

The Role of Marker Assisted Breeding in the LSU AgCenter Rice Breeding Program

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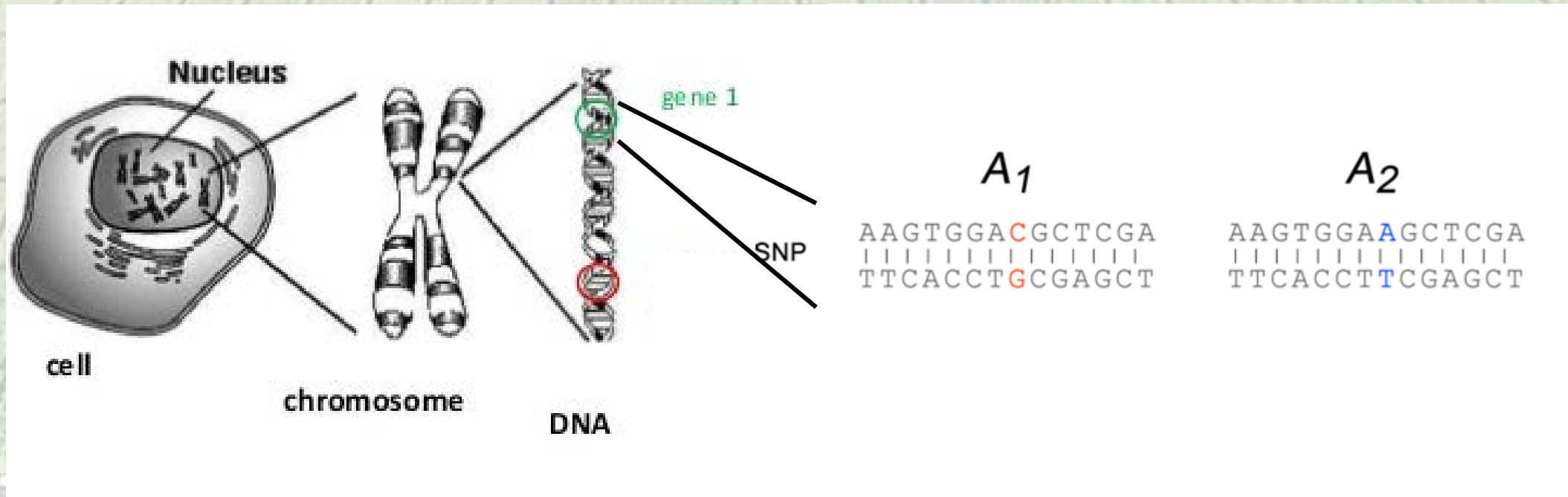


Outline

- Introduction: What is a molecular marker?
- How do we identify and develop them?
- How are they applied in our breeding efforts?
- How can they be of utility after the variety is developed?

What is a Molecular Marker?

- A region of the genome with a discernable difference between individuals of interest
- Could be associated with a trait of interest, but most markers are not



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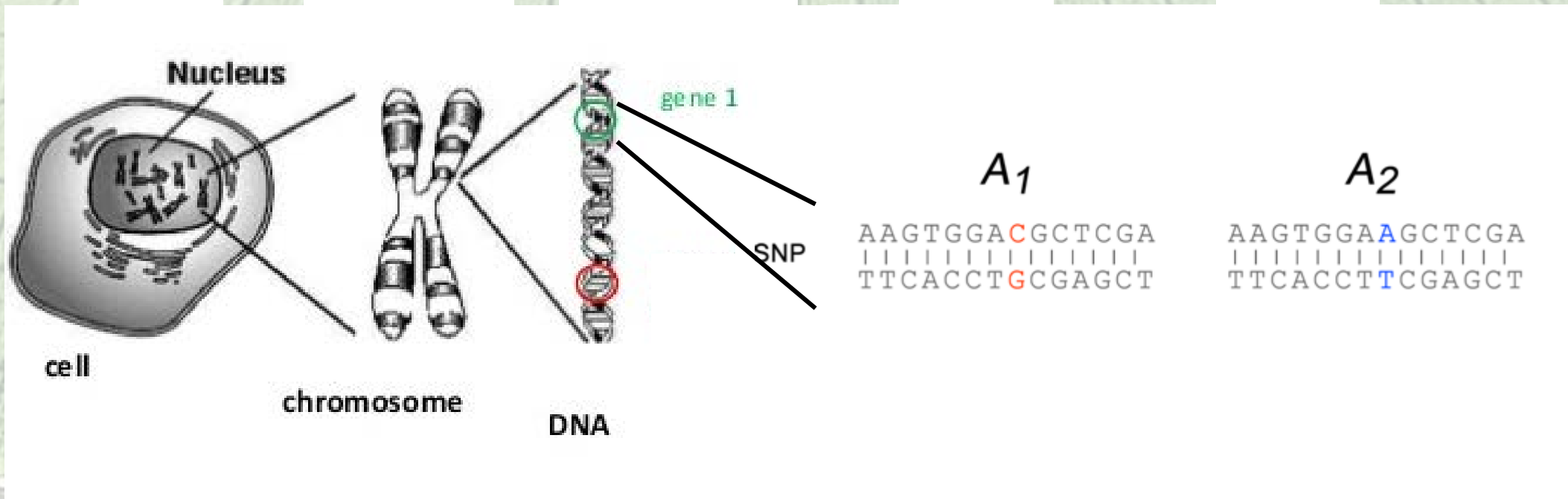
Book

Chapter

Sentence

Word

Letter



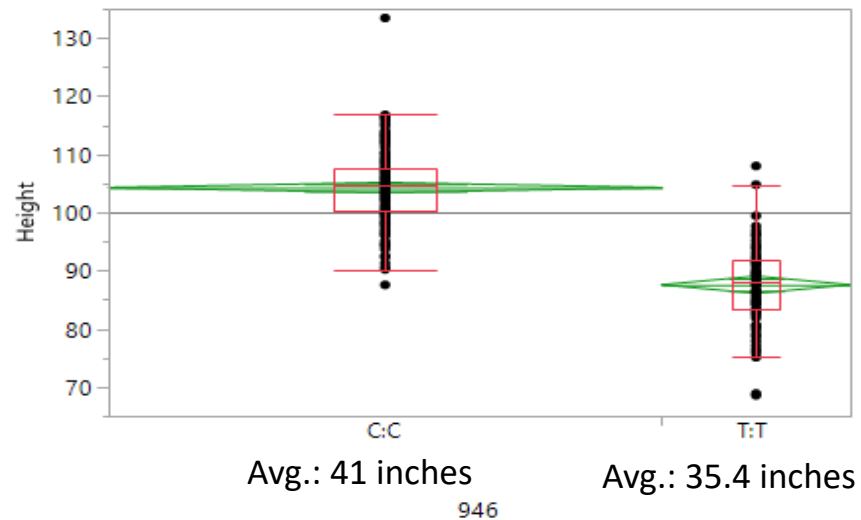
How do we Identify and Develop Markers for our Breeding Purposes?

