SCRI Update
NFPT Meeting in Caldwell, 2013

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Today's Objectives

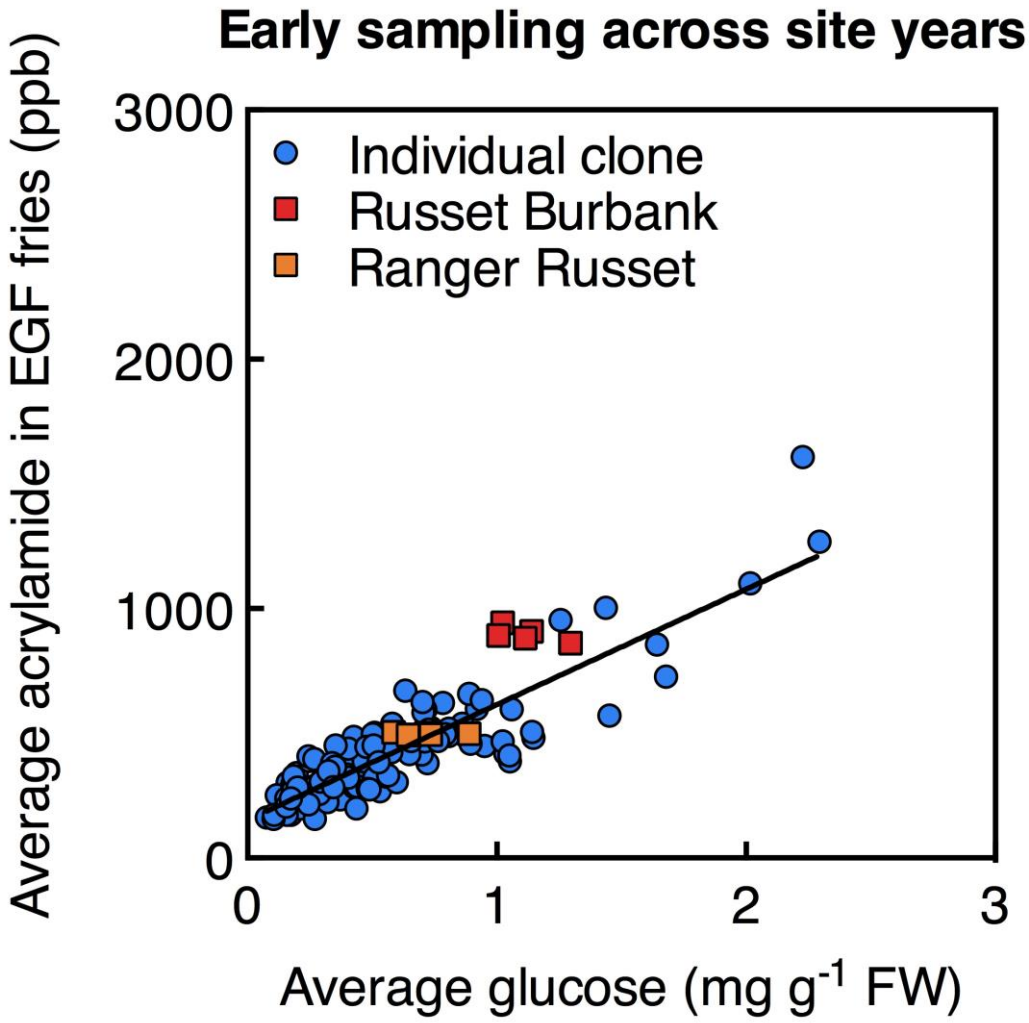
- Correlation between glucose and acrylamide levels
- Consumer attribute testing
- Maximum likelihood testing
- Seed production

- Agronomic trials

Correlation between Glucose and Acrylamide

- Correlations weaker as storage season progresses
- Substantial variability despite strong relationships at glucose < 1.0 mg g^{-1}
- Relationship and variability consistent across locations
- Consider limiting acrylamide analysis to targeted glucose levels (i.e. < 0.5 mg g^{-1})

