Use of Biochemical Markers to Predict Changes in Processing Quality

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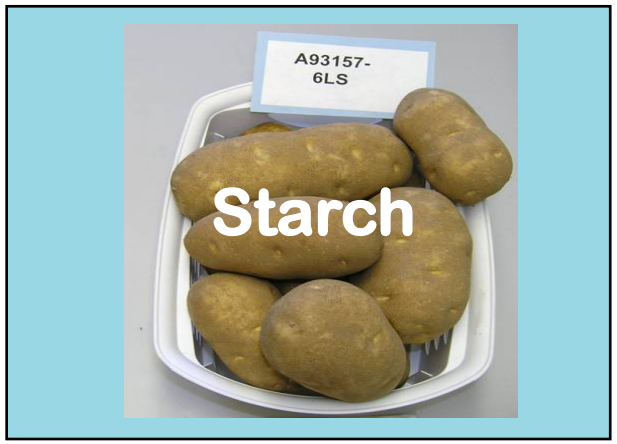
Key Biochemical Reactions in Starch Conversion During Storage



A-II Isozymes of UGPase

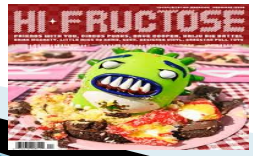
12-Carbon

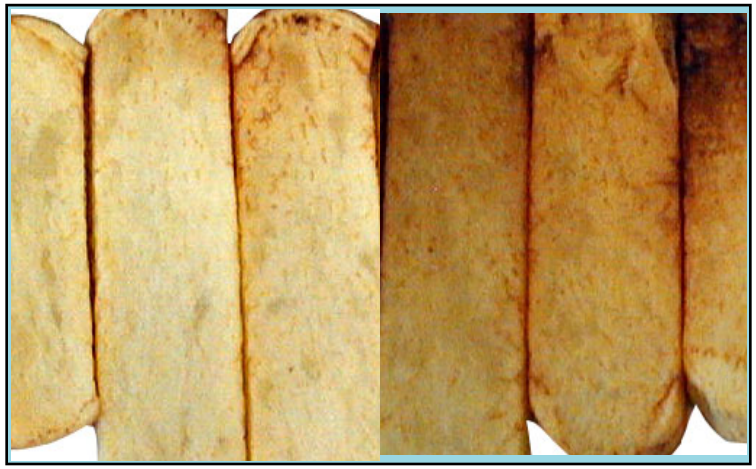
Sucrose

Acid Invertase

Reducing Sugars

Two 6-Carbon





Marker Development

- Total Number of Clones: 400 over two years
- Storage Temp: 42°F
- Storage Duration: Six Months
- Parameters:
  - Acid Invertase Activity
  - Glucose
  - Sucrose
  - UGPase Isozymes
  - Chip Color

