

Rice Quality Parameters in Rice Breeding



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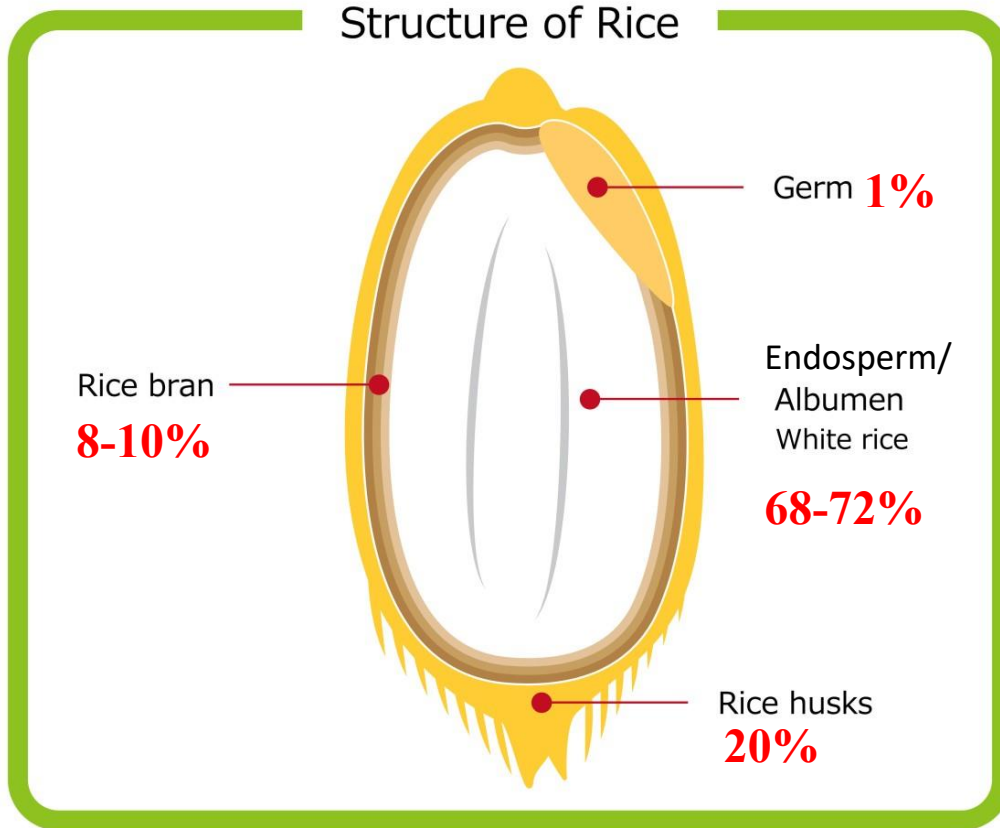
Grower Rice Quality Meeting
July 18, 2024

Grain Quality

- Milling
- Chalk
- Protein
- Amylose
- Taste
- Visual appearance
- Cooking characteristics



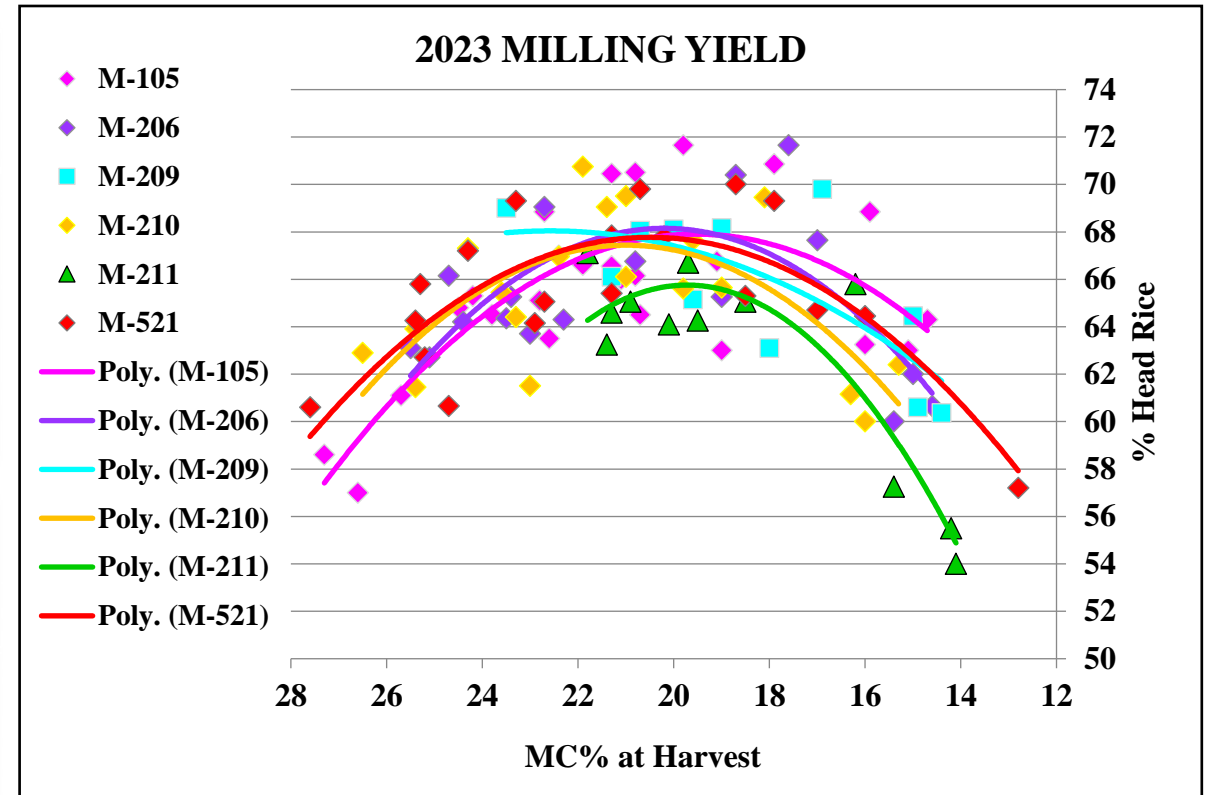
Rice Milling Yield



- Endosperm/Albumen = 68-72% of paddy rice by weight.
- Rice can be broken during milling process
 - Head rice – milled rice 75% of the size of whole kernel
 - Total Milling Yield - % of head + broken
 - Often written as a fraction: head/total (62/71)
- Genetics, Environment, Harvest Moisture, Management



Milling Yield Evaluation



% Head Rice: **67%** (65-68%)

Total Milled Rice (18-22%MC): **70%** (69-72)

Chalk

- Opaque area of grain
 1. Genetics
 - Variety
 2. Environment
 - High heat - increased packing rate of starch granules (amyloplasts) occurs during grain filling which causes air spaces in the endosperm of the kernels to form.
 - T. Siebenmorgen
- $\leq 73^{\circ}\text{F}$ nighttime air temp @ grain filling begin to see increased chalk
- $\leq 75^{\circ}\text{F}$ nighttime air temp @ grain fill expect a chalky year



Chalk and Fissuring



Chalk also leads to decreased milling b/c chalky areas tend to be weaker and more prone to breakage than translucent rice kernels.



Immature kernels can also be considered chalky when mixed with mature translucent grains when rice is harvested too early.