Tuber glucose and acrylamide in fries of trial clones and checks



Source: NFPT

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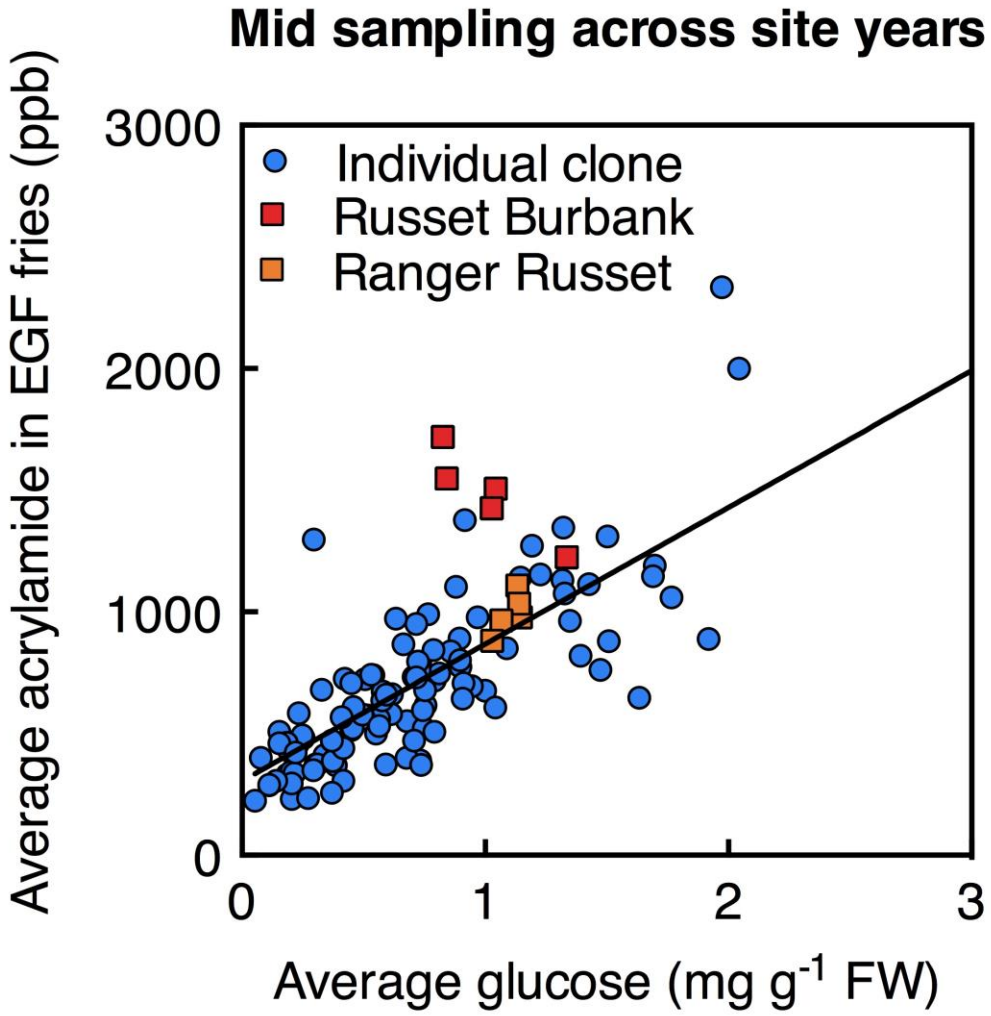