Marker Development

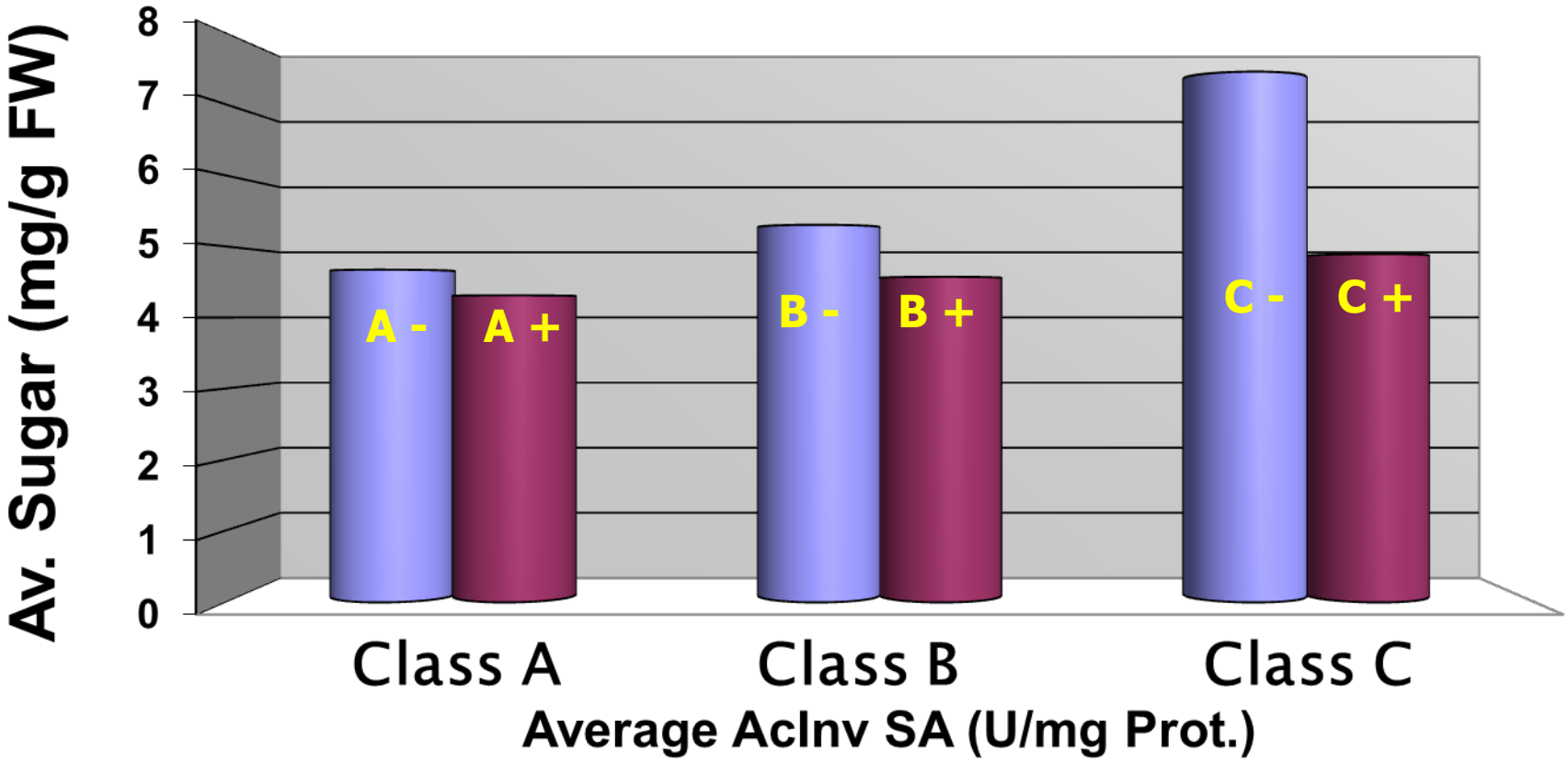
All the clones were divided in three major classes

A. Clones with up to 1 unit of Acid Invertase Activity
   a. Clones with A-II isozyme of UGPase (A+)
   b. Clones without A-II isozyme of UGPase (A-)

B. Clones with 1 – 3 Units of Acid Invertase Activity
   a. Clones with A-II isozyme of UGPase (B+)
   b. Clones without A-II isozyme of UGPase (B-)