Grain Quality Evaluation (physical)

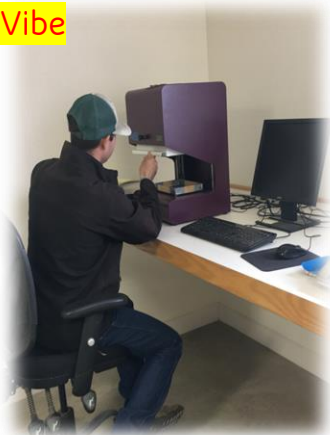
ID	MC	% Whole Chalky (2022)	% Whole Chalky (2023)	Whiteness	Vitreous Whiteness	Ave. Length	Ave. Width	L/W	1000-g Weight (g)
M-105	19	1.9	3.17	133	124	5.57	2.37	2.35	18.21
M-206	19	3.2	1.34	132	124	5.65	2.45	2.31	20.15
M-209	19	2	0.19	131	125	5.93	2.43	2.44	21.75
M-210	19.8	1.9	1.77	133	125	5.71	2.44	2.34	20.62
M-211	19.7	2.6	0.49	132	126	5.88	2.57	2.29	22.29
M-521	18.5	2.4	0.81	131	124	5.69	2.43	2.34	20.22

Long
7.2-8mm
3 times width

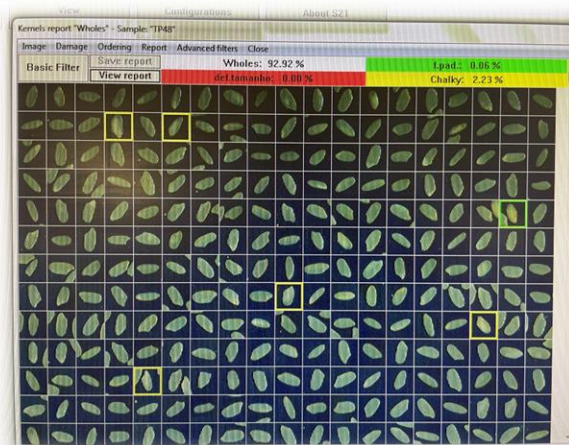
Med
6.1-6.5mm
2.5 times width

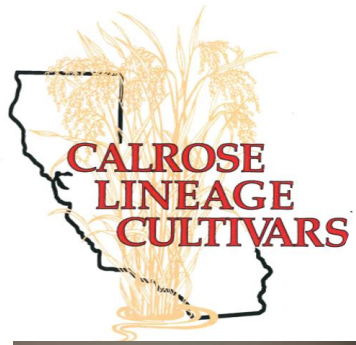
Short
5.1-5.7mm
2 times width

Vibe



S-21

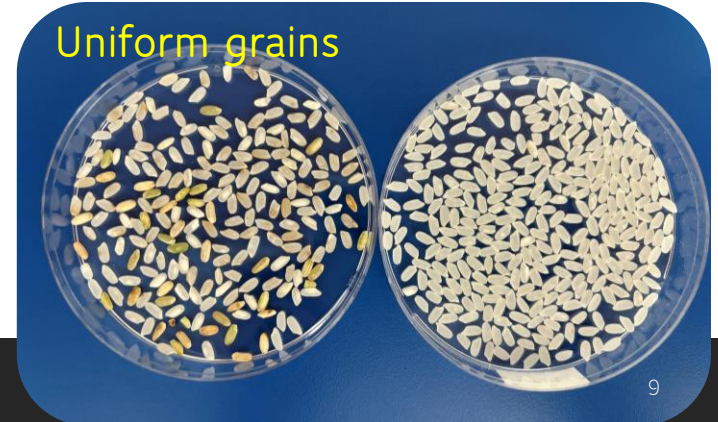




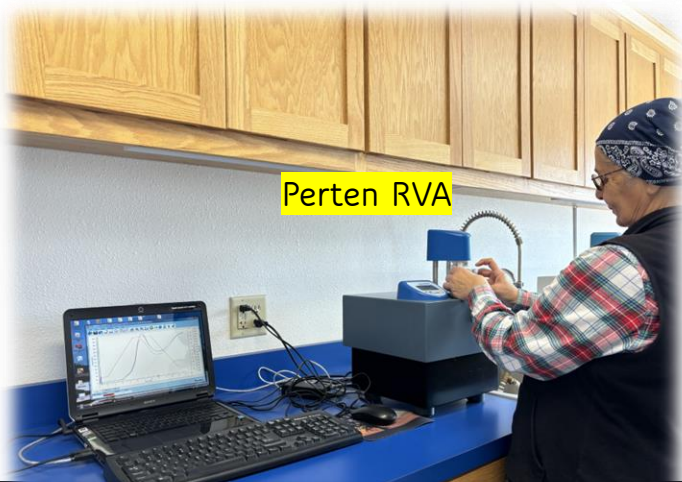
Panicle Selection



Visual Grain Quality Evaluation



Physicochemical Properties of Calrose



Variety ID	M-105	M-206	M-209	M-210	M-211	M-401	Calrose Average	Koshihikari
U.S. Market Type	MG	MG	MG	MG	MG	Premium Medium Grain	MG	Premium Short Grain
Amylose (%)	18.4	17.7	17.1	15.7	14.4	18.1	16.4	17.6
Gelatinization Temp.	Low	Low	Low	Low	Low	Low	Low	Low
Protein (%)								
Brown	6.5	6.7	6.8	7.3	5.8	5.9	6.6	6.5
Milled	5.6	5.9	6	6.4	5.1	5.2	5.8	5.5

Amylose content: Waxy = 1-2%, Very Low 2-9%, low 10-20%, Intermediate 20-25%, high >25%

RES Sensory/Eating Quality Evaluation



TRAIT	RATING SCALE	Calrose-1	Calrose-2
	UNCOOKED RICE		
Chalkiness	1 to 5, with 1 having most chalk and 5 having least chalk		
Translucency	1 to 5, with 1 being opaque and 5 being most translucent		
Whiteness	1 to 5, with 1 being brownish and 5 being whitest		
Colored Grain	1 to 5, with 1 having too many discolored grains and 5 having zero discolored grains		
Bran Streaks	1 to 5, with 1 having too many bran streaks and 5 having zero bran streaks		
Grain Uniformity	1 to 5, with 1 having most variable appearance and 5 being most uniform		
Overall Appearance	1 to 5, with 1 being least acceptable and 5 having excellent appearance		
Grain Type	Acceptable to market grain type? Yes/No		
	COOKED RICE		
Aroma	1 to 5, with 1 having no aroma and 5 having most desirable aroma		
Glossiness	1 to 5, with 1 not glossy and 5 being most glossy		
Whiteness	1 to 5, with 1 being brownish and 5 being whitest		
Cohesiveness	1 to 5, with 1 being very sticky and 5 being not cohesive		
Softness	1 to 5, with 1 as hardest and 5 being softest		
Mouthfeel	1 to 5, with 1 being dry-rough and 5 having moist-smooth texture		
Taste	1 to 5, with 1 as least satisfactory and 5 having best taste		
Overall Rank	1 to 3, with 1 having most attractive cooked appearance and best taste		

Consumer/Market Acceptability Testing



Dr. Anna McClung,
USDA



Trevor Stockton, TN



Brett Seuss, NC

Spencer Thomson, NC

Dawn Yanagihara, NC

Chad Carter

Paul Feribach, IL

Michael Touhy, SF

Rice Quality in Current Calrose Varieties



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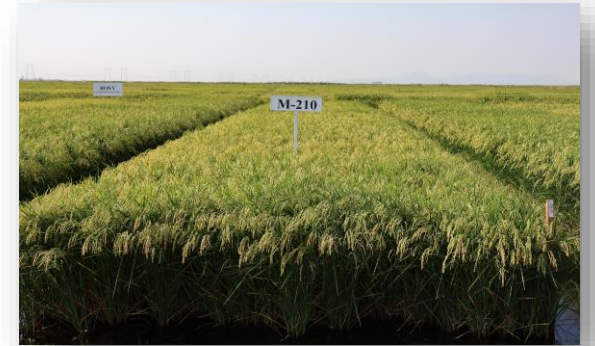
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Rice Quality Meeting
June 26, 2024