- Leverage public databases built primarily off basic research
- For markers associated with a trait, significant discovery and validation conducted to ensure:
 - Trait/gene is useful in our environments
 - Marker is effective at predicting gene in our germplasm

Validation of Trait Markers: Plant Height

- Does Gene/Marker Segregate with the Trait in a Breeding Population?

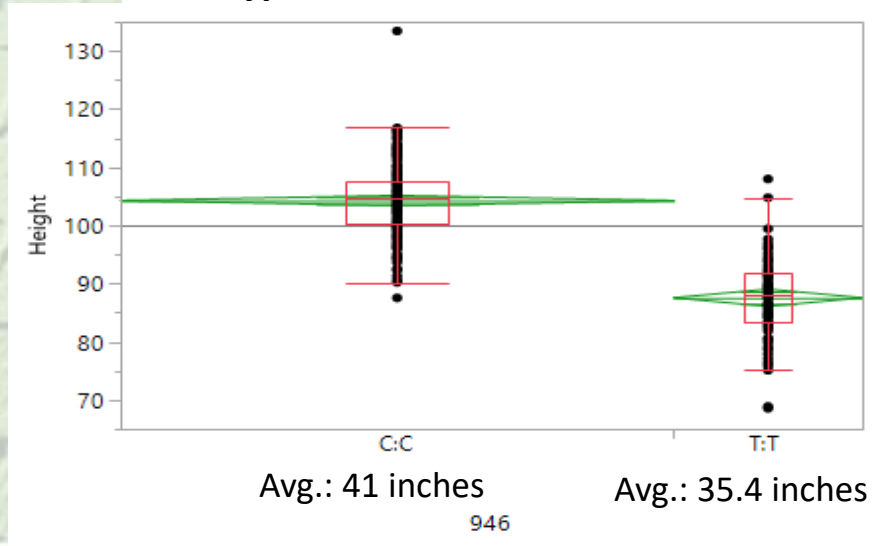
250 Lines from a Cross between LaGrue and Cypress



Validation of Trait Markers: Plant Height

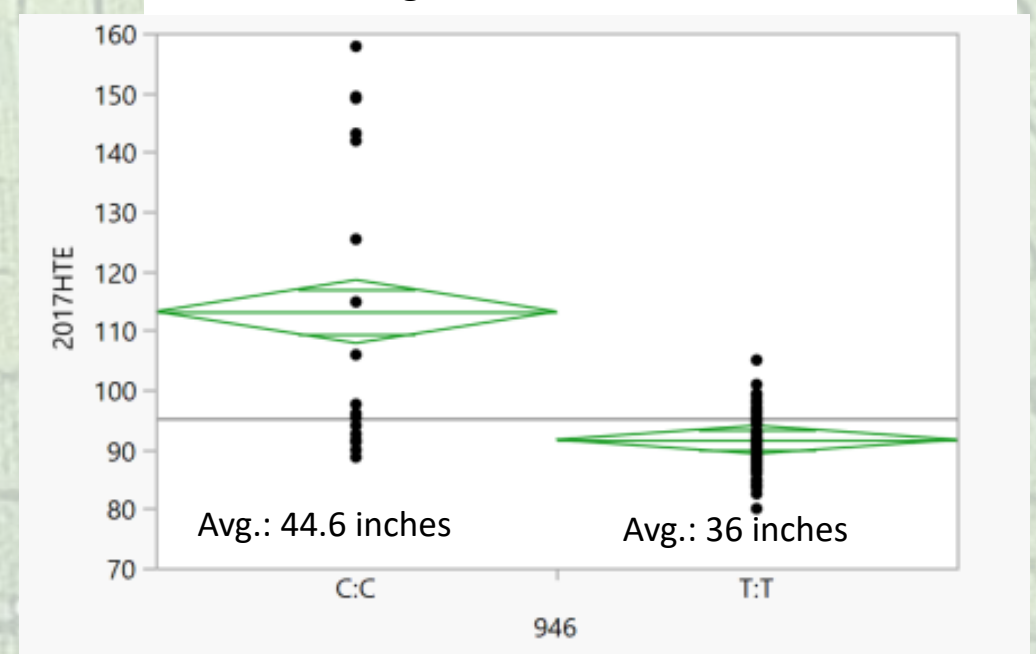
- Does Gene/Marker Segregate with the Trait in a Breeding Population?

250 Lines from a Cross between LaGrue and Cypress



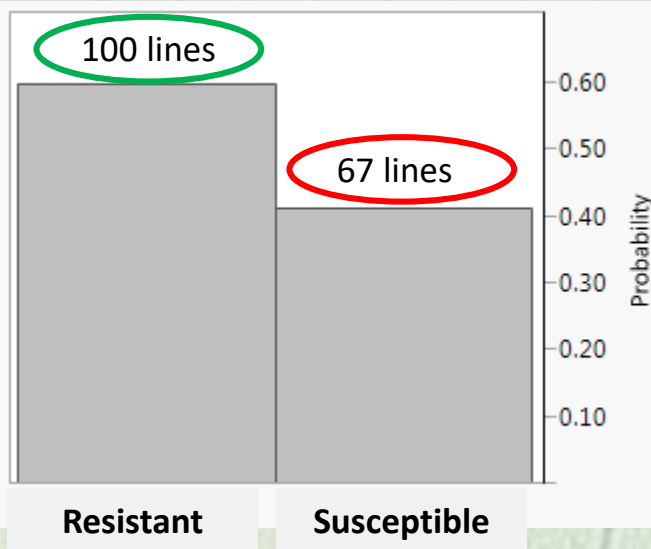
- Does the Marker Accurately Predict Trait Across Target Germplasm?

