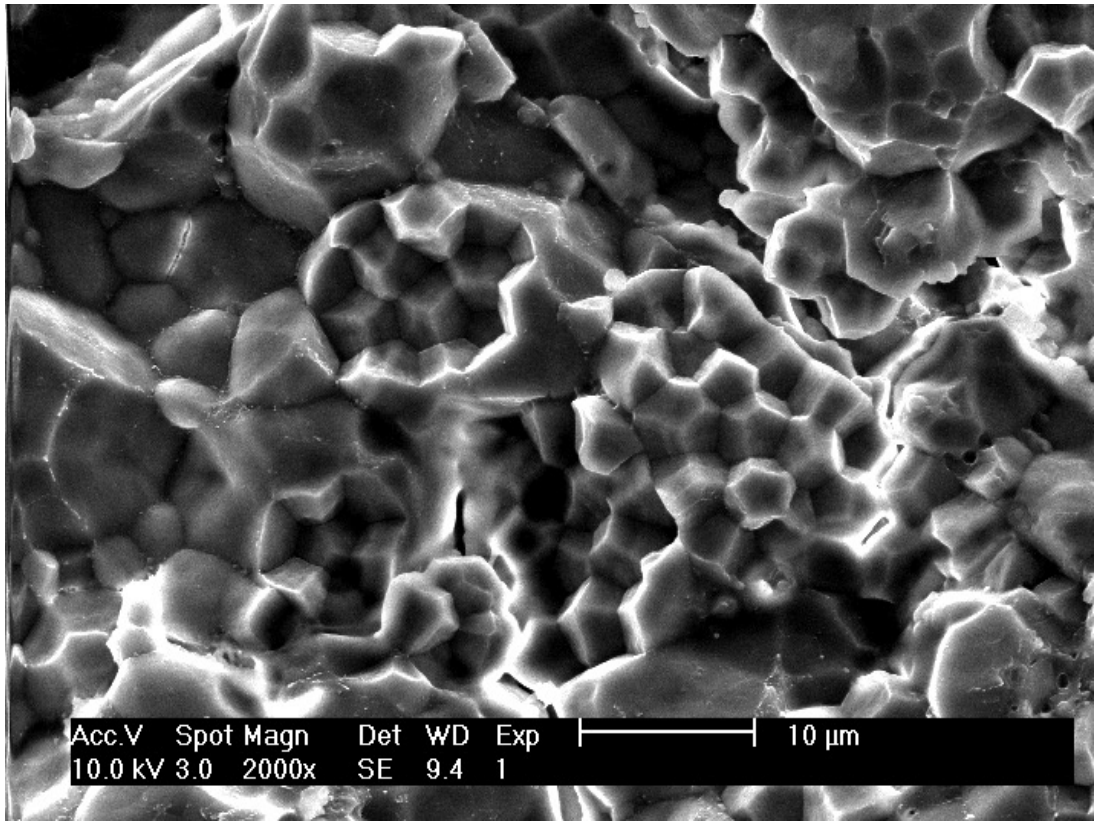
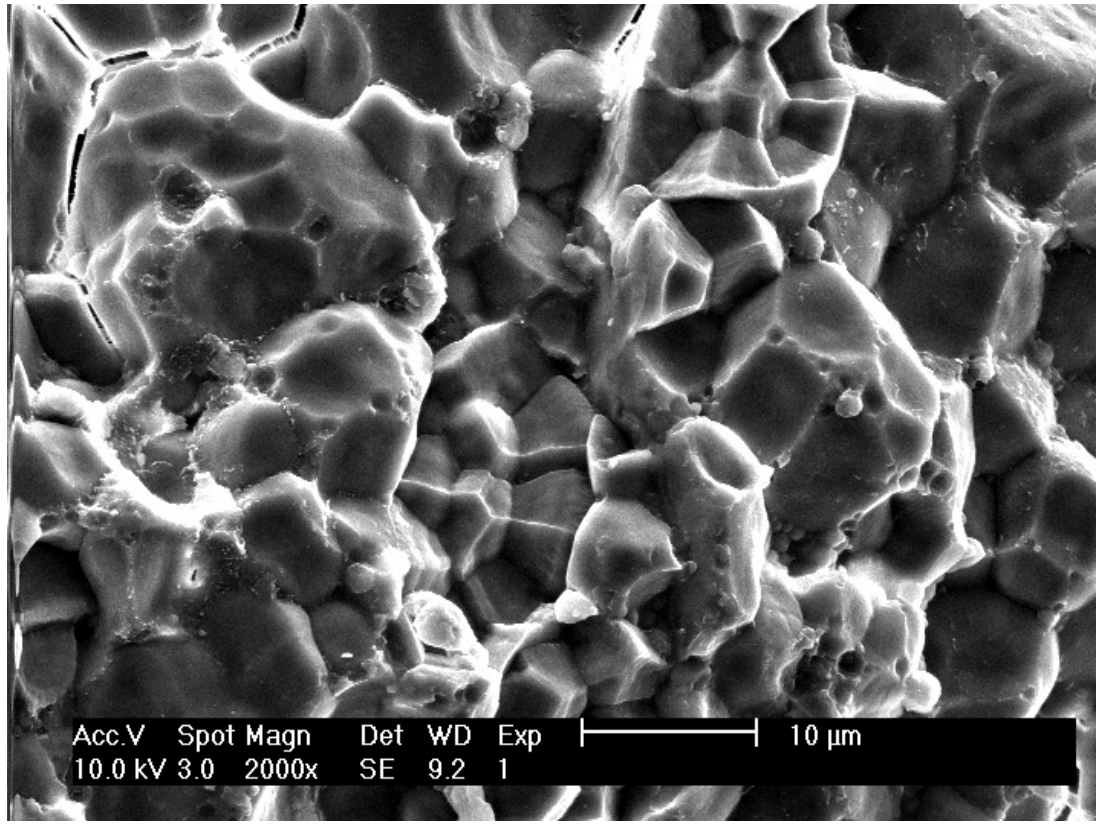
STARCH GRANULES PACKING IN RICE KERNELS