Calrose Medium Grain Varieties

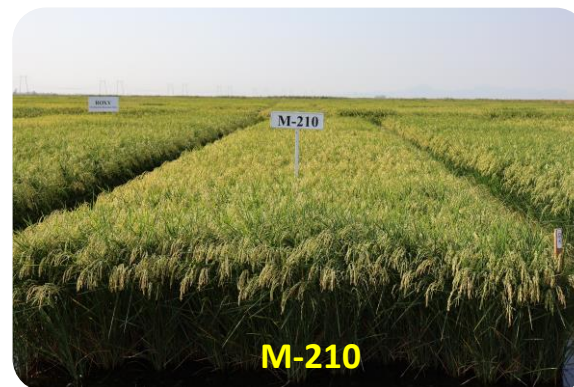
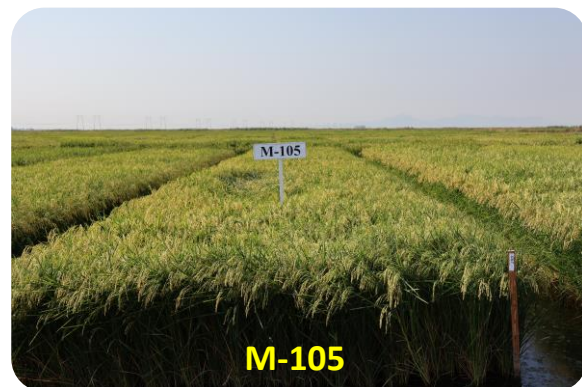
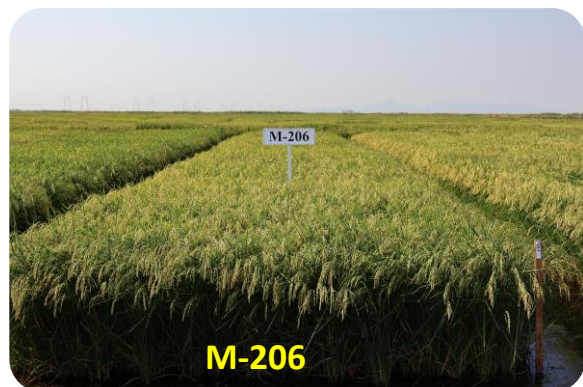
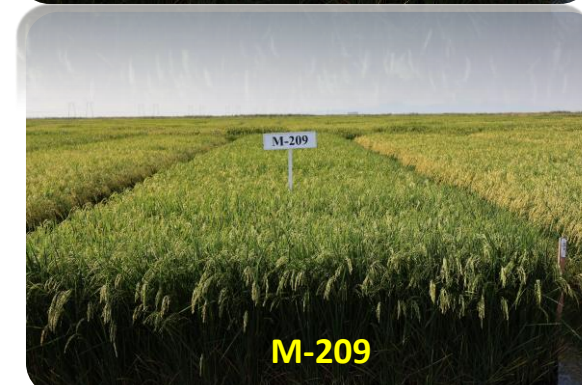
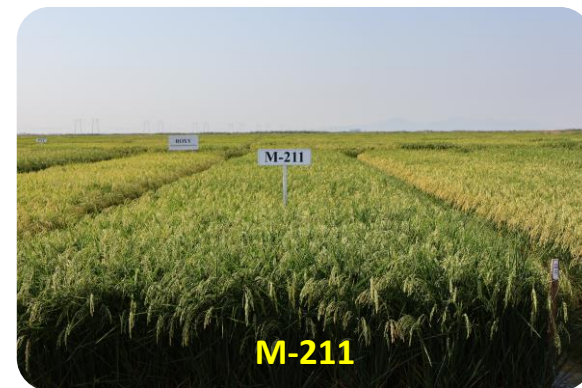
- M-105
 - Earliest: 1-2 days earlier than M-206, 3-5 days south of 20
 - Won yield contest in 2023 (132.5 sacks)
 - Can lodge
- M-206, M-210, M-521
 - Very similar (early, stable milling)
 - M-210 & M-521 blast resistance
 - M-521 ROXY herbicide tolerance
- M-209
 - Later variety (7 days in 2023)
 - High higher yielding
 - Not suited southern region
 - Reduced lodging
 - Susceptible to smut?
- M-211
 - Later variety (7 days in 2023)
 - Highest yielding
 - Not suited southern region
 - Susceptible to chalk
 - Milling falls off quickly
 - Reduced lodging
- M-401
 - Premium quality
 - Latest maturing (photoperiod sensitive), Milling falls off quickly





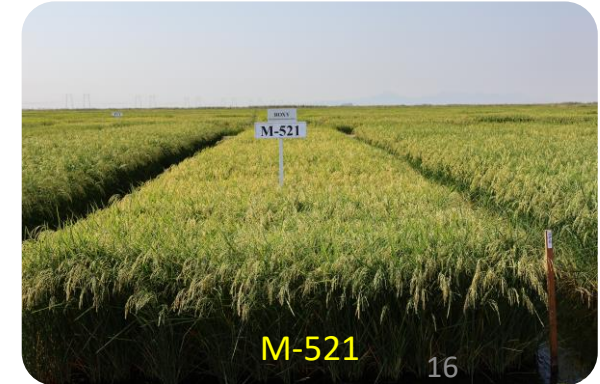
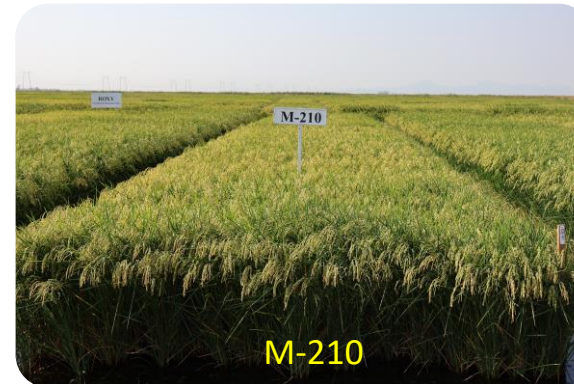
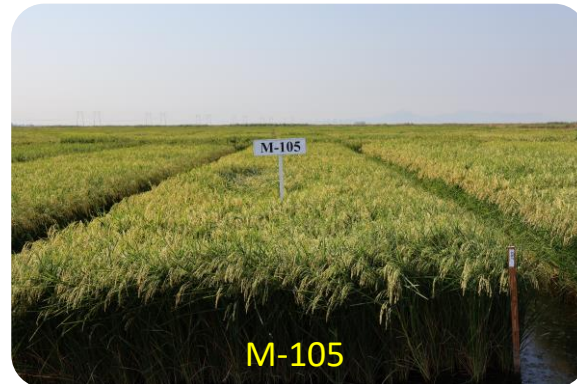
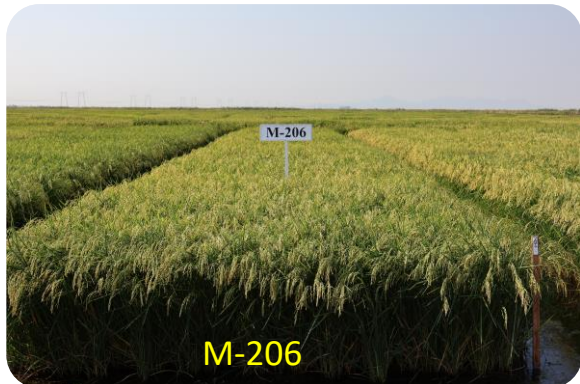
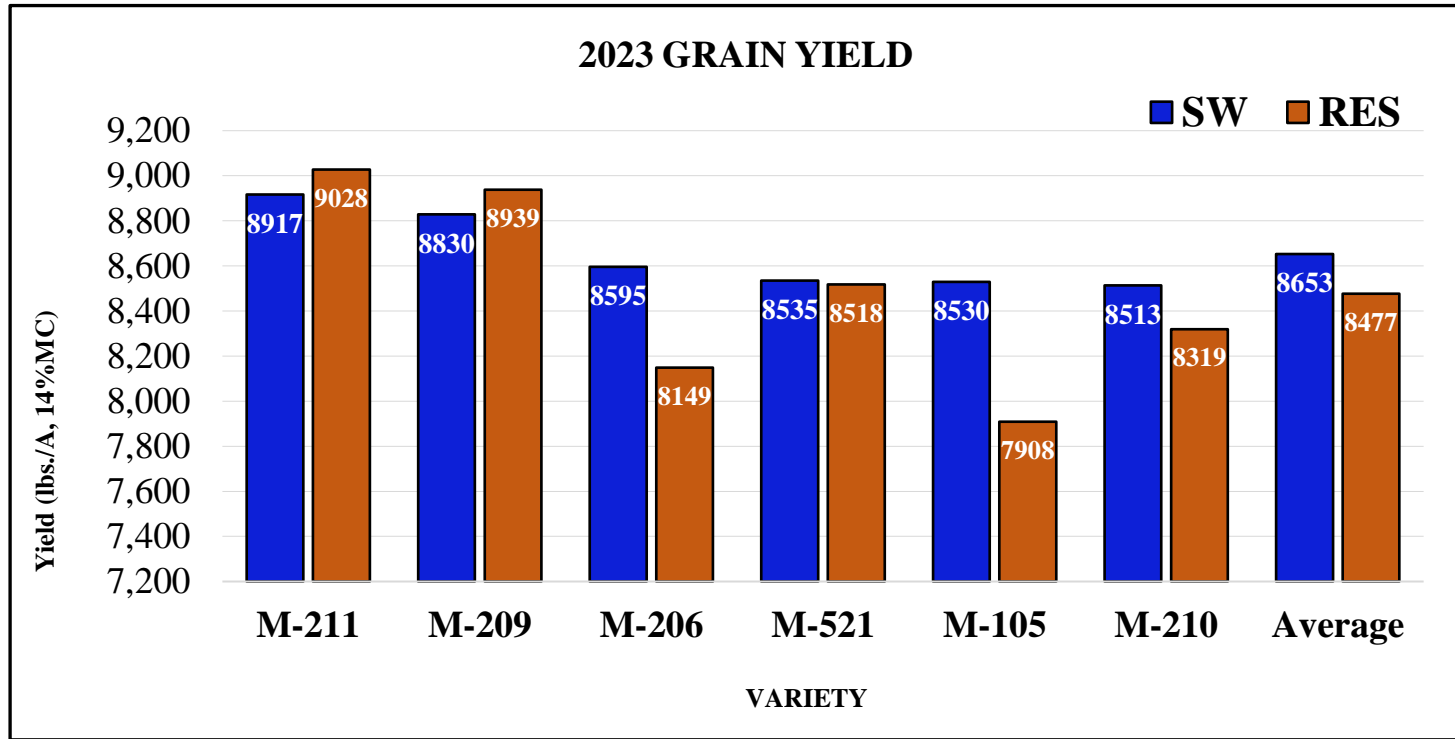
2023 AGRONOMIC SUMMARY OF CALROSE VARIETIES