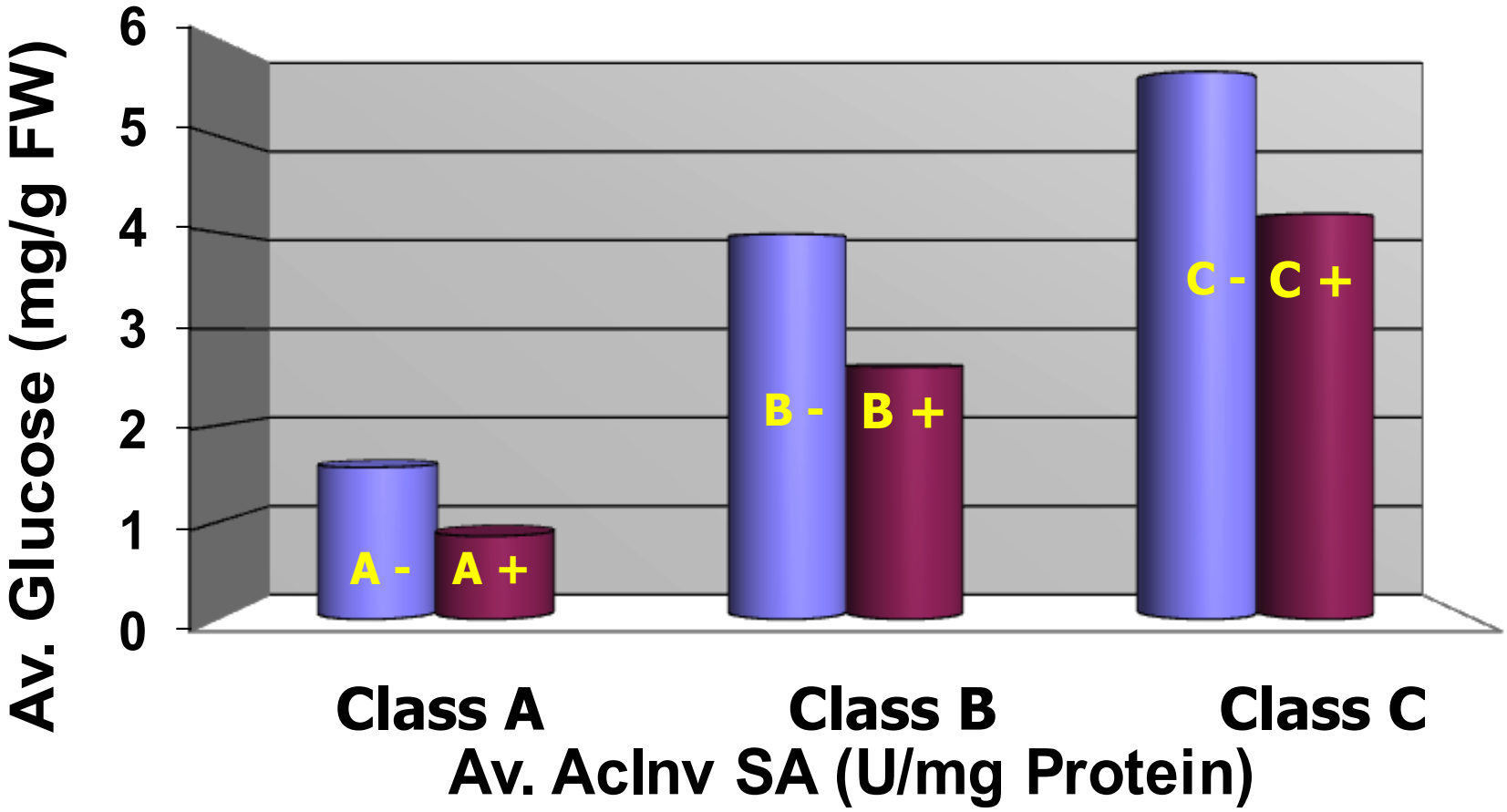
C. Clones with more than 3 units of Acid Invertase Act.
   a. Clones with A-II isozyme of UGPase (C+)
   b. Clones without A-II isozyme of UGPase (C-)

Average Sucrose Formation



Potatoes were stored at 42°F for 6 months

Average Glucose Formation



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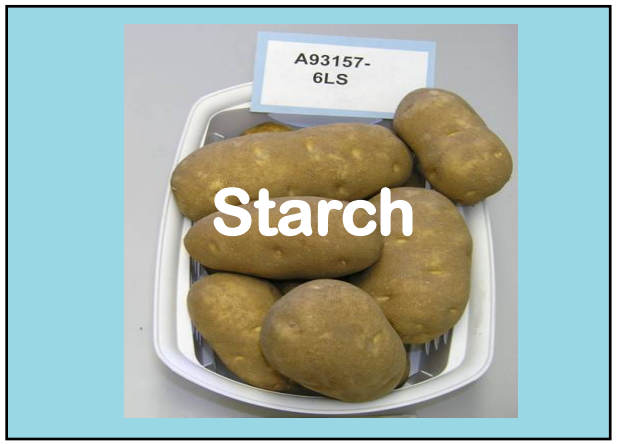