102 Long Grain Lines from Louisiana



Validation of Trait Markers: Blast

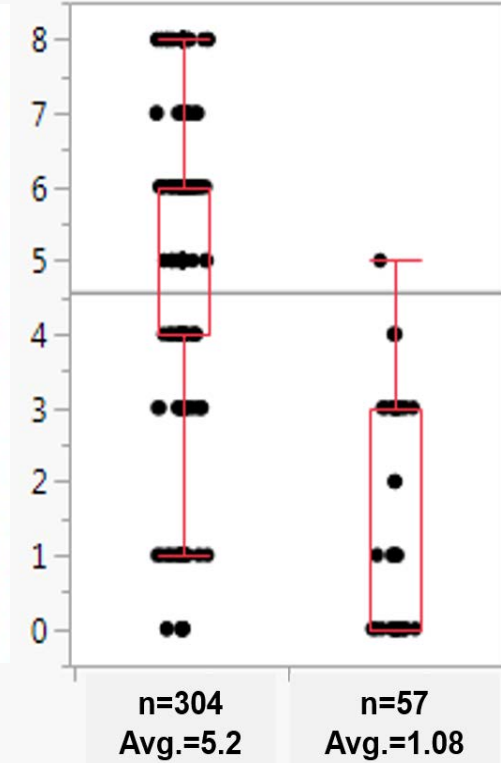
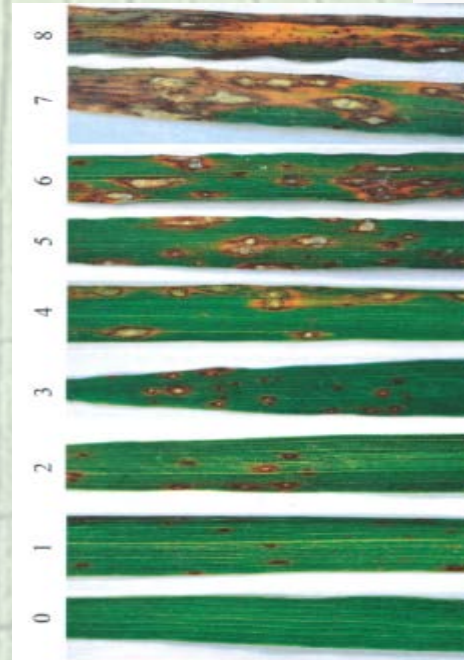
Phenotypic Distribution Across a Population of 167 Lines



Res: 97
Sus: 3

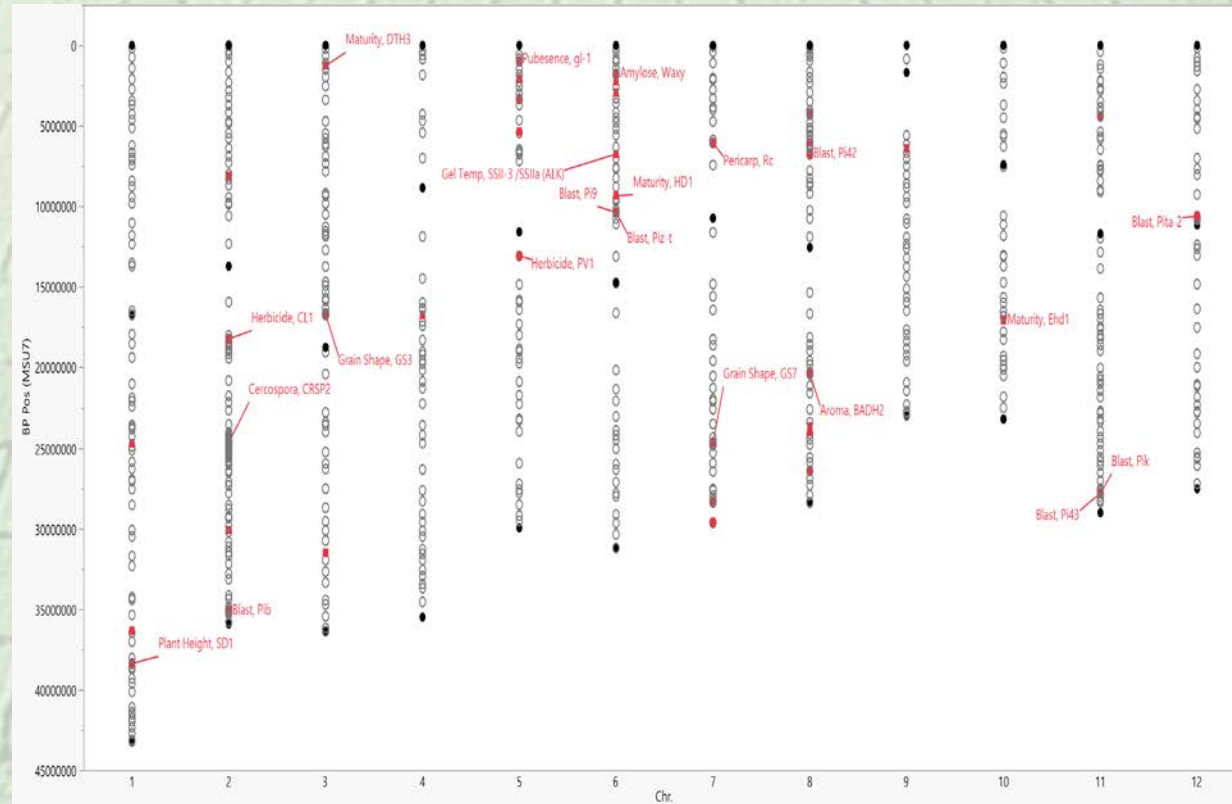
Res: 2
Sus: 65

Marker Prediction



Current Trait Markers

- Diseases
 - Blast
 - Pita
 - Piz
 - Pib
 - Pi9
 - Pik
 - Cercospora
- Agronomic Traits
 - Herbicide
 - Clearfield
 - Provisia
 - Maturity
 - Pubescence