23 ID	Seedling Vigor		Days to 50% Heading		Plant Height (cm)		Lodging (%)		Panicle Blanking (%)		Stem rot
	SW	RES	SW	RES	SW	RES	SW	RES	SJ	GH	RES
M-521	4.9	4.9	83	77	102	108	44	17	1	5	5.0
M-211	4.9	4.9	89	84	106	112	32	7	2	31	4.9
M-210	4.9	4.9	84	77	101	106	49	33	1	7	4.8
M-209	4.8	4.8	89	84	102	107	27	0	2	33	4.3
M-206	4.8	4.9	83	77	103	107	46	38	1	5	4.2
M-105	4.8	4.8	82	75	102	109	45	31	1	6	4.7
MEAN	4.8	4.9	85	79	104	108	43	31	2	23	3.8
5%LSD	0.0	0.1	5	1	18	4	19	25	2	26	1.4
CV	1.8	1.2	11	2	36	4	91	85	69	112	31.3

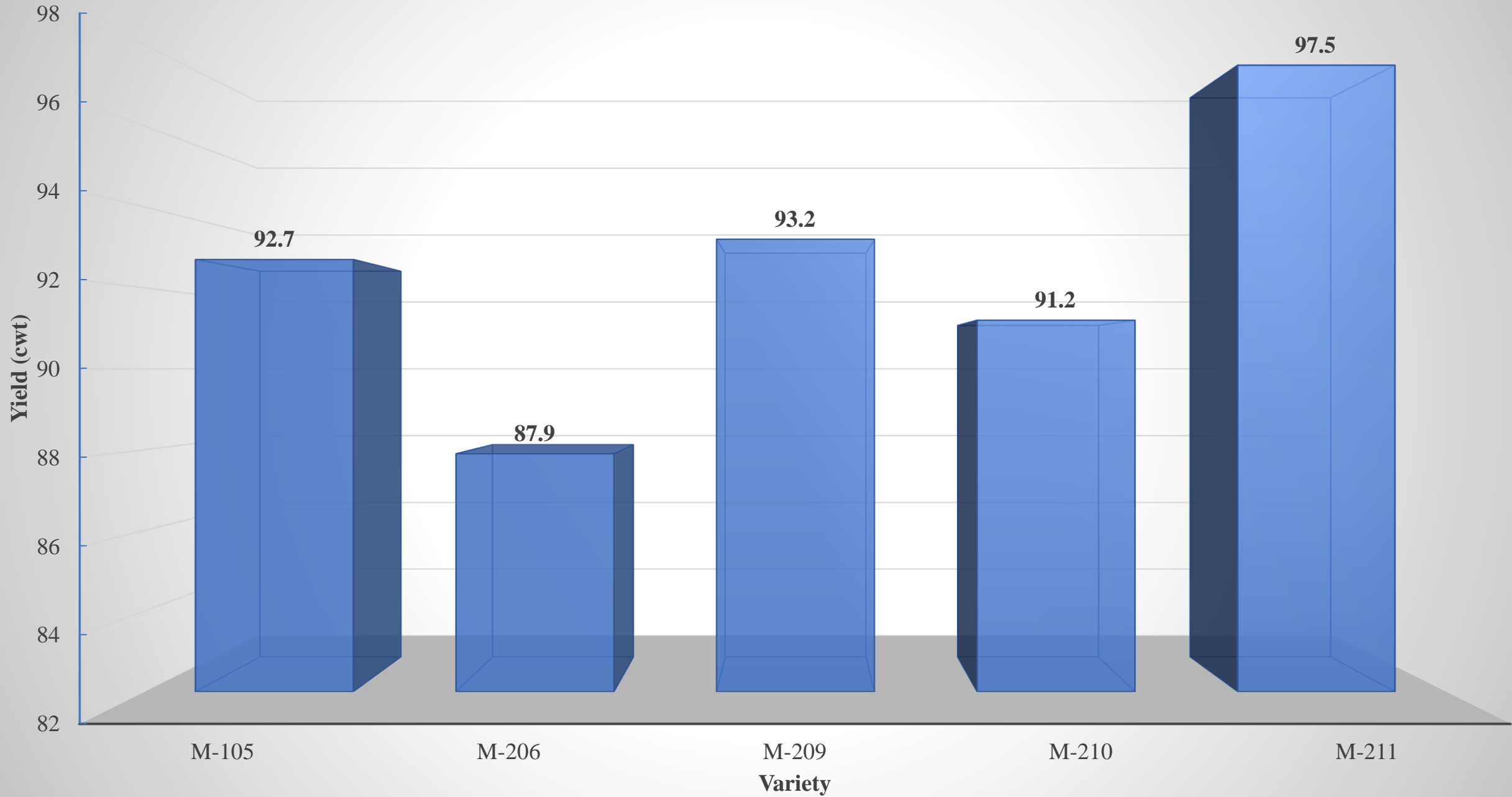




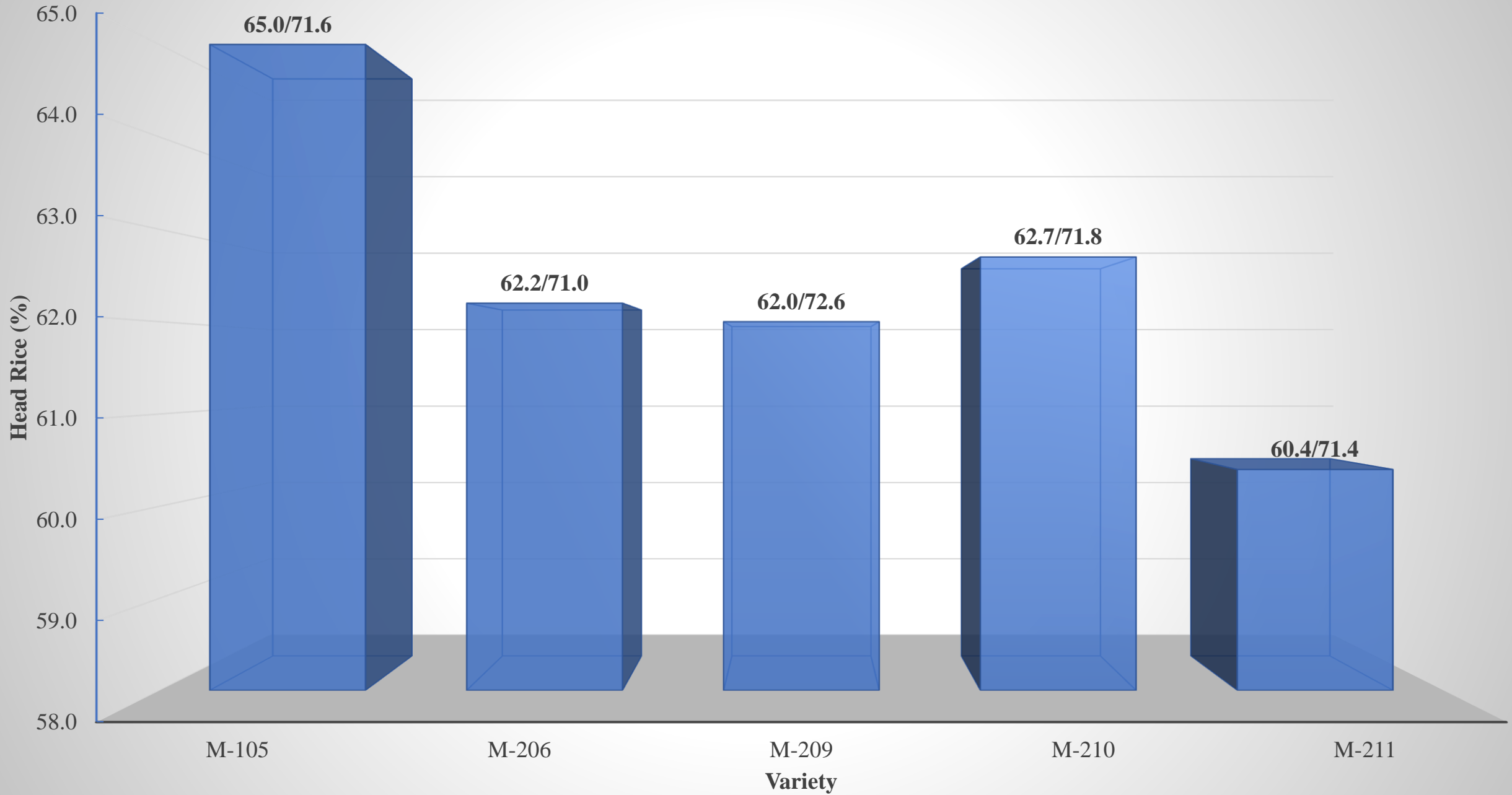
2023 CALROSE VARIETY PERFORMANCE



2023 BUCRA Yields by Variety

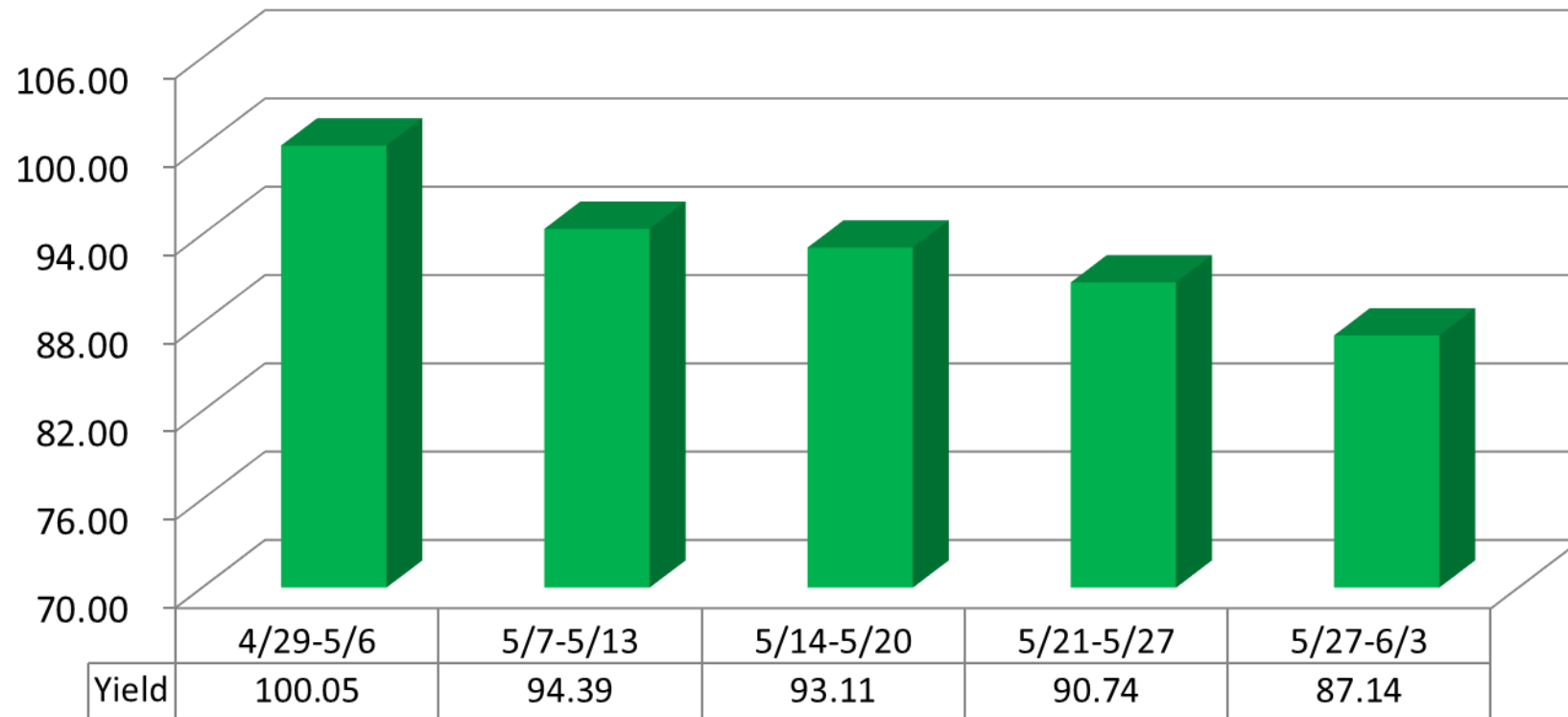


2023 BUCRA Milling by Variety





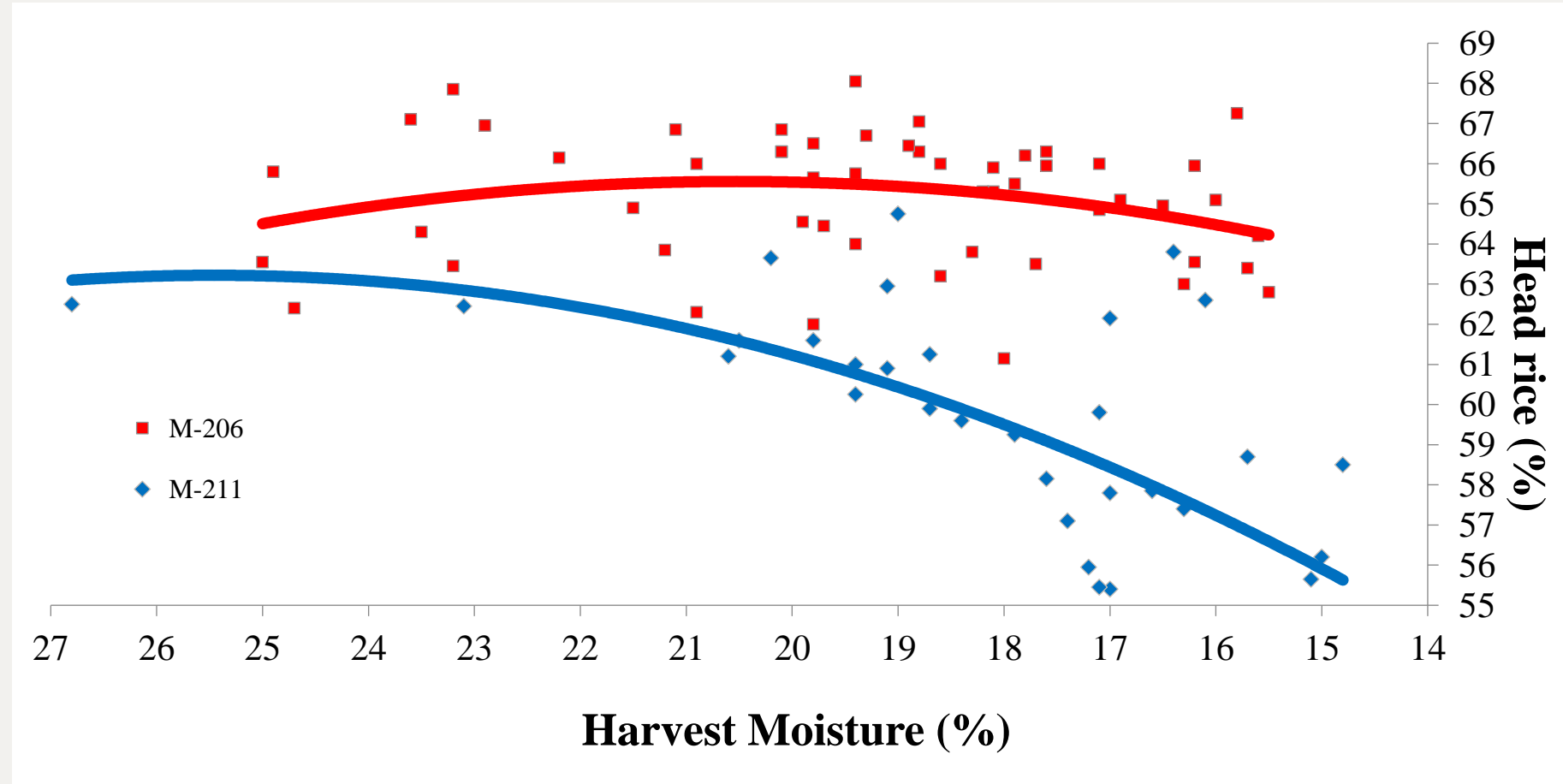
Overall Yield by Plant Date



Effect of harvest grain moisture on head rice yield of M-211 and M-206