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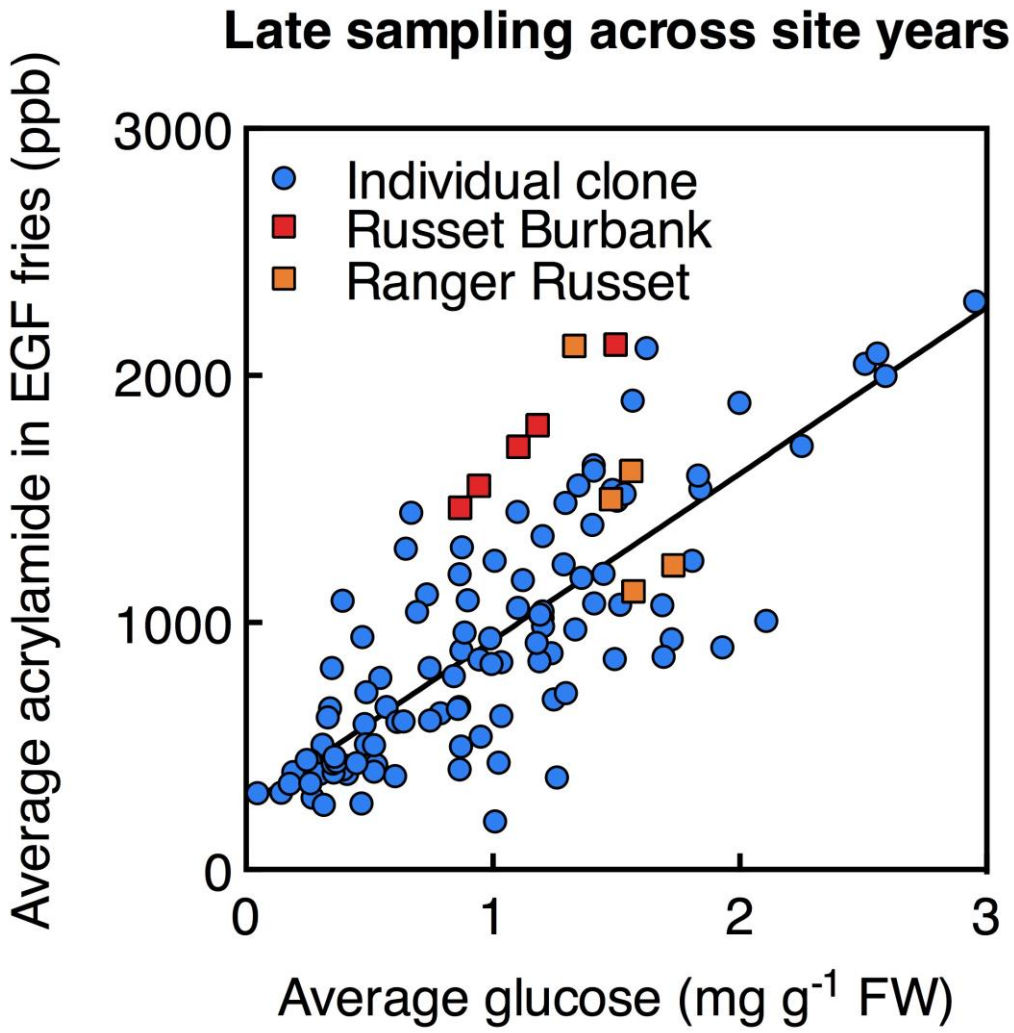