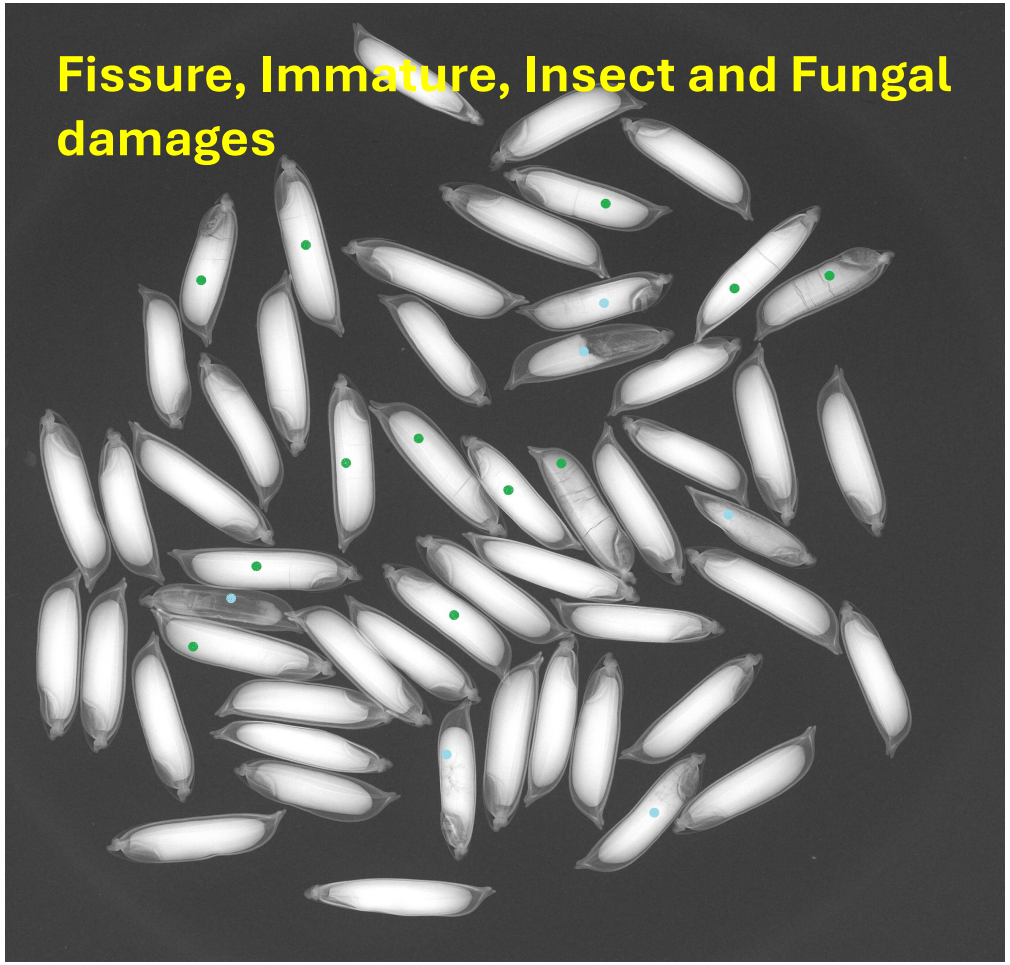
Translucent kernel

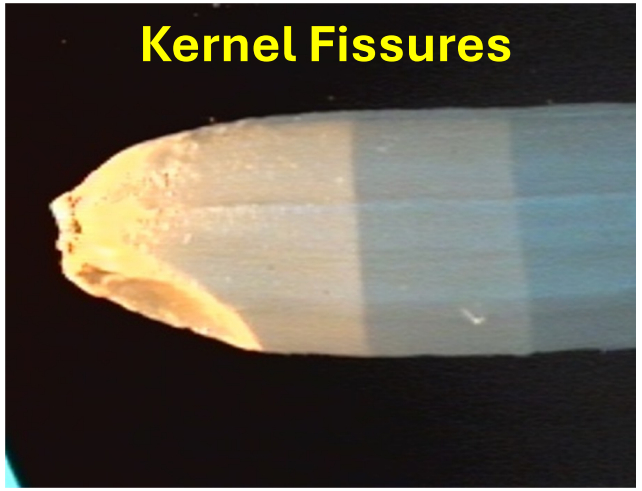


Chalky kernel



COMMON QUALITY ISSUES: FISSURE, IMMATURE, INSECT & FUNGI DAMAGES





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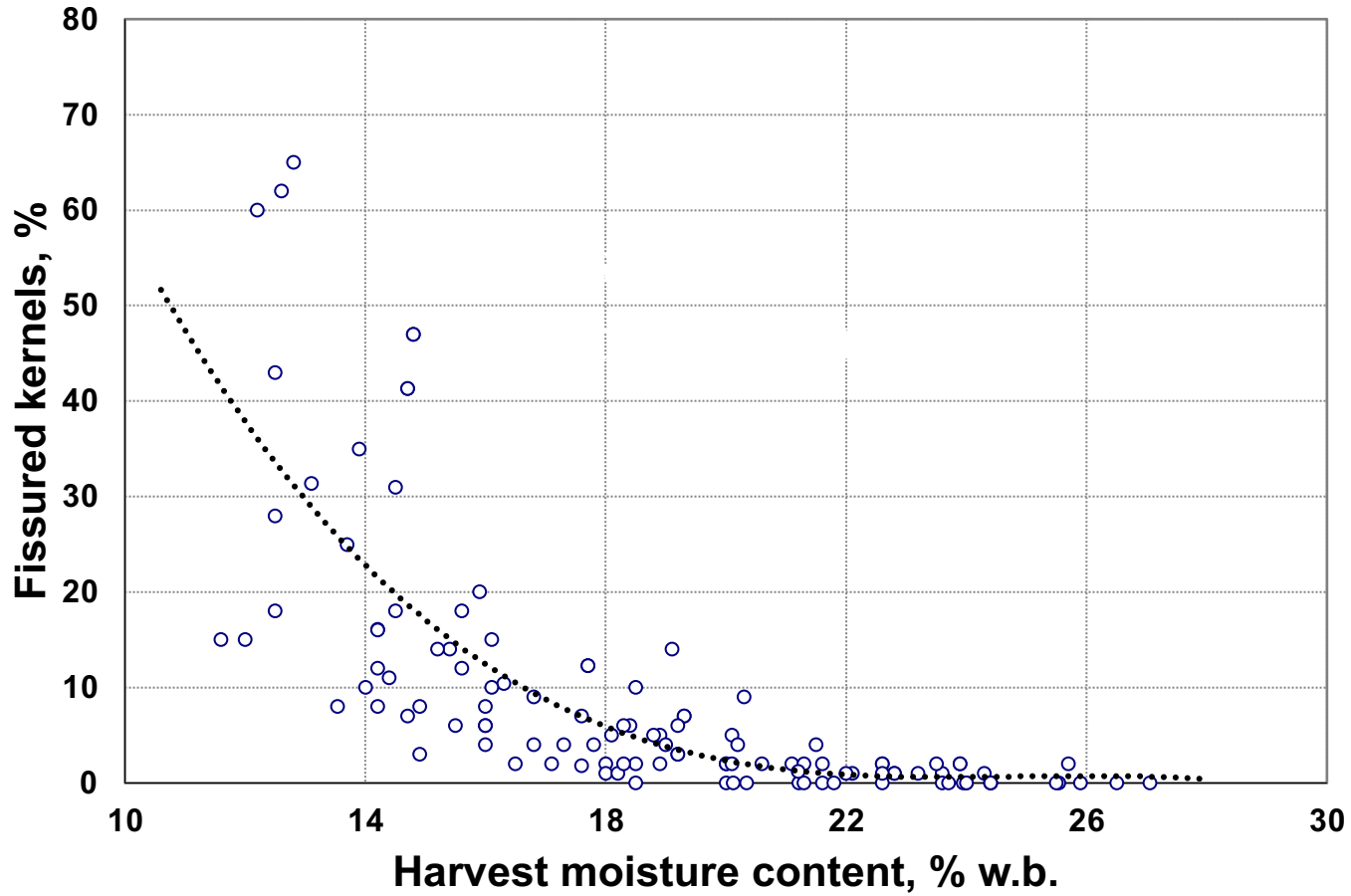