Relationship between harvest moisture and head rice

- Head rice decreases with decreasing harvest moisture
- M-211, M-401 more susceptible than other Calrose
- Due to drying-rehydrating-drying causing moisture stress fissuring





Environmental Effect on Rice Quality Parameters of California Calrose Varieties

Harrell, D.L.; Zhang, Z.; DeLeon, T.; Maulana, F.; Sharma, N.; Zaunbrecher, G.; McKenzie, K.; Shelton, C; Linguist, B., and Kongchum, M.

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39th Rice Technical Working Group
February 20-23, 2023
Hot Springs, Arkansas

Grain Quality Questions

- Can grain quality (taste, protein, and amylose) be altered significantly by environment?
 - Protein, amylose, taste
- Do some Calrose varieties have a greater grain quality response across environments (locations) than others?

Rice Variety Trials by CA Locations



Materials and methods

- 5 California Calrose Rice Varieties
 - M-105
 - M-206
 - M-210
 - M-211
 - M-521 (19Y4000)
- 8 Variety Trial Locations
 1. Glenn – Ben Gordon (2022) Wiley (2023)
 2. North Butte – Eric Larrabee
 3. Butte – Rice Experiment Station
 4. San Joaquin – Del Rio Partners
 5. South Butte – Carl Schohr
 6. Sutter – Matt Lauppe
 7. Yuba – Michael Rue
 8. North Yolo – Kim Gallagher (2023)

Rice Variety Trials by CA Locations



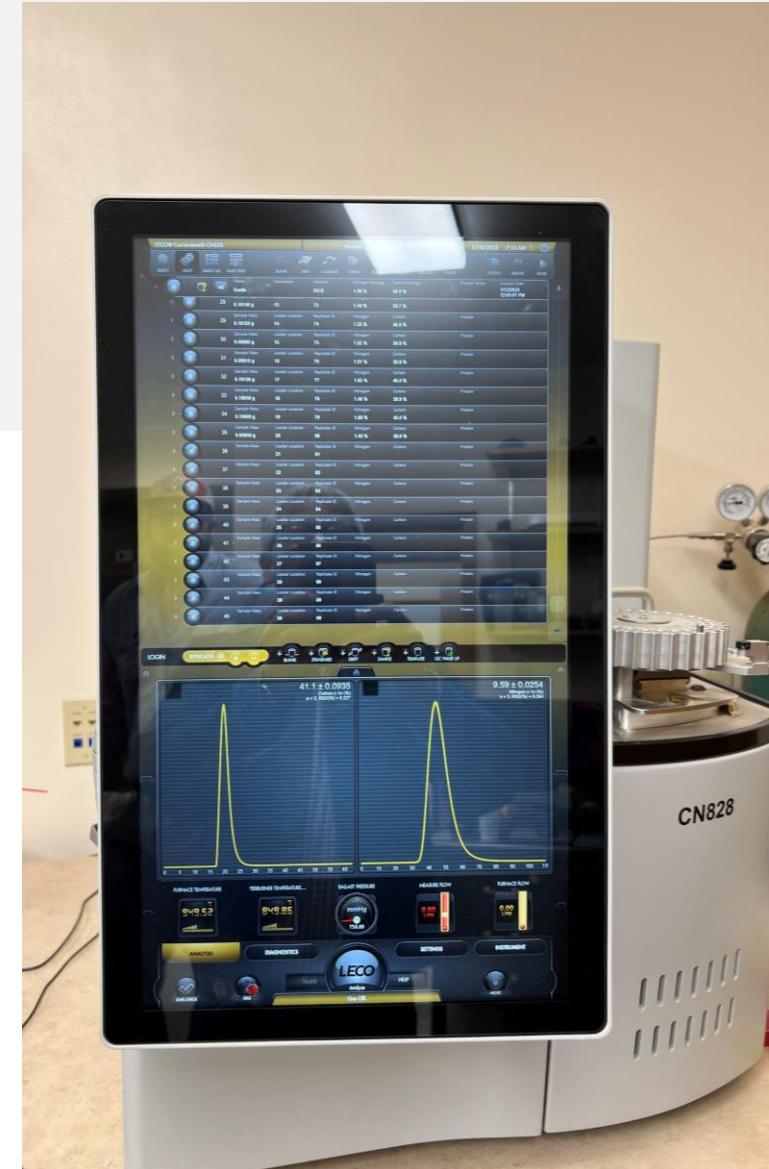
Materials and methods

- Milling
 - Dried to 13% (can drier)
- Lab
 - Dehulled & milled: Yamamoto
 - Size sorted: Satake



Materials and Methods

- Satake Taste Instrument
 - Taste, Protein, Amylose
 - NIR
- Protein
 - Combustion analysis (LECO CN828)



Materials and Methods

- Apparent Amylose Content
 - 1 N NaOH / 10% EtOH digestion
 - 10-minute digest
 - Colometric (iodine/acetic acid solution @ 600nm)
 - Lachat flow analyzer