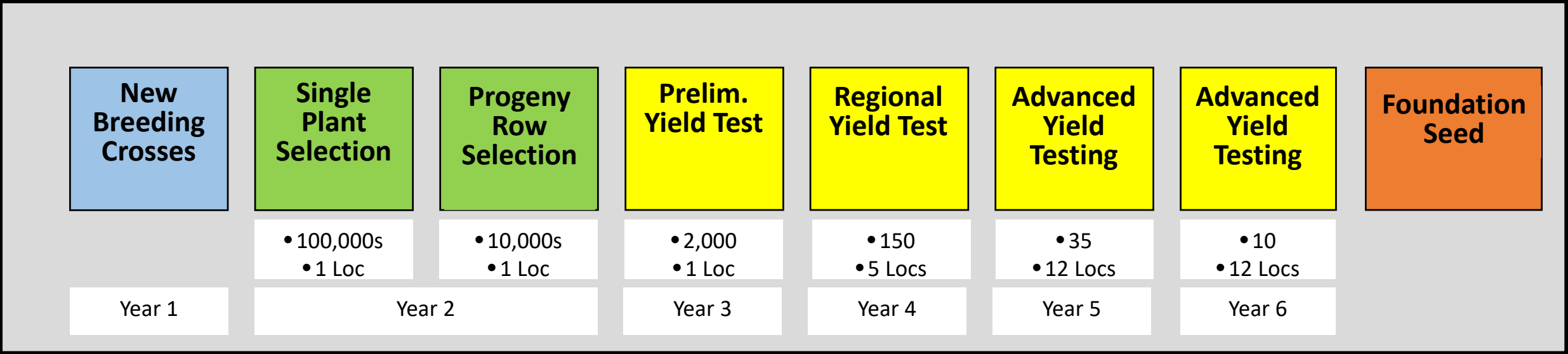


- Grain Traits
 - Grain Length (GS3)
 - Grain Width
- Grain Quality
 - Amylose
 - Low
 - Intermediate 2
 - Intermediate 3
 - High
 - Gel Temp
 - Pericarp color
 - Aroma

How are Markers Applied in Our Breeding Program?

- Selection for Traits of Interest
- Confirmation of Breeding Crosses
- Purity and Uniformity of Foundation Seed

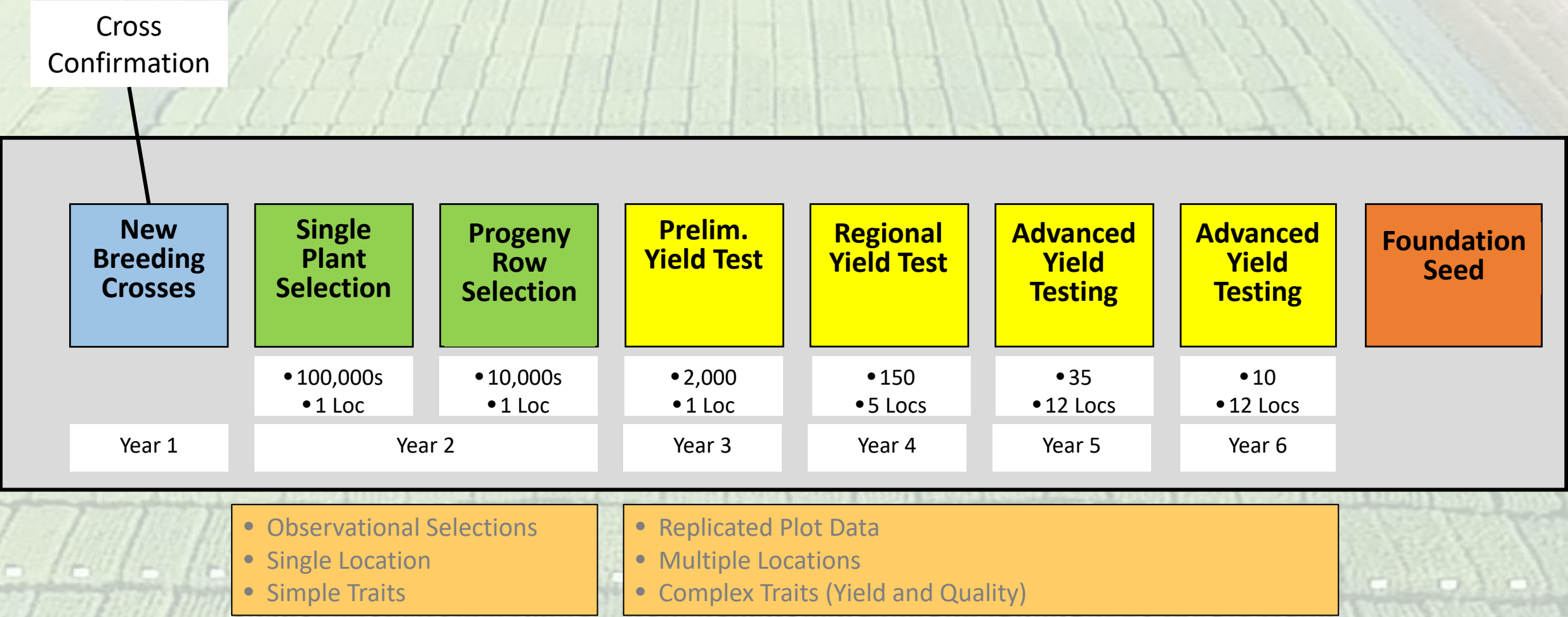
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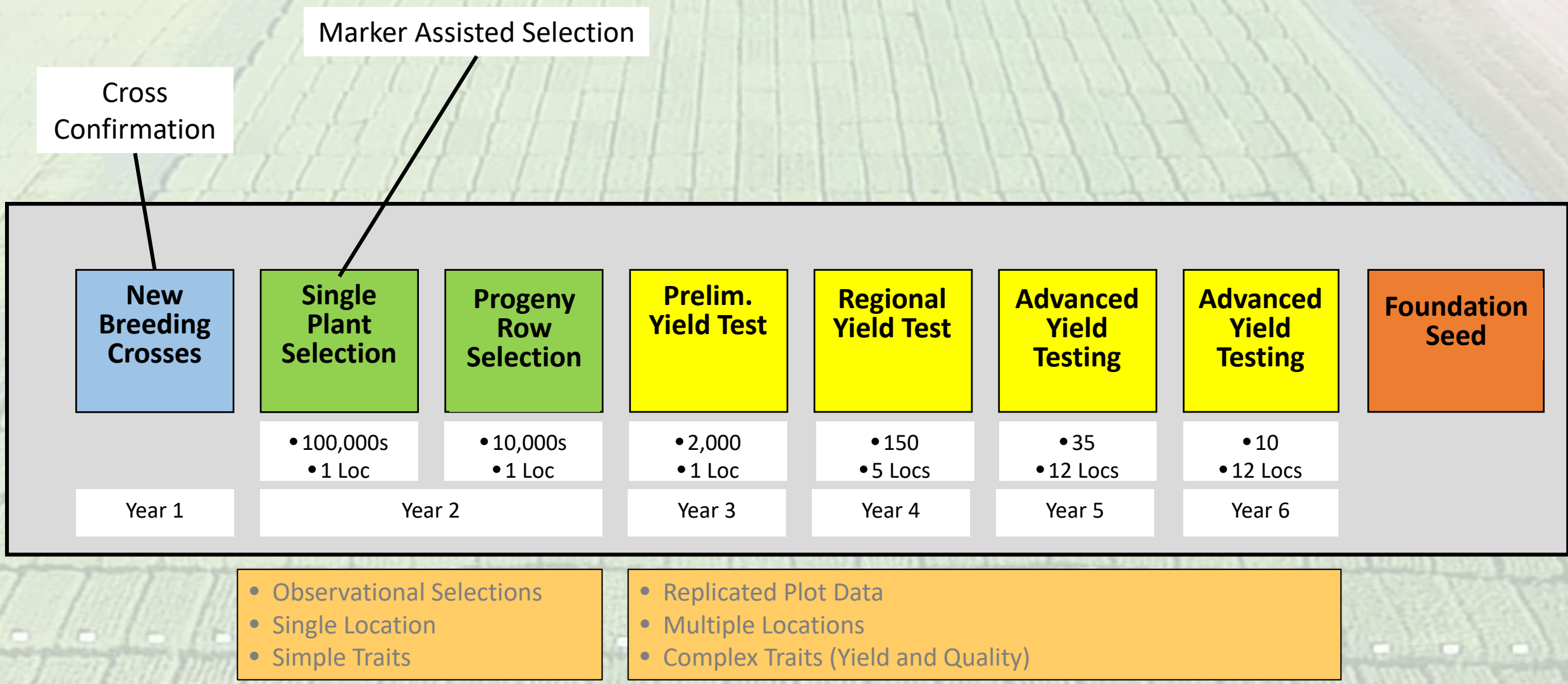
- Observational Selections
- Single Location
- Simple Traits