KERNEL FISSURING AND HARVEST MOISTURE CONTENT



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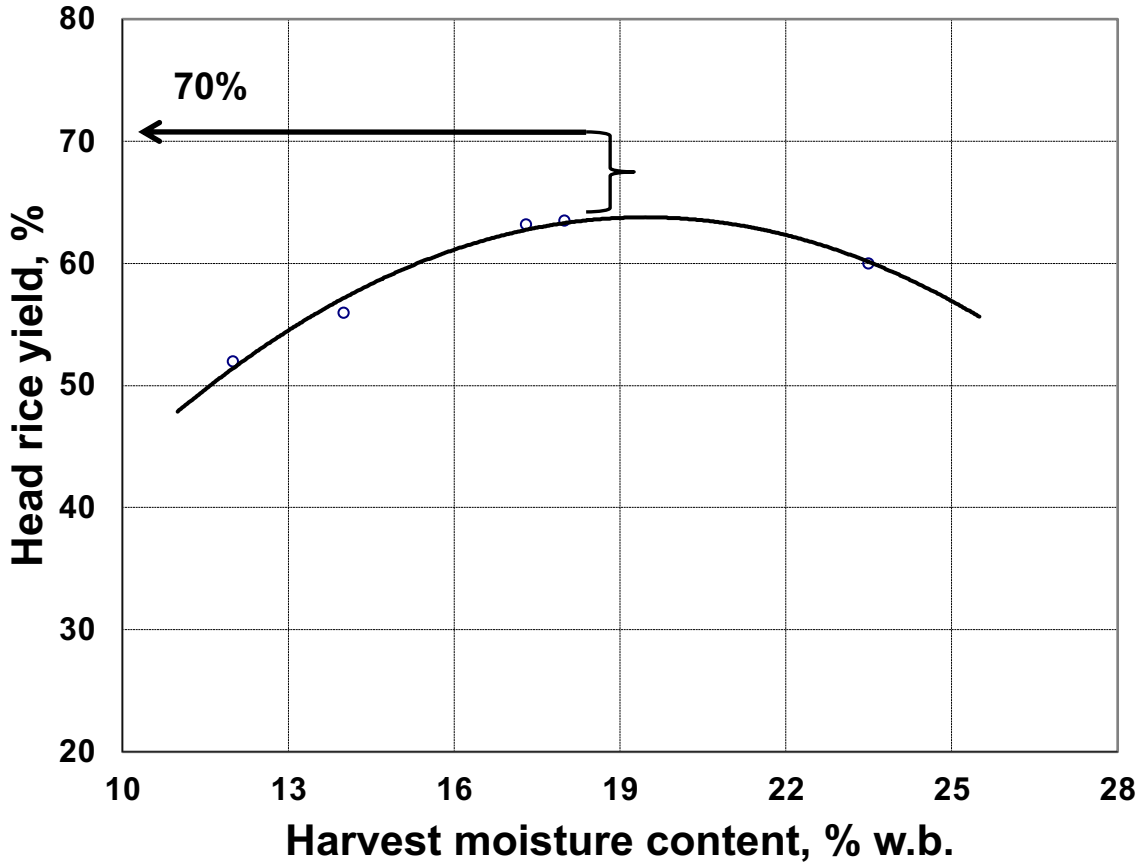
OPTIMAL HARVEST MOISTURE CONTENT



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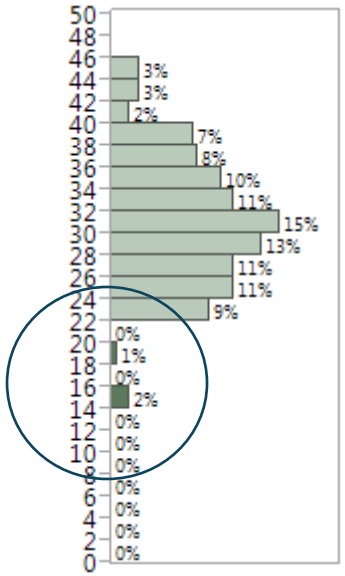
KERNEL BREAKING FORCE DISTRIBUTIONS