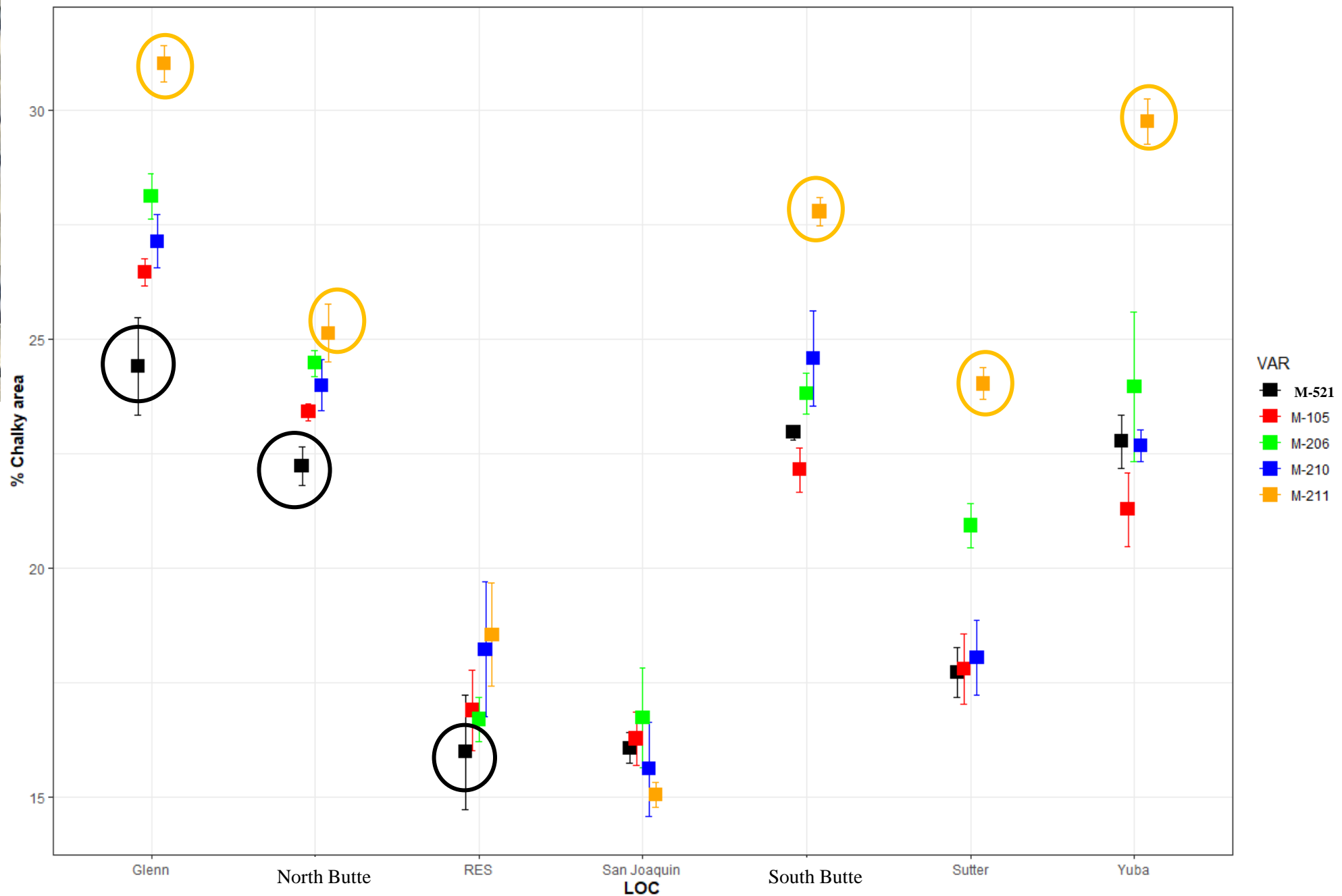


2022 Chalk

(% chalky area by
521 instrument)

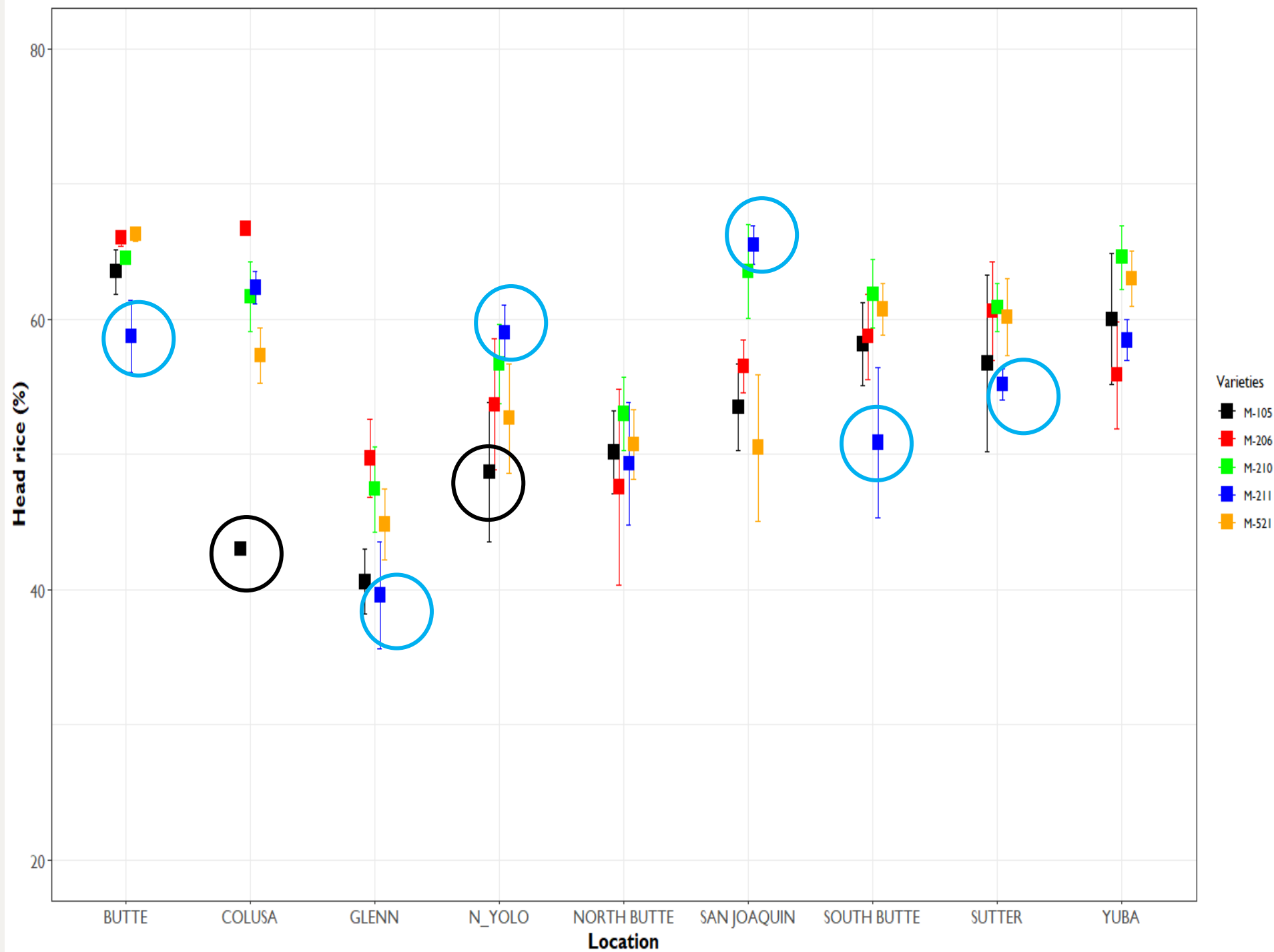


- Scanner – not the same as USDA methodology
- M-521
 - Highest 0 locations
 - Lowest 2 location
 - Overall slightly lower