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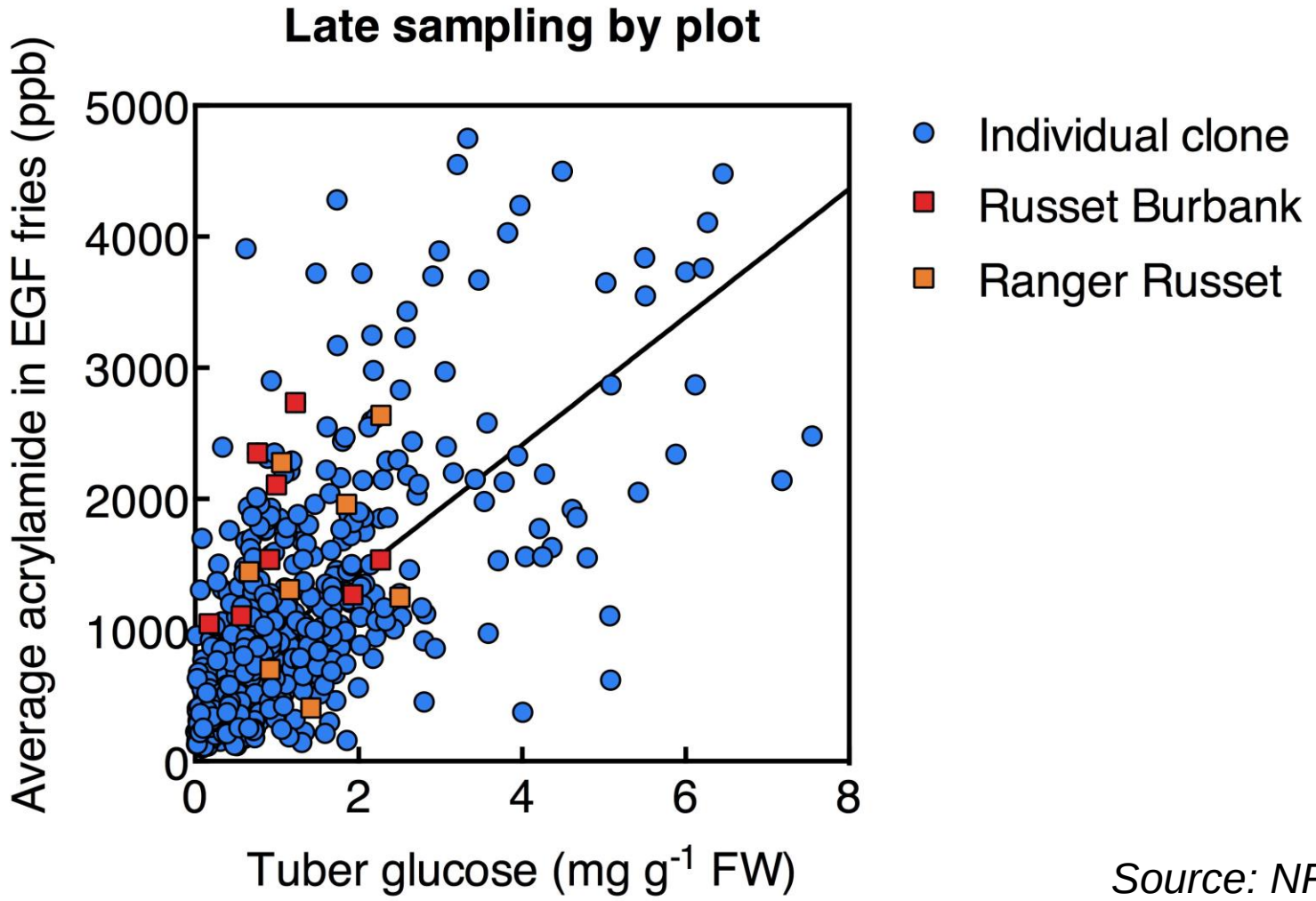