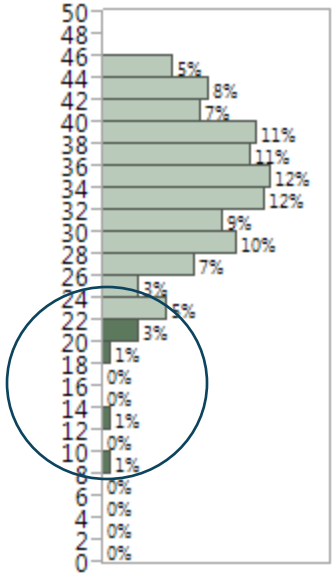


Cheniere

65% HRY @45 s

Fissure: 3.7%

Chalk:

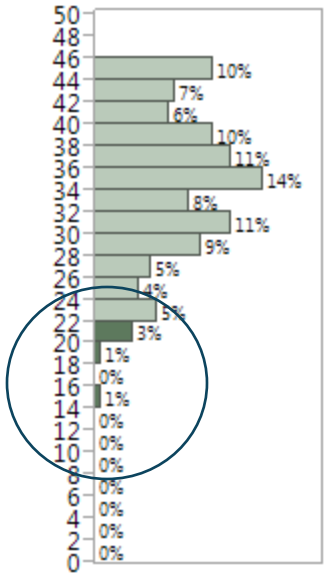


XL723

60% HRY @45 s

Fissure: 7.2%

Chalk:

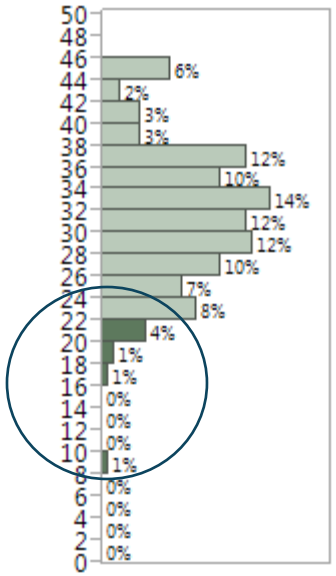


XL753

58% HRY @45 s

Fissure: 10.5%

Chalk:



XP762

55% HRY @45 s

Fissure: 9.1%

Chalk:

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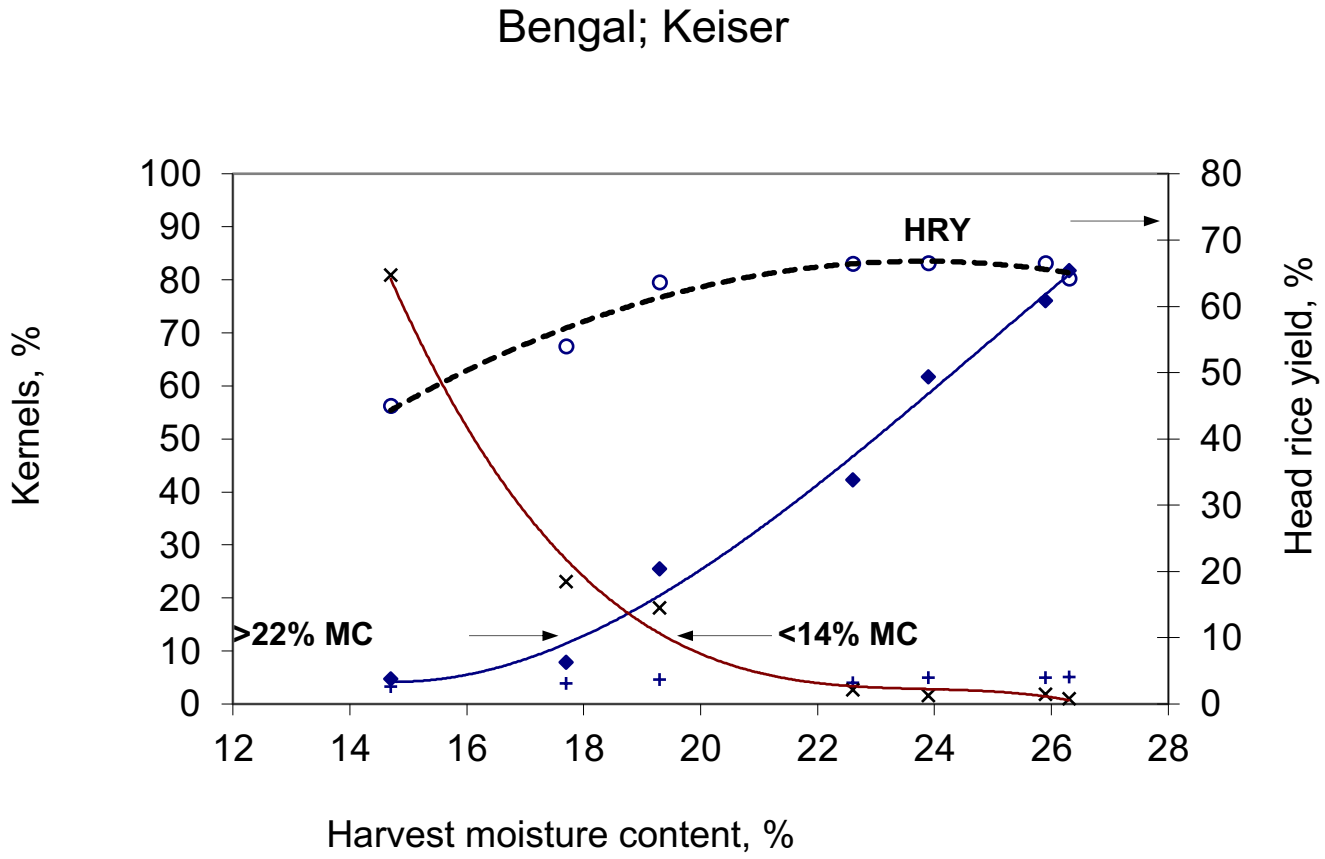
LOW AND HIGH MOISTURE CONTENT KERNELS AFFECT HEAD RICE YIELD



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RICE GRAIN QUALITY FUNDAMENTALS SUMMARY

- **Panicle architecture** and kernel development
- Harvest moisture contents and distribution in panicles (**optimal harvest HMC**)
- Kernel **size** and **shape** (impacts drying, milling, end-use processing)
- Kernel **fissuring** (field and drying—the glass transition theory)
- **N fertilizer and irrigation**
- **Starch Chemistry**