- Replicated Plot Data
- Multiple Locations
- Complex Traits (Yield and Quality)

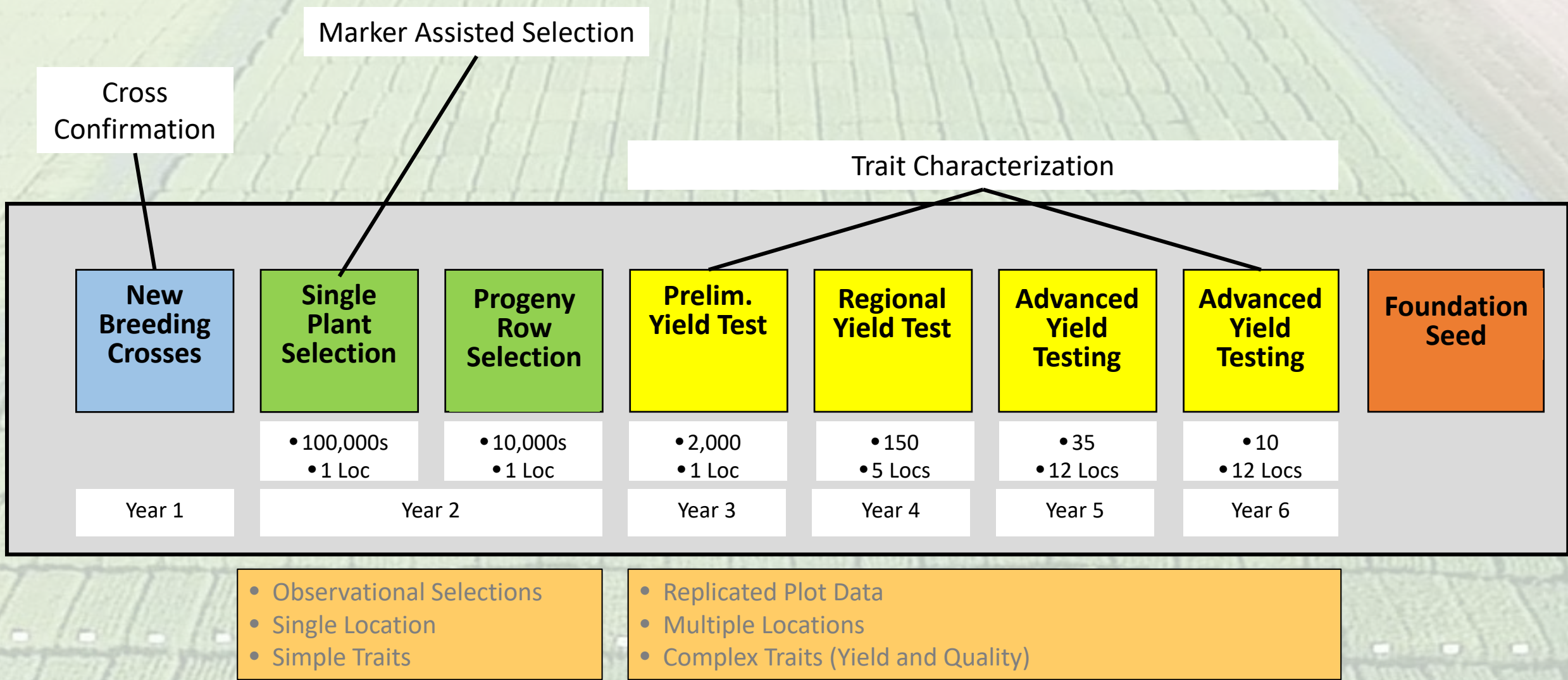
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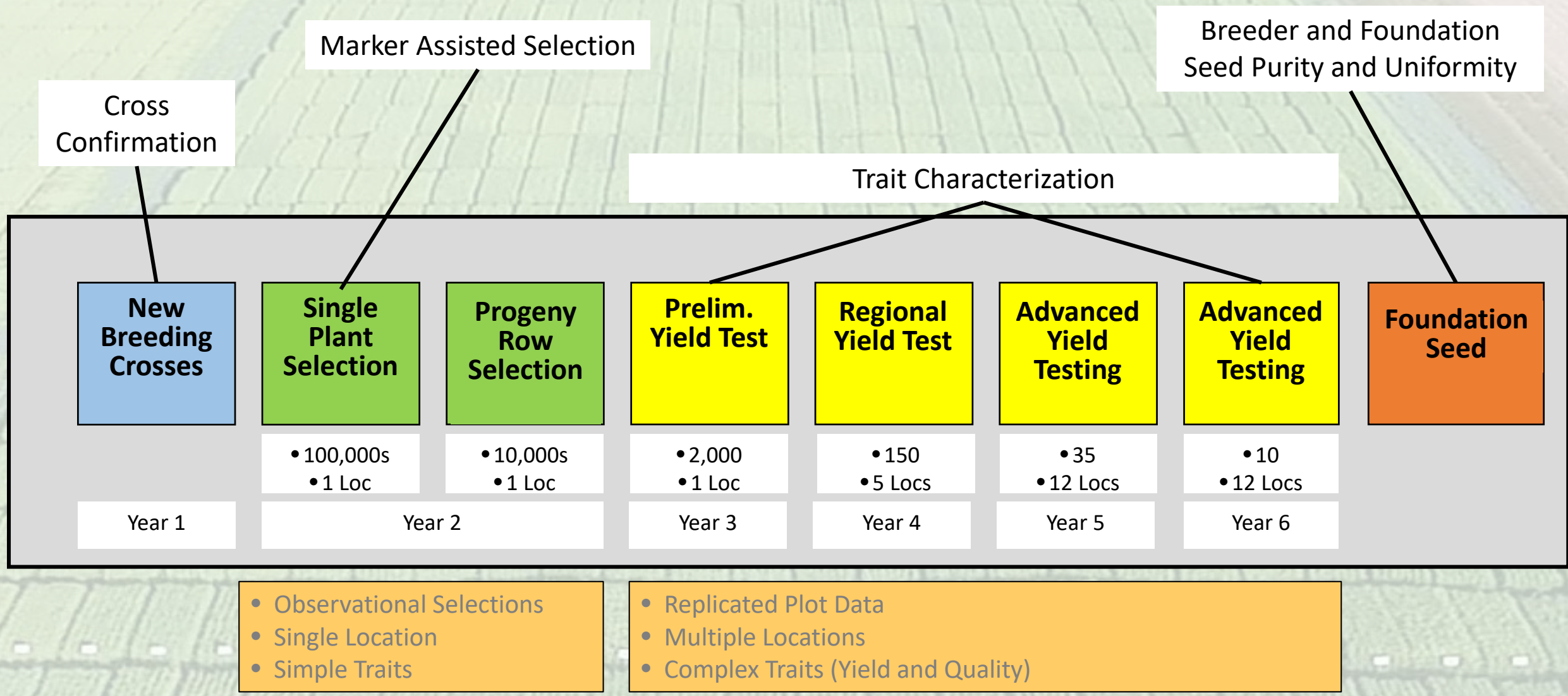