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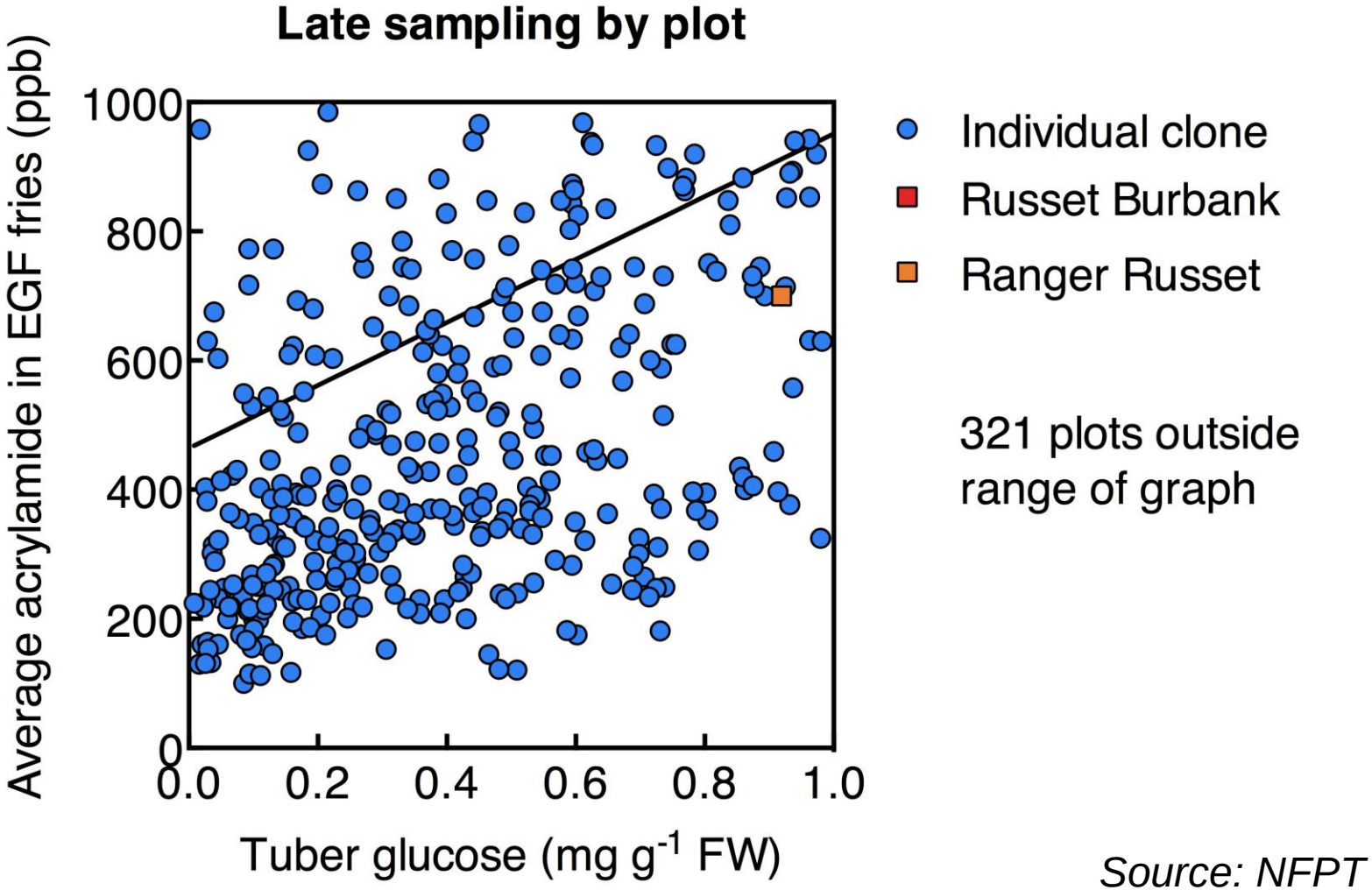