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BREEDING PROGRAMS ADDRESSES GRAIN QUALITY & SUSTAINABILITY

- Yield, milling, and functional properties
- Sourcing genetic pool resistant to kernel fissuring and kernel **chalk**

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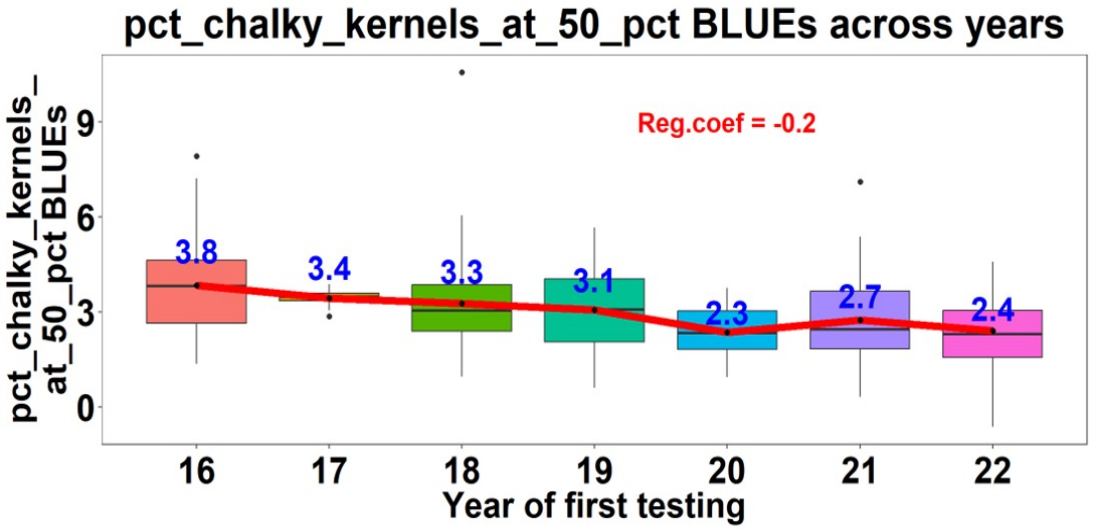
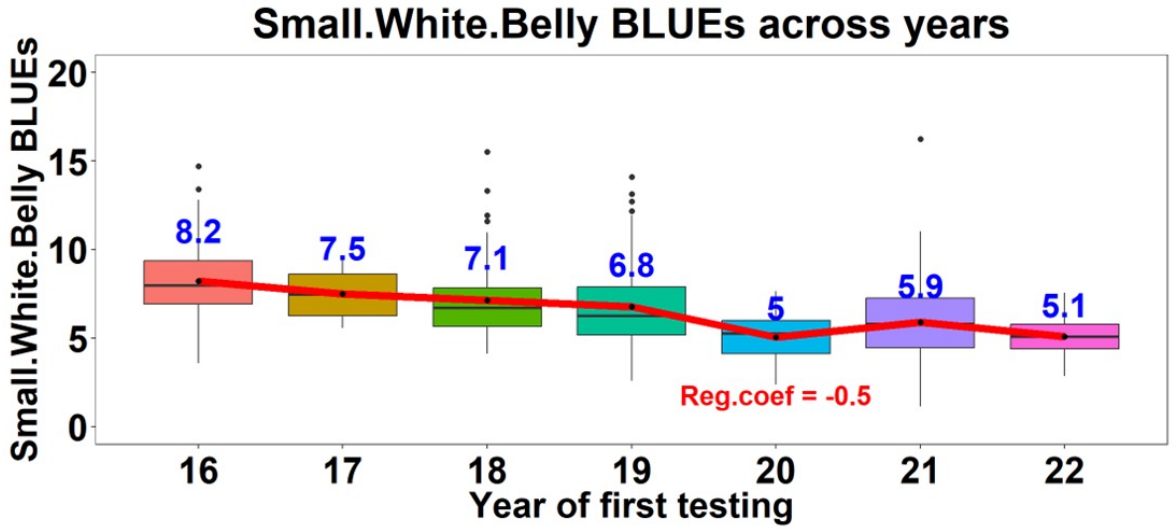
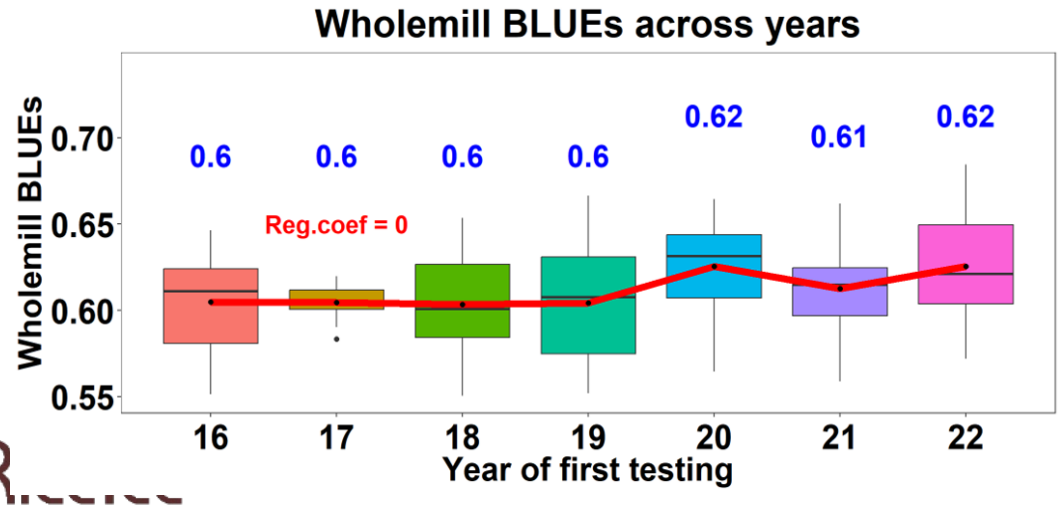
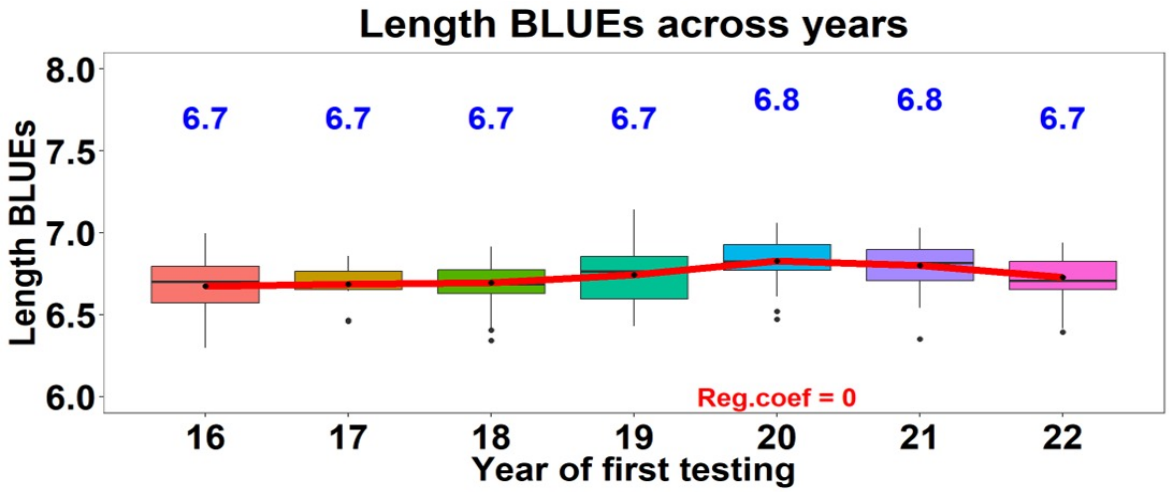
Breeding Programs addresses Grain Quality