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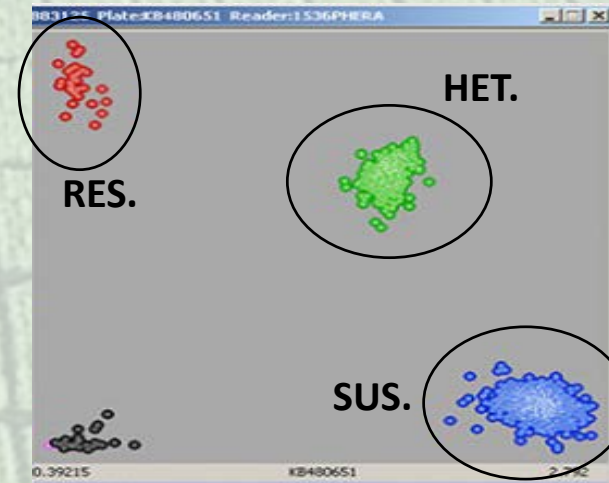
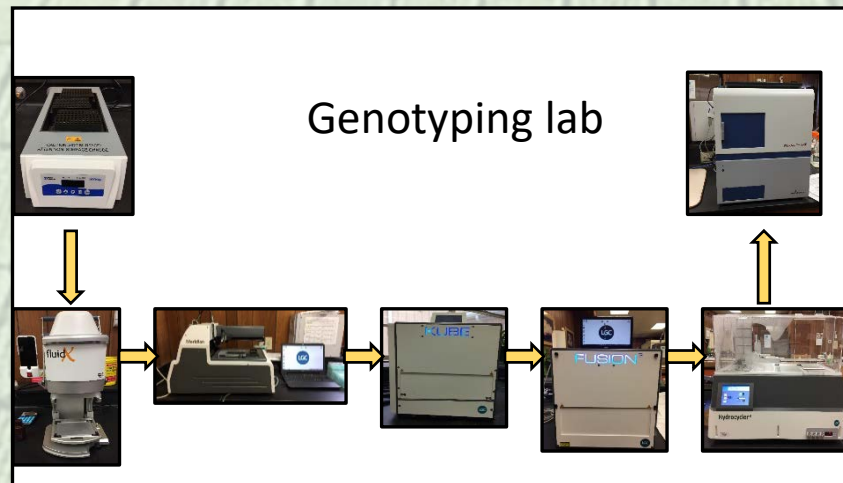
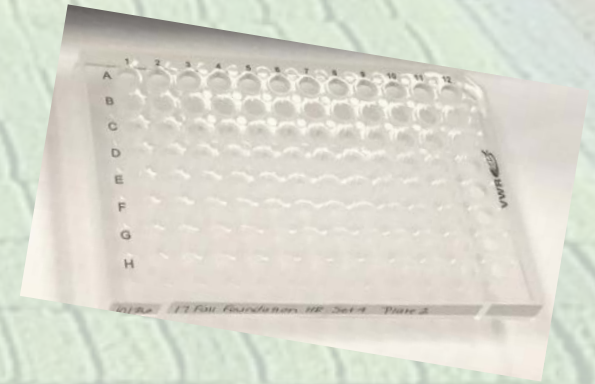
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Marker Assisted Selection Workflow