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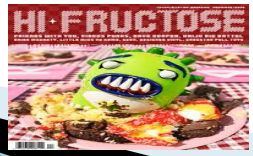
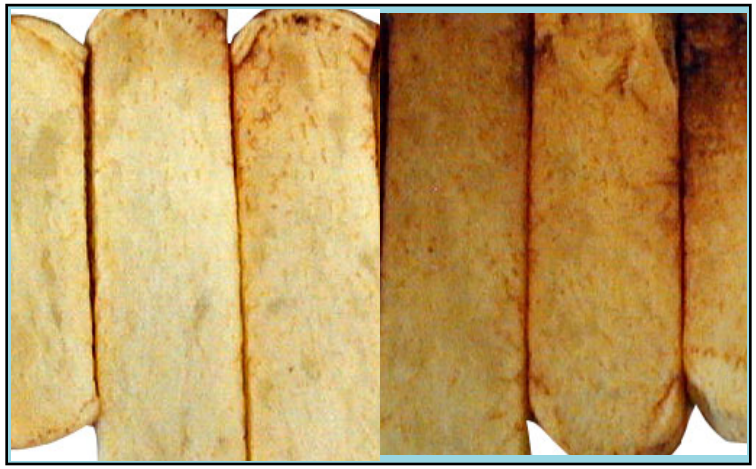
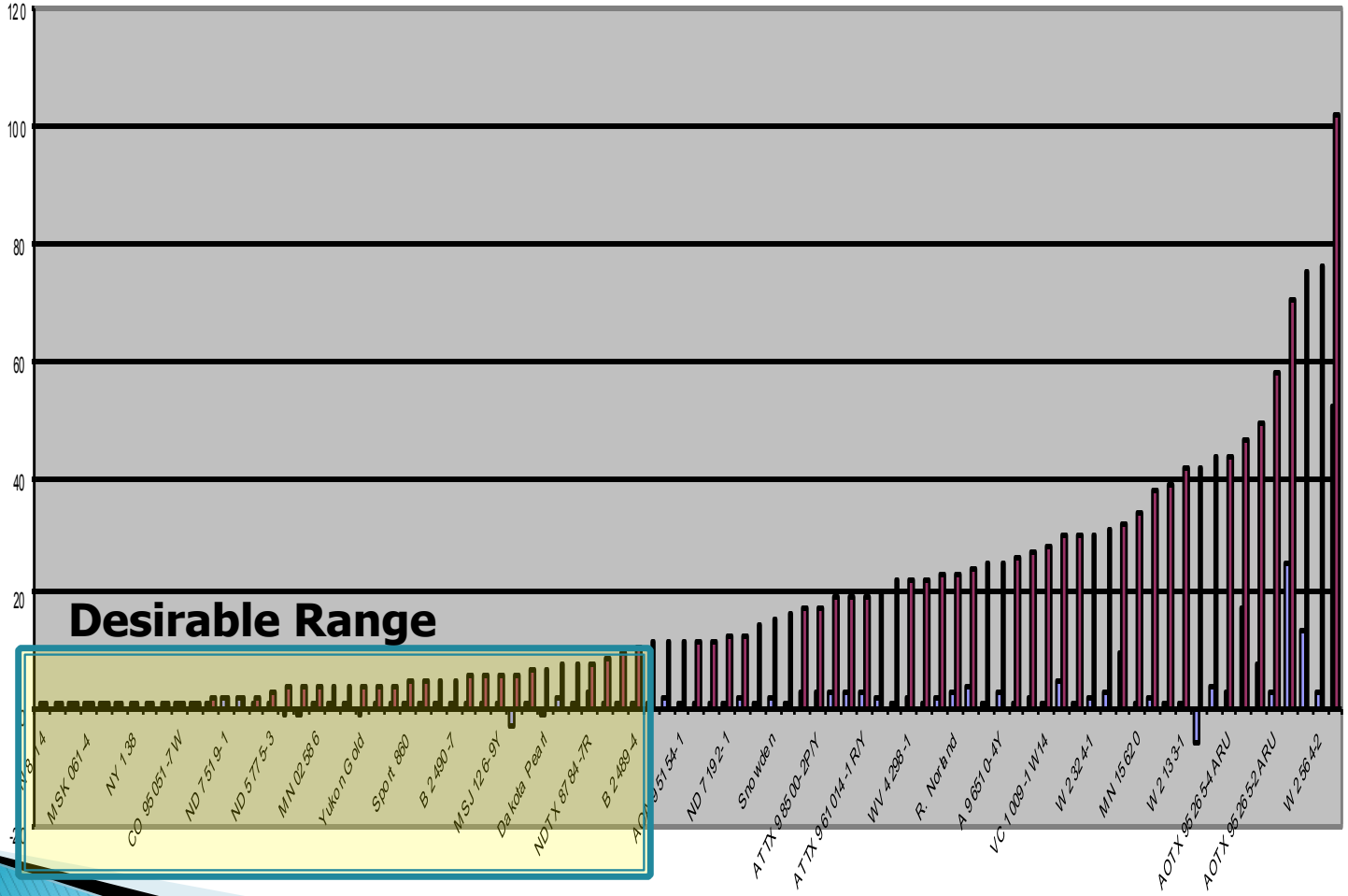
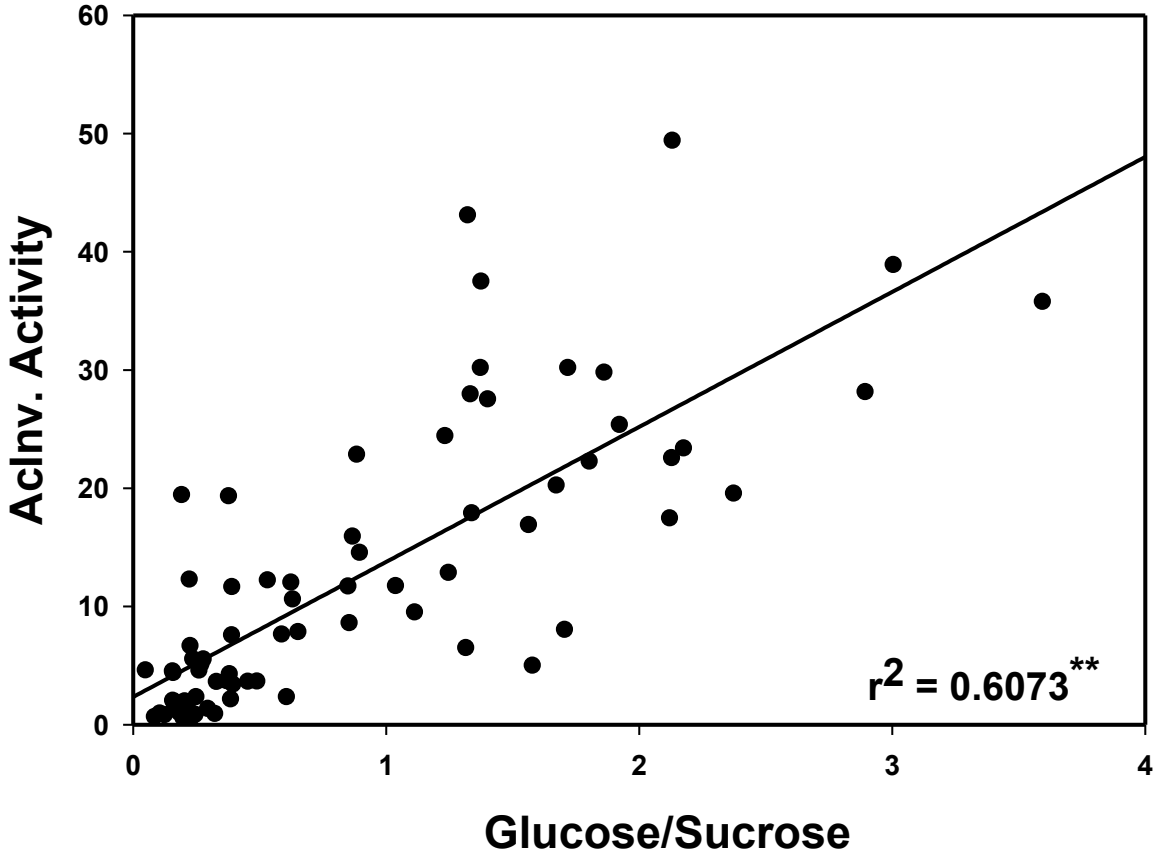