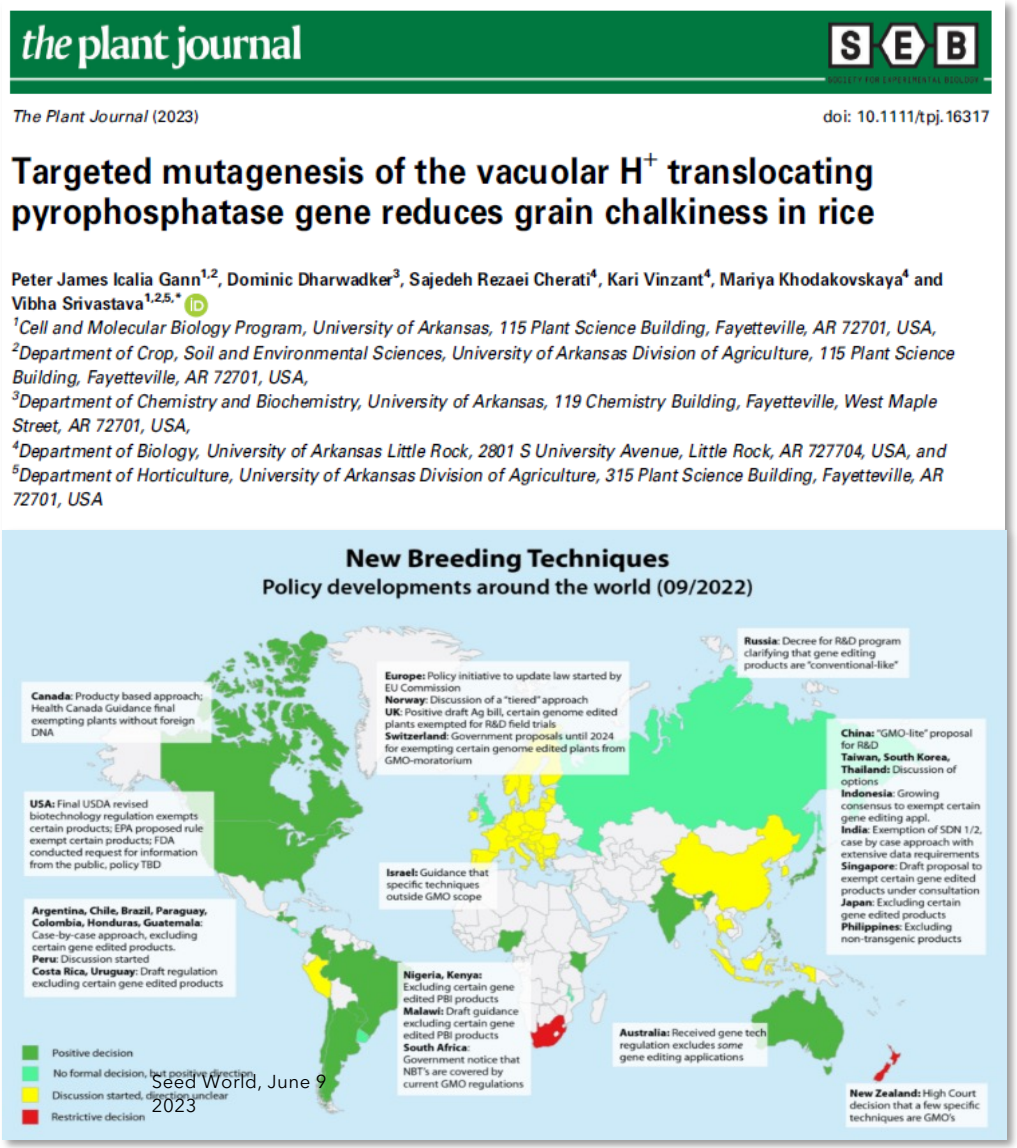






Gene Editing--a tool to improve Grain Quality

- **Gene editing technology** allows for the generation of precise targeted changes within the genome of an organism
  - This may well open new opportunities to address grain quality challenges at the genetic level
- Can be used for both R&D
- Global regulatory picture is complicated but trending toward a more uniform gene editing friendly system.
  - Many nations allow non-GMO path to market for gene edited products that contain no foreign DNA
  - Including USA, Brazil, India and many others
  - Even draft EU framework allows for gene edited products to come to market



the plant journal — SEB

The Plant Journal (2023) doi: 10.1111/tpj.16317

Targeted mutagenesis of the vacuolar H^+ translocating pyrophosphatase gene reduces grain chalkiness in rice