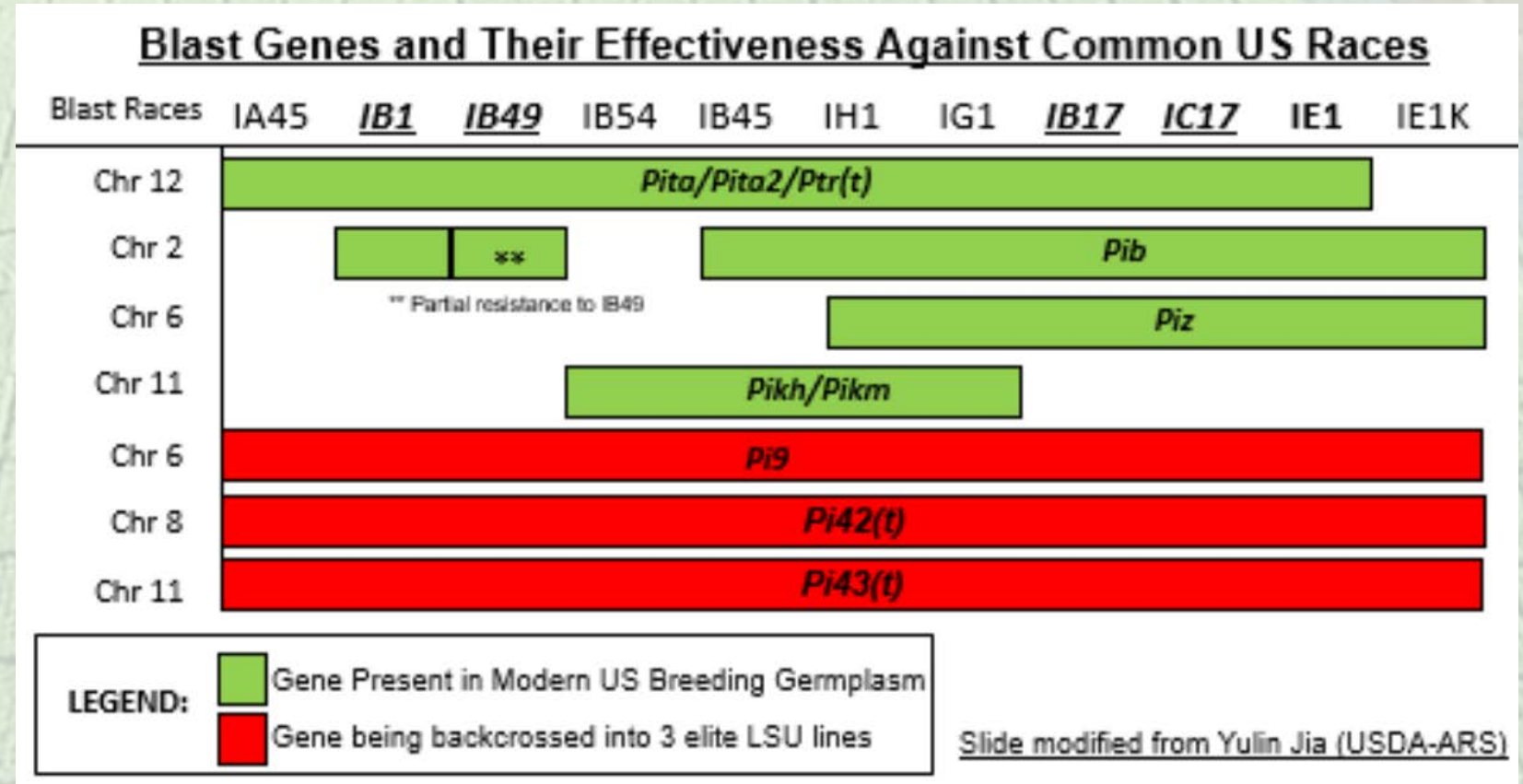
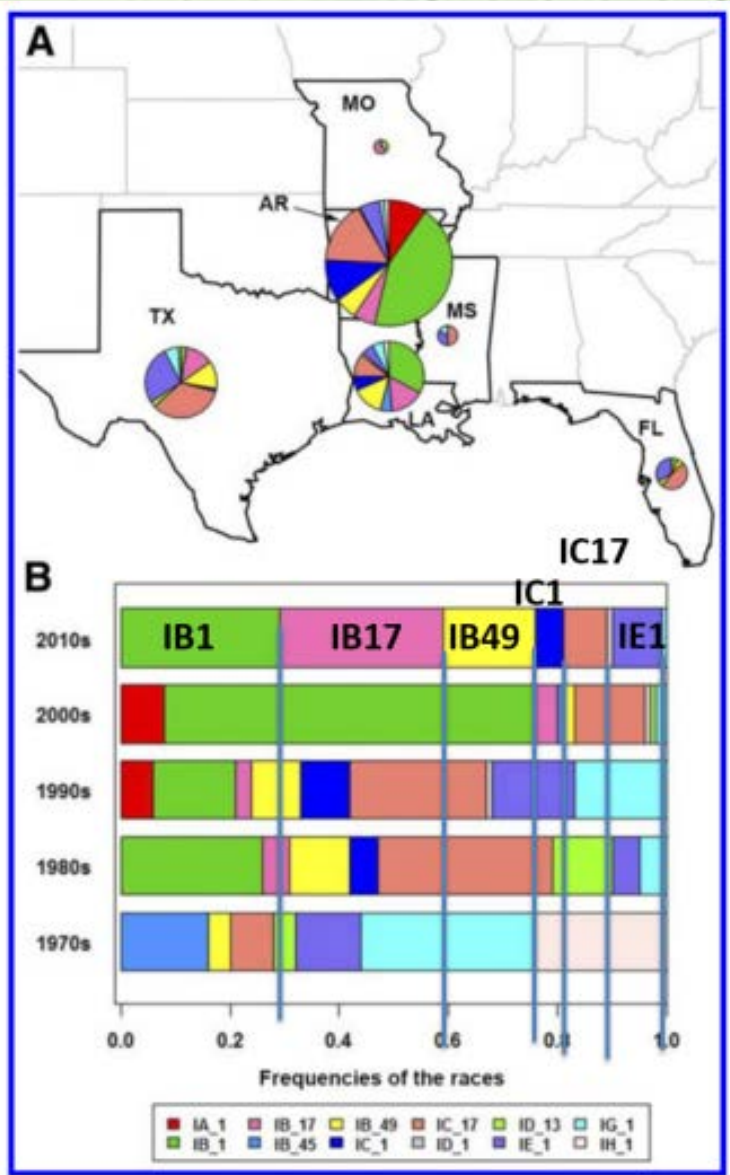
Leaf Punch