Screening for Acid Invertase Activity



Relationship Between Acid Invertase and Glucose Forming Potential



Biochemical Marker Stability over Years

Markers to Predict CIS Resistance

Parent Selection

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   a. Clones with A-II isozyme of UGPase (A+)
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B. Clones with 1 – 3 Units of Acid Invertase Activity
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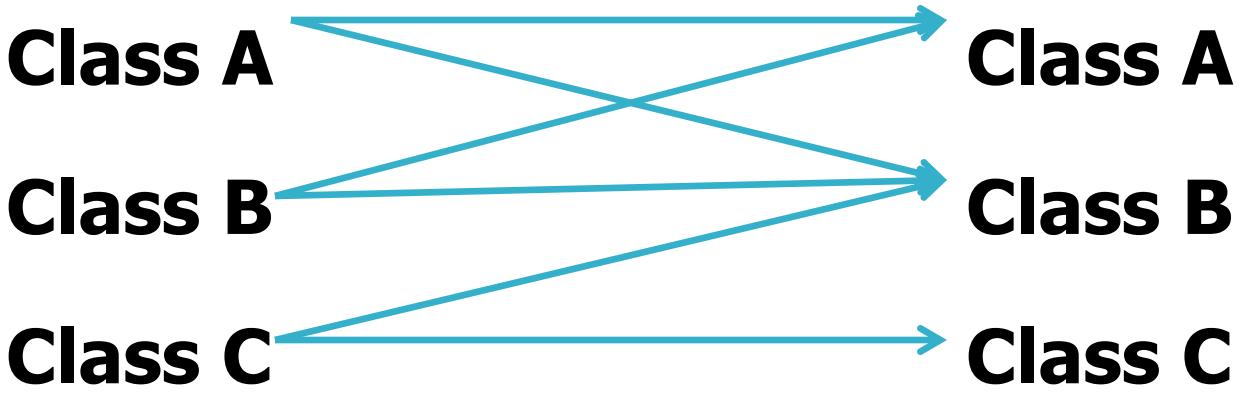
Cold Sweetening Resistance Class Change Possibilities



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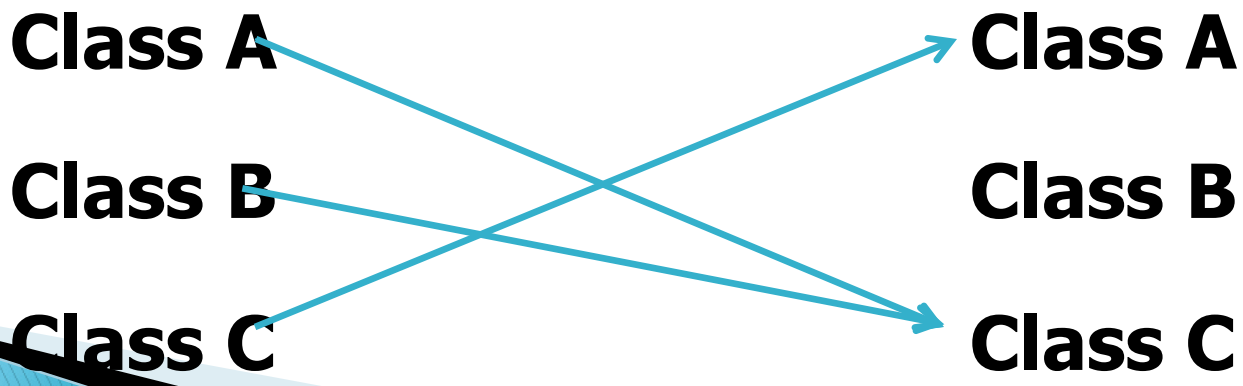


Cold Sweetening Resistance Class over Years Class A

	Basal Acid Invertase Activity (units/mg protein/hr)						
Clone	2006-07	2007-08	2008-09	2009-10	Average	CIS Class	A-II
ND5255-59		0.6	0.37	0.82	0.6	A	-
ND8-14	0.77	0.38	0.82	0.67	0.66	A	-
MSJ147-1	0.93	0.75	0.84	0.84	0.84	A	+
NY138		0.34	1.3	1.02	0.88	A	+
NY139		0.41	1.09	1.19	0.9	A	+
ND8304-2		0.52	0.1	2.2	0.94	A	-
MSJ126-9Y	0.88	0.86	1.11		0.95	A	-
W2310-3		0.78	1.49	0.72	0.99	A	-