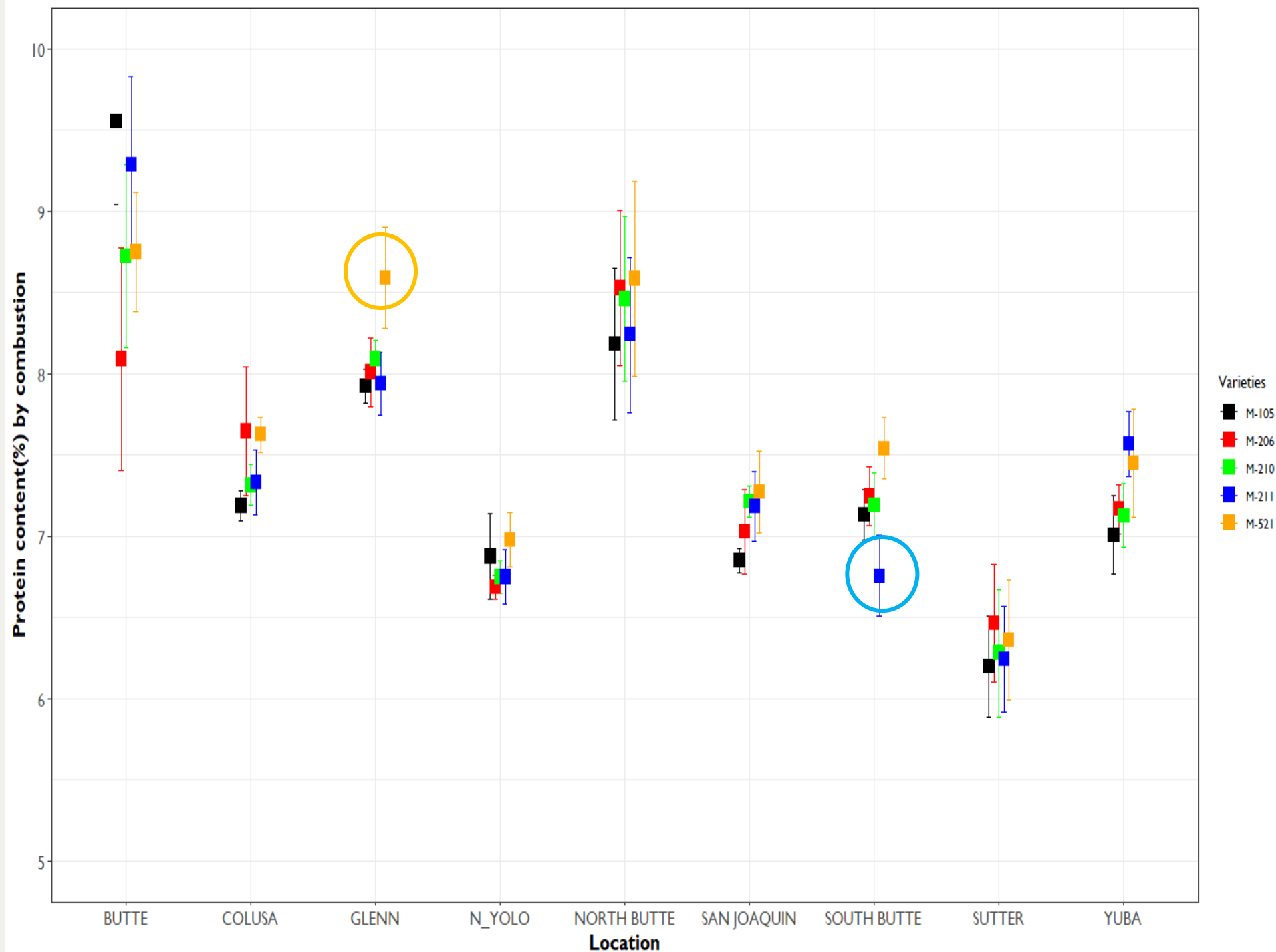
2023 + 2022 Head Rice


- Environmental effect
- General Trends:
 - M-211 – VARIABLE
lowest @ 4
Highest @ 2
 - M-105 – lowest @ 2
 - M-206 & M-210 often at the top



2023 + 2022 Protein Content (by combustion)

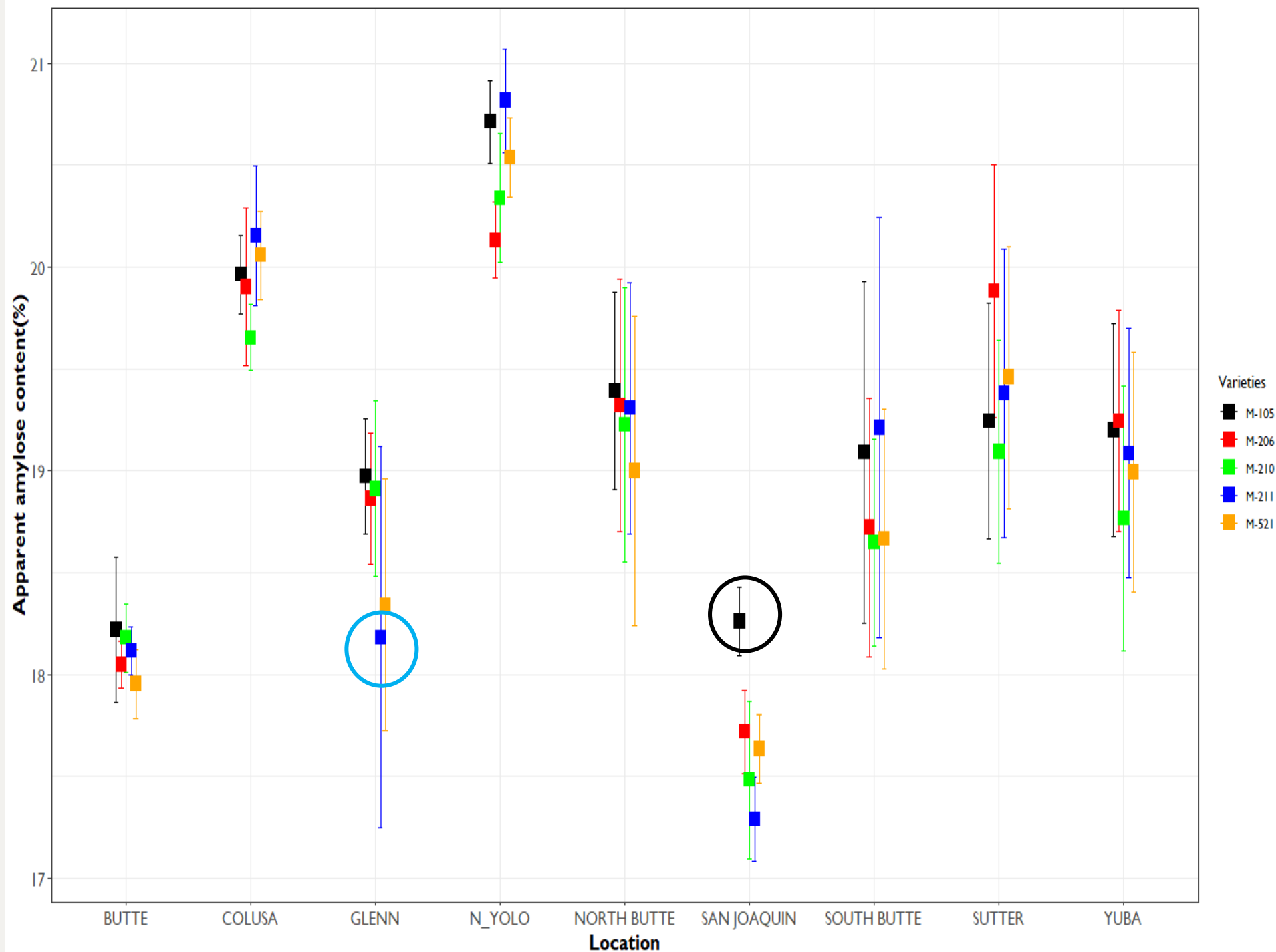
- N fertility can cause higher protein content
- Most varieties have similar protein
- M-521 – higher @ 1 location
- M-211 – lower @ 1 location





2023 + 2022 Amylose (%) (apparent amylose)

- Determined chemically
- Calrose varieties are all similar
- Environmental effect
- Can find outliers sometimes





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Field Day August 28, 2024