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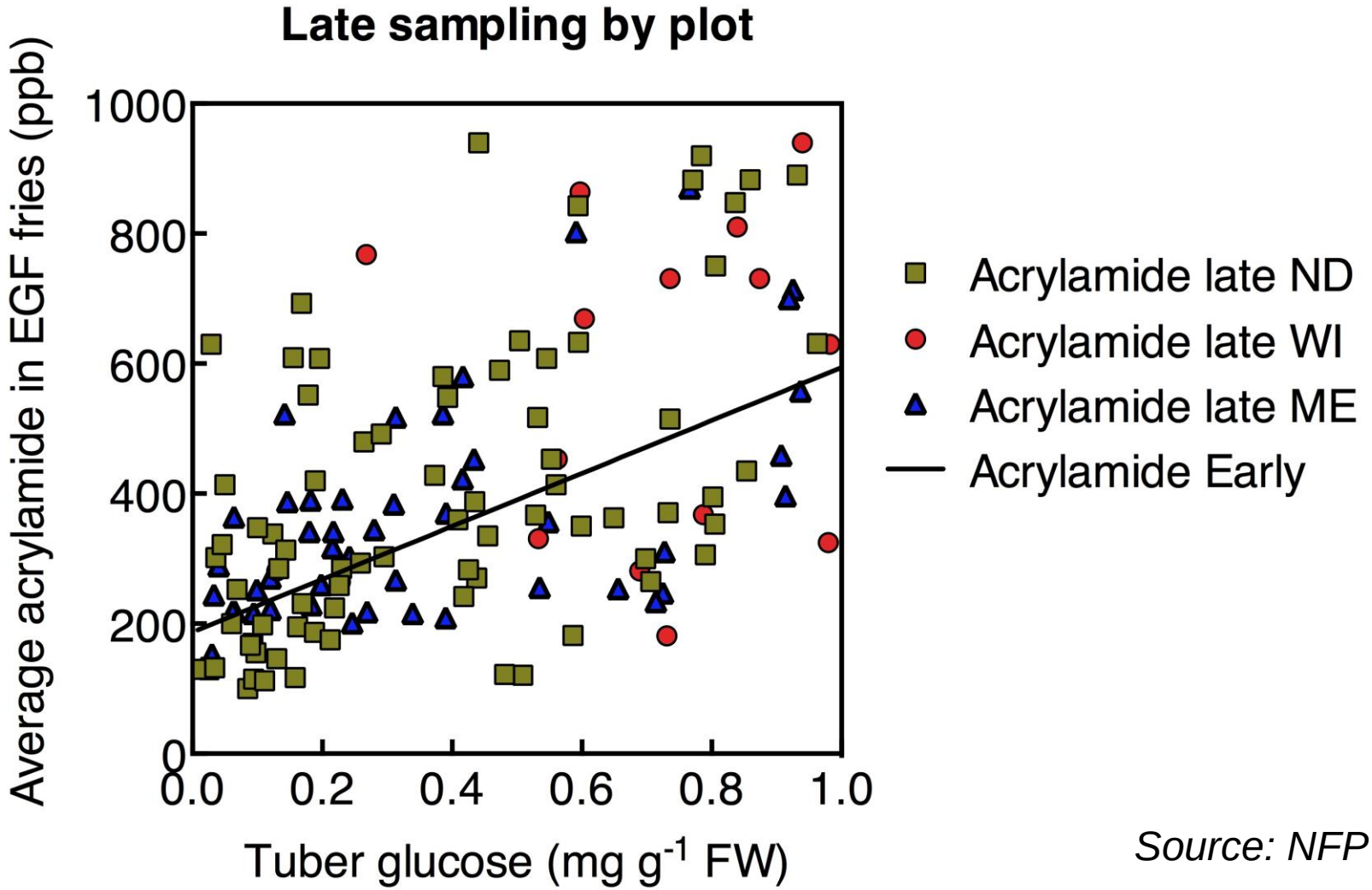