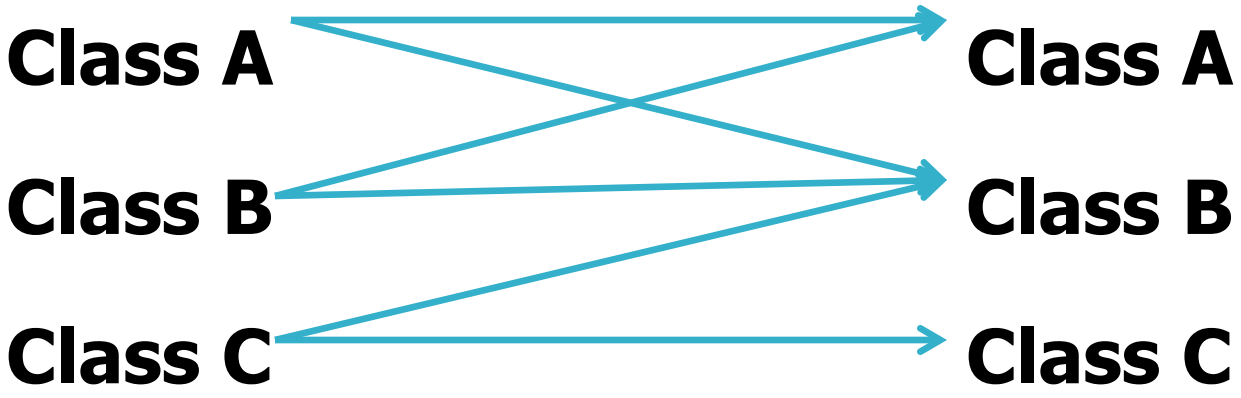
Cold Sweetening Resistance Class over Years Class B

	Basal Acid Invertase Activity (units/mg protein/hr)						
Clone	2006-07	2007-08	2008-09	2009-10	Average	CIS Class	A-II
ND5775-3	**0.83**	**0.88**	1.21	1.47	1.1	B	+
Dakota Pearl		1	**0.75**	1.75	1.17	B	-
MSK061-4	1.04	1.2	1.34	1.37	1.24	B	-
Atlantic		**0.74**	**0.51**	2.72	1.32	B	+
Premier Russet	1.75	1.9	0.95		1.53	B	-
Sport 860	0.98	2.72	**0.11**	1.68	1.37	B	-
Dakota Crisp	1.97	1.4	0.76		1.38	B	+
Ivory Crisp	1.99	**0.74**	1.4		1.38	B	-
MSN191-2Y		**0.14**	2.55	2.95	1.88	B	+
W2978-3		**0.35**	2.55	1.63	1.45	B	-
W2438-3Y	2.64	**0.76**	1.25	1.27	1.48	B	-
W2717-5	**0.35**	2.55	1.63		1.51	B	+
ND7192-1		2.15	0.62	1.82	1.53	B	-
W2683-2RUS	0.93	1.34	2.37		1.54	B	-
A91814-5	1.76	1.75	1.29		1.6	B	+
Clearwater Russet		**0.42**	2.14	2.8	1.79	B	-
Snowden	1.23	2.91	1.97	2.21	2.08	B	+
NorValley	2.2	2.76	2.89		2.62	B	+

Cold Sweetening Resistance Class over Years Class C

	Basal Acid Invertase Activity (units/mg protein/hr)						
Clone	2006-07	2007-08	2008-09	2009-10	Average	CIS Class	A-II
W2324-1		**2.41**	5.09	**1.9**	3.14	C	+
Dark Red Norland	3.38	3.54	3.88		3.6	C	-
Shepody	3.19	**2.69**	**1.65**	7.54	3.77	C	+
Red Pontiac	**2.22**	4.35	5	4.1	3.92	C	-
MN15620	5.55	3.99	**2.16**	5.56	4.31	C	-
Russet Burbank	5.18	**2.38**	**2.85**	9.94	5.09	C	+
Yukon Gold		4.9	7.72	4.83	5.81	C	+