Peter James Icalia Gann[1,2], Dominic Dharwadker[3], Sajedeh Rezaei Cherati[4], Kari Vinzant[4], Mariya Khodakovskaya[4] and Vibha Srivastava[1,2,5,*]

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Seed World, June 9 2023

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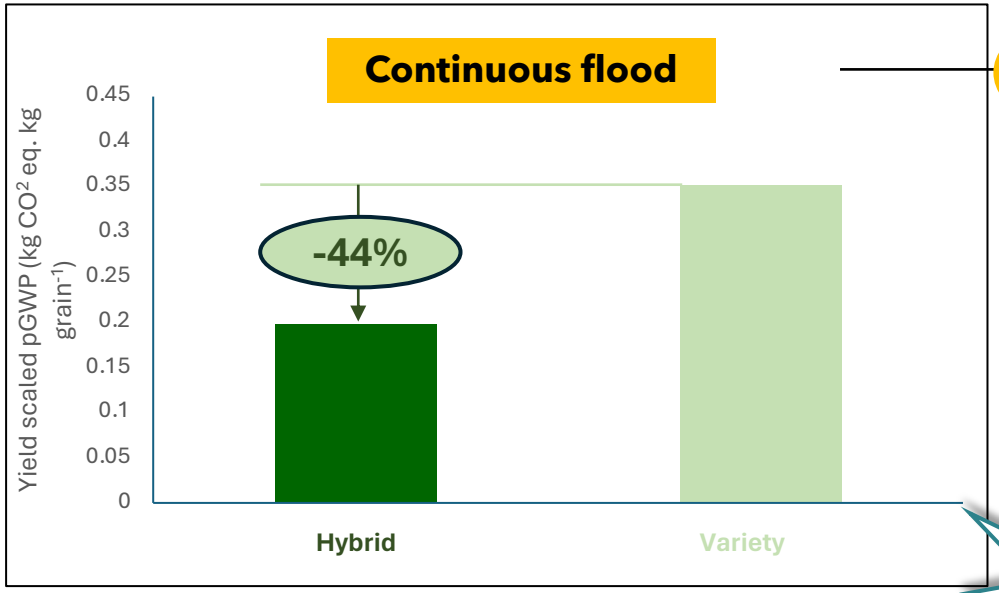
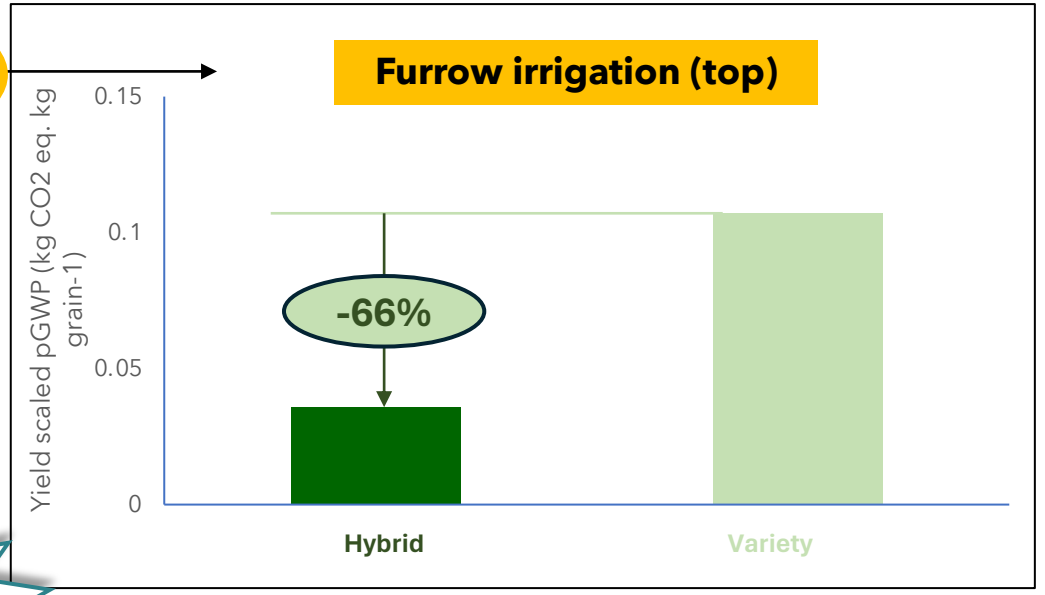
HYBRIDS WITH 40-70% LOWER CH4 EMISSIONS VS. VARIETIES



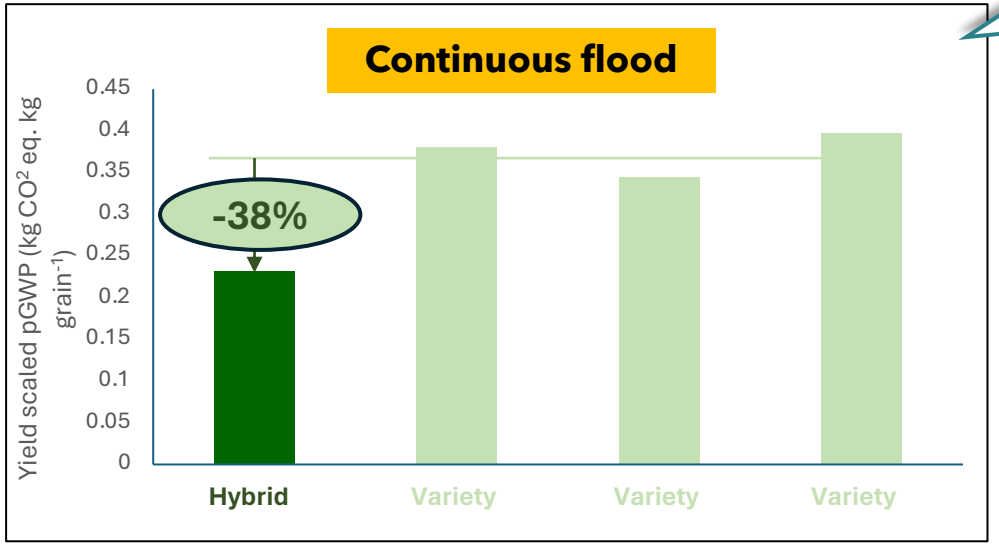
USDA-ARS and Univ. of Arkansas, Harrisburg, AR, Adviento-Borbe, 2022.