Characterization and Purity

Pedigree	Grain	HT	CL	PV	Aroma	PITA	25	250	387	494	484	386	507	54	39	478
CL 111	L	CL	YY	AA	GG	SUS	CC	GG	TT	GG	CC	CC	GG	CC	TT	CC
CL 151	L	CL	YY	AA	GG	SUS	CC	TT	AA	AA	CC	CC	GG	CC	TT	TT
CL 153	L	CL	YY	AA	GG	RES	TT	GG	AA	AA	CC	CC	GG	CC	TT	TT
CYPRESS	L		XX	AA	GG	SUS	CC	TT	TT	AA	CC	CC	GG	CC	TT	TT
CATAHOULA	L		XX	AA	GG	RES	CC	GG	AA	GG	TT	CC	TT	GG	TT	TT
CHENIERE	L		XX	AA	GG	SUS	CC	TT	AA	GG	TT	CC	GG	GG	TT	TT
MERMENTAU	L		XX	AA	GG	SUS	TT	TT	AA	AA	TT	CC	TT	CC	AA	TT
JAZZMAN 2	L		XX	AA	TT	SUS	CC	GG	AA	AA	CC	AA	GG	CC	AA	TT
PVL 24A	L	PV	XX	TT	GG	SUS	CC	GG	AA	GG	CC	CC	GG	GG	TT	TT
CL 272	M	CL	YY	AA	GG	SUS	TT	GG	TT	GG	CC	AA	GG	CC	TT	CC
JUPITER	M		XX	AA	GG	SUS	TT	TT	AA	GG	TT	AA	GG	CC	AA	CC
CAFFEY	M		XX	AA	GG	SUS	CC	TT	AA	AG	CC	AA	GG	GG	TA	CC

How can they be of utility after the variety is developed?



Blast DNA Marker Characterization

RVMT-Table 8.

Variety		
	Blast	Blast Resistance Spectrum
Caffey	R	Limited
Catahoula	MR	Broad
Cheniere	MS	Limited
CL111	MS	Intermediate
CL151	VS	Limited
CL153	MS	Broad
CL163	VS	Limited
CL172	MS	Broad
CL272	MS	Intermediate
CLXL729	R	n/a*
CLXL745	R	n/a*
Cocodrie	MS	Limited
Della-2	R	Unknown
Diamond	S	Minimal
Jazzman	R	Unknown
Jazzman 2	MS	Minimal
Jupiter	S	Limited
LaKast	S	Minimal
Mermentau	S	Limited
PVL01	S	Limited
Roy J	S	Minimal
Titan	MS	Intermediate
XL753	R	n/a*
XL760	R	n/a*

Common Races of Blast in Southern US

	IA45	<u>IB1</u>	<u>IB49</u>	IB54	IB45	IH1	IG1	<u>IC17</u>	IE1	IE1K
Chr 12	Pita/Pita2/Ptr(t)									
Chr 2		**			Pib					
Chr 6					Piz(t)					
Chr 11			Pikh/Pikm							

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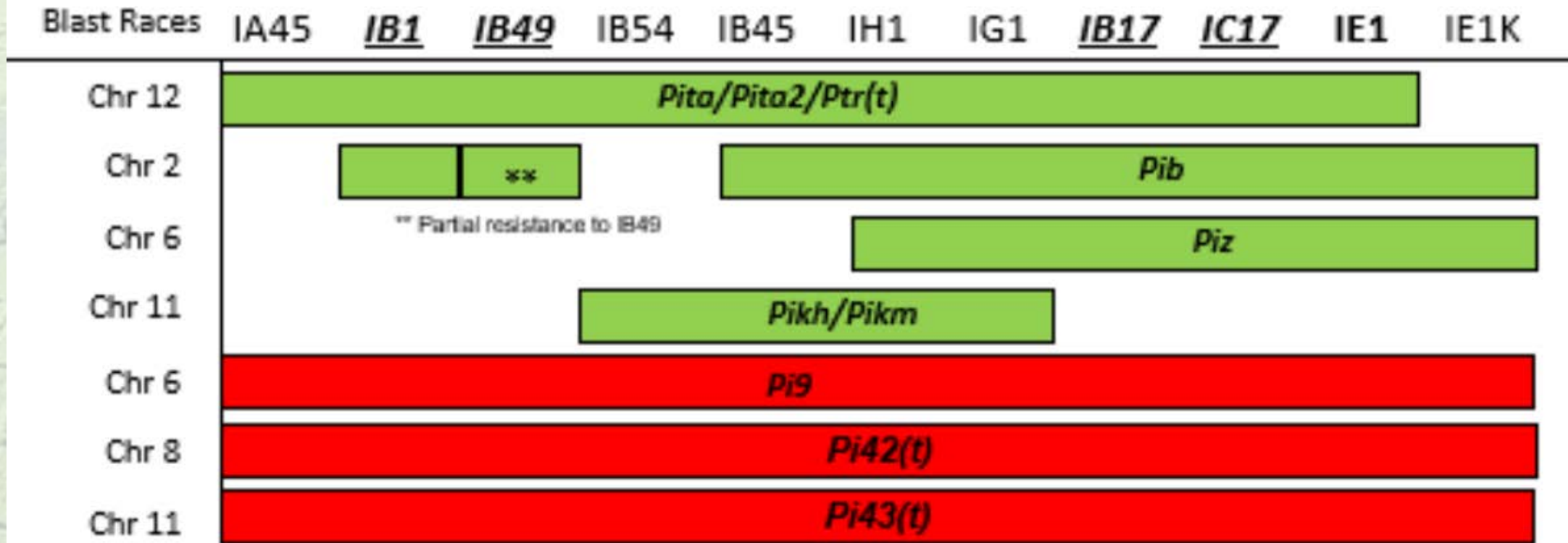
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Chr 6							<div>Piz(t)</div>			
Chr 11			<div>Pikh/Pikm</div>							

Future Breeding Targets for Blast Resistance

Blast Genes and Their Effectiveness Against Common US Races



LEGEND:



Gene Present in Modern US Breeding Germplasm



Gene being backcrossed into 3 elite LSU lines

Slide modified from Yulin Jia (USDA-ARS)

Summary

- The LSU AgCenter rice breeding program is utilizing DNA markers at all stages of the breeding program
- DNA molecular markers are another tool
- They complement much of what we do in the field, but are not a replacement