Cold Sweetening Resistance Class Change Possibilities



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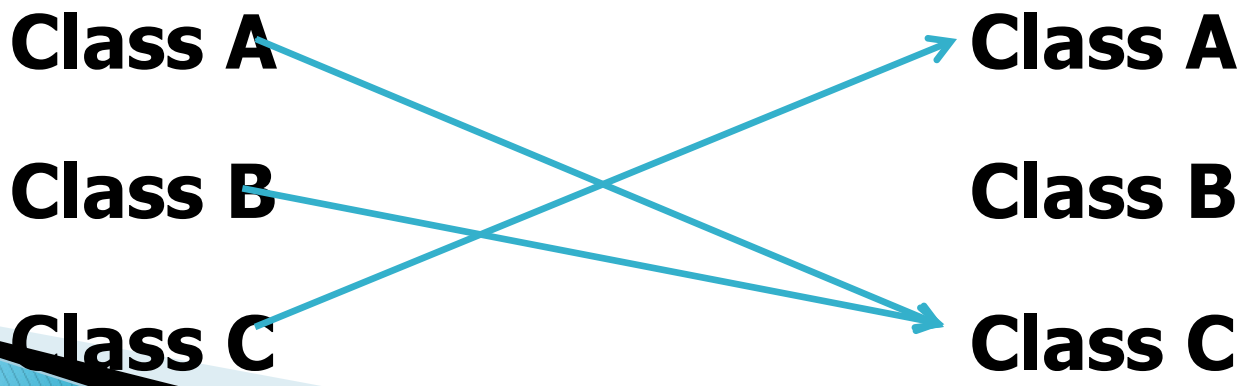

Cold Sweetening Resistance Class Summary

- A potato clone characterized as cold sweetening Resistant class maintain its processing quality over the years.

Potential Use of the Biochemical Markers

- Characterization of NFPT Clones for Cold-Sweetening Resistance
- Characterization of NCPT Clones for Cold-Sweetening Resistance
- Characterization of Advanced Breeding Clones in Various Potato Breeding Programs
- **BENEFITS**: Parent Selection for Determining Crosses
- New Markers Could Be Developed for Other Important Traits

Use of Biochemical Markers in North Central Region Potato Breeding

Diallele Cross

Class	A+	A−	B+	B−	C+	C−
A+	A+A+	A+A−	A+B+	A+B−	A+C+	A+C−
A−	A−A+	A−A+	A−B+	A−B−	A−C+	A−C−
B+	B+A+	B+A−	B+B+	B+B−	B+C+	B+C−
B−	B−A+	B−A−	B−B+	B−B−	B−C+	B−C−
C+	C+A+	C+A−	C+B+	C+B−	C+C+	C+C−
C−	C−A+	C−A−	C−B+	C−B−	C−C+	C−C−

Population Developed

- Family Selection
  - FRY (3 Families, 150 Clones)
    - Premier Rus X AF4526-2 (Class A- X __)
    - Premier Rus X AOND95249-1 (Class A- X C)
    - Premier Rus X MN 18747 (Class A- X C)
  - CHIP (39 Families, 1124 Clones)
    - Dakota Pearl X Atlantic (Class B- X B+)
    - Dakota Pearl X MN02696 (Class B- X A-)
    - Atlantic X Dakota Pearl (Class B+ X B-)
    - Atlantic X ND860-2 (ClassB+ X A-)
    - Atlantic X NY138 (Class B+ X A+)
    - Atlantic X NY139 (Class B+ X A+)
    - OTHERS

Use of Biochemical Markers in Potato Breeding – NCPT/USPB

- Parents : 39 Families
- Clones : 1124
- Storage Temperature : 40°F and 45°F
- Storage Duration: Six Months
- Parameters :
  - Glucose
  - Sucrose
  - Fry color
  - Basal Acid Invertase Activity
  - Total Acid Invertase Activity
  - Isozymes of UGPase


Mondak Gold
Total = 113.35 grams
Mondak Gold
Total = 105.11 grams


RB - Dark
Total = 136.85 grams
RB - Light
Total = 70.81 grams

Thank You


Thanks You
Photo by Jeff Miller