-50% to -80%

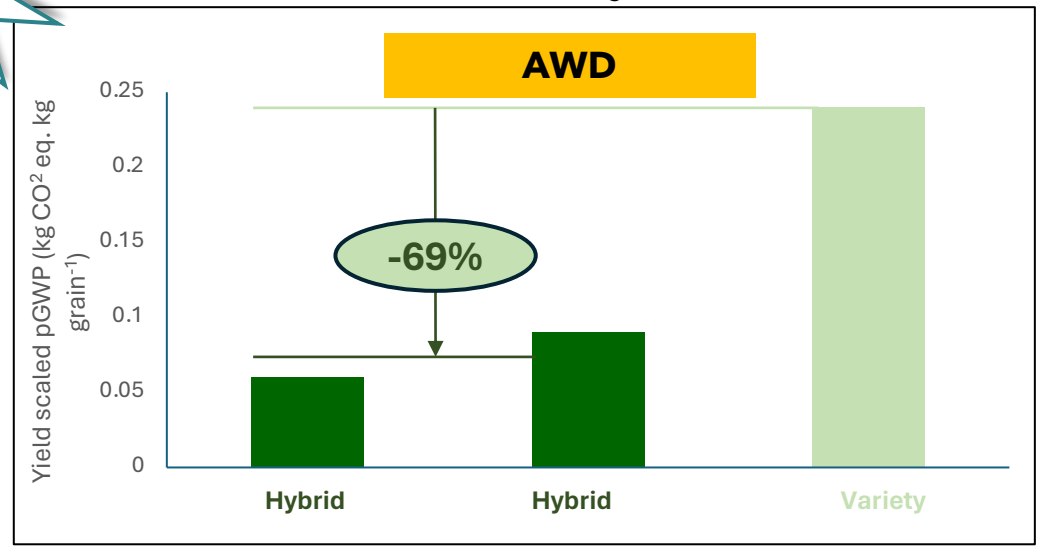
~1t CO2e/acre



USDA-ARS and Univ. of Arkansas, Harrisburg, AR, Adviento-Borbe, 2022.

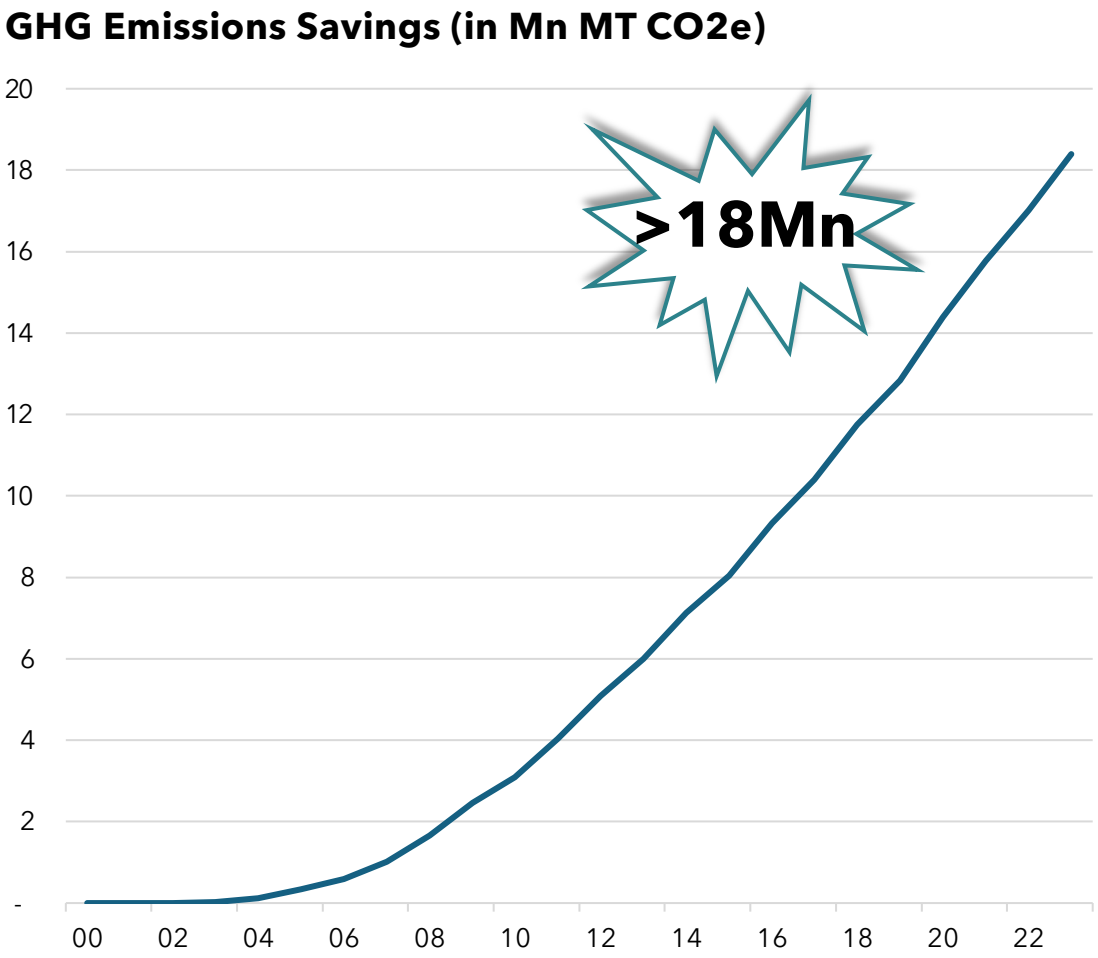


University of Arkansas, Stuttgart, AR, 2012. Simmonds et al, 2015.



Studies conducted at EMBRAPA Clima Temperado, Estação Experimental Terras Baixas, Capão do Leão, RS, Brazil. 2021-2022

MORE VALUE FOR THE PLANET



- Plant hybrid rice
- Change irrigation practices (eg AWD)

+ Less water use
+ Less energy use
+ Less land use

THANK YOU!