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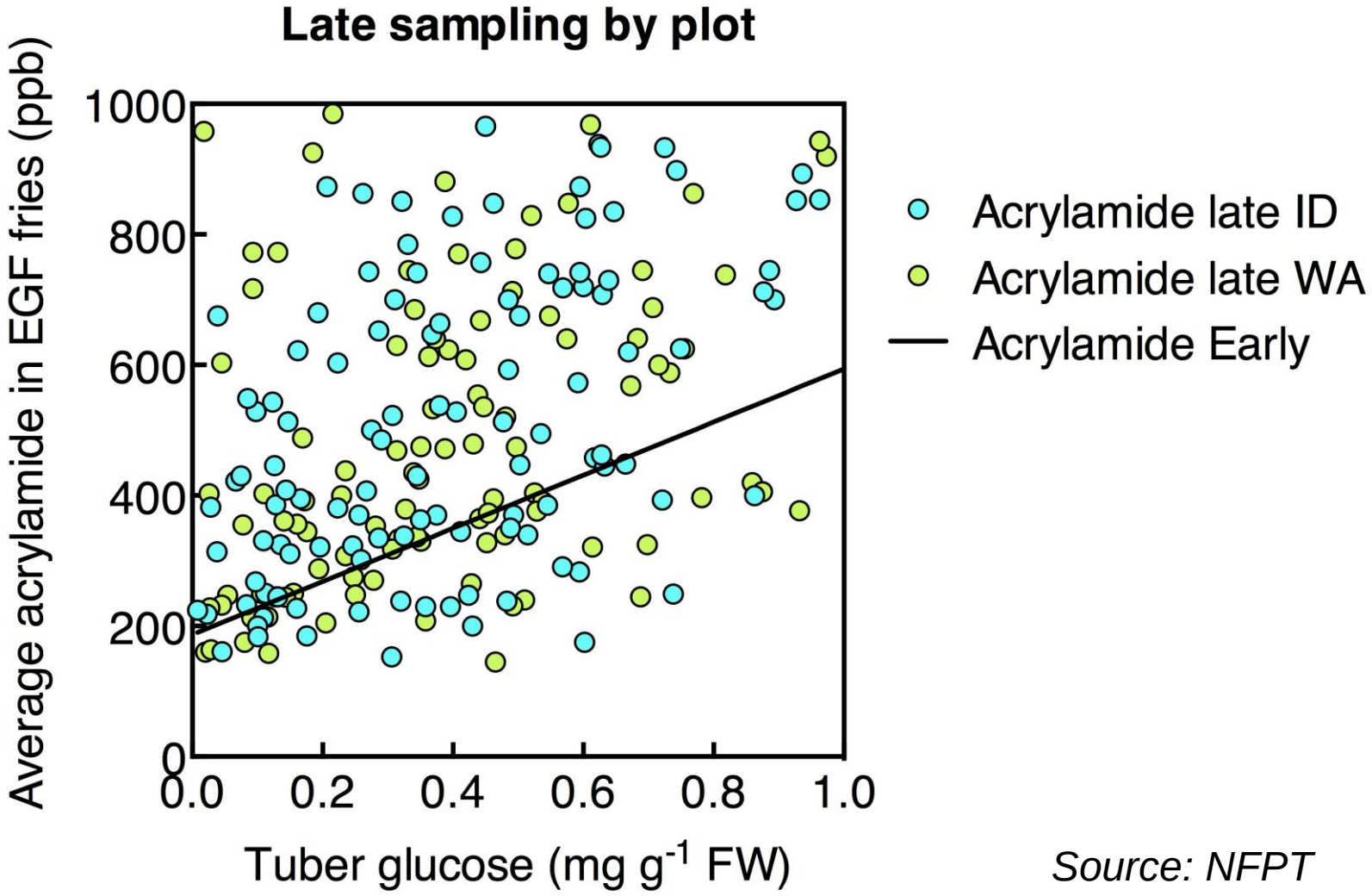
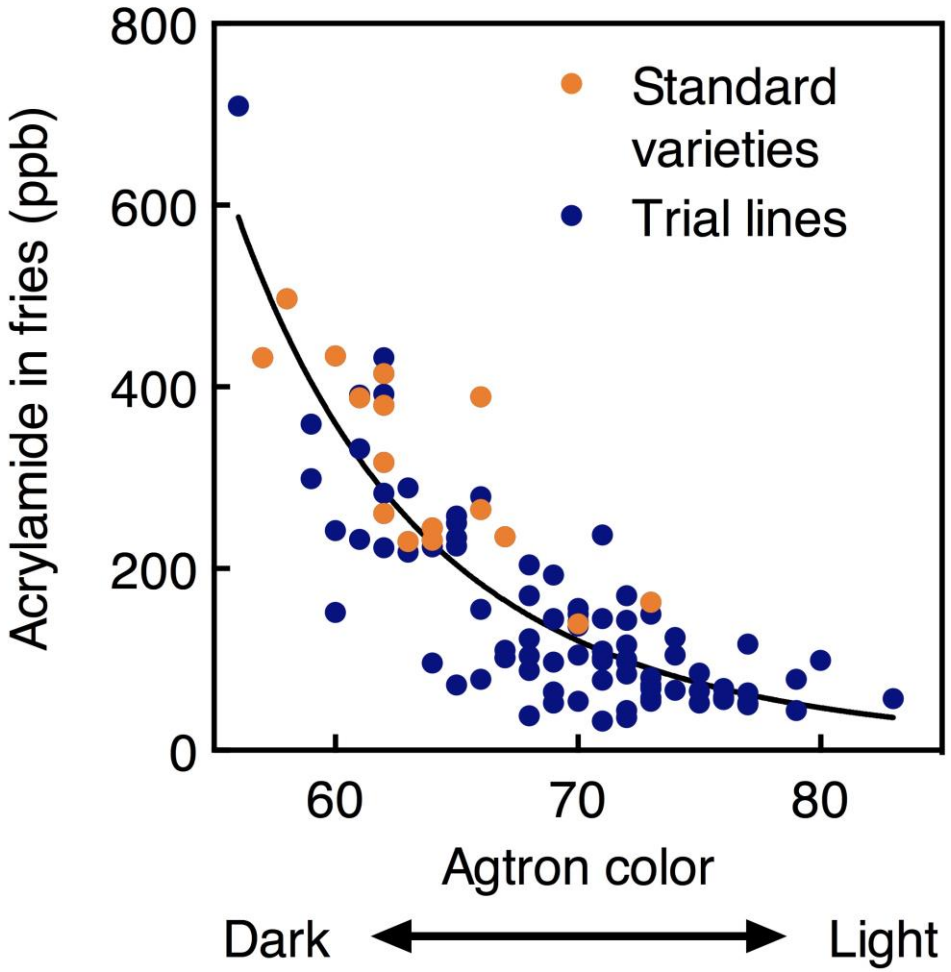
Tuber glucose and acrylamide in fries of trial clones and checks



Source: NFPT

Many clones have excellent fry color and low acrylamide-forming potential

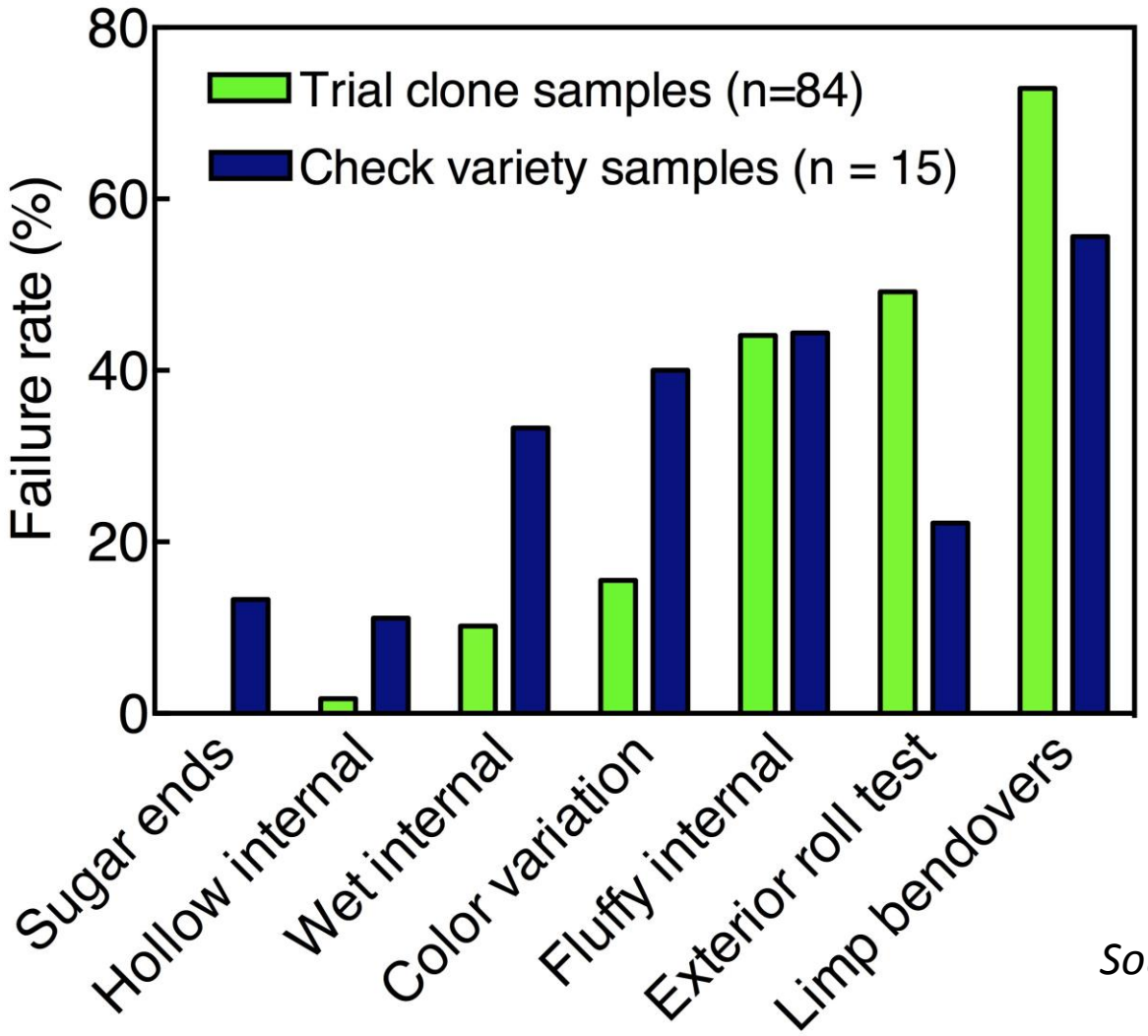


Fry color was good but other attributes were poor

Process Rank	#	Variety	Location	Agtron Color	Sugar ends (finished)	Color Variation (finished)	% Units limp/bendovers	% units hollow internal (pics FGH)	% Units Fluffy Internal (pics CDE)	% Units firm/wet internal	% Good External (roll test)	Fry Length (1 = too short, 2= slightly short, 3=target, 4=slightly long, 5=too long)	Overall Appearance (Color, dullness, oily, defects)
1	70	W8946-1RUS	ID	70	0	6	8.0%	0.0%	82.0%	10.0%	86.0	4	5 wet units
2	38	A02424-83LB	ID	77	0	0	6.0%	10.0%	80.0%	4.0%	74.0	4	2 wet units, slight dull appearance
3	24	AF4296-3	ME	72	0	8	4.0%	10.0%	76.0%	10.0%	86.0	2	
4	83	ND060735-4	ND	73	0	2	14.0%	10.0%	70.0%	6.0%	84.0	3	
5	TG	Burbank	ID	73	1	3	14.0%	4.0%	72.0%	10.0%	82.0	3	
5	27	AF-4342-3	ID	77	0	2	14.0%	6.0%	68.0%	12.0%	84.0	3	6 wet units
7	33	A0073-2	ID	75	0	0	20.0%	2.0%	68.0%	10.0%	82.0	4	slight grey cast
8	40	A03921-2	ID	73	0	3	16.0%	6.0%	76.0%	2.0%	68.0	5	
9	3	AO02183-2	WI	66	0	10	14.0%	8.0%	68.0%	10.0%	88.0	4	lot of partial CV
10	55	AC99375-1RU	WA	68	0	4	18.0%	6.0%	68.0%	8.0%	76.0	3	dull grey spotty, grey tips, unacceptable

Source: NFPT

Failure rate of samples for select processing criteria



Source: NFPT

Conducting Fair Comparisons

- Are current evaluations identifying limitations in the genotypes relative to recent history
- Comparisons with standards in the plot
  - Is this a fair comparison?
- Comparing the reality of the plots with the ideal
- Compare the reality with the potential

December 2012 Caldwell meeting

- Identified need to begin moving select lines to pivot-scale trials
- Identified need for additional data on promising clones
- Refined list of attributes
- Identified late season storage as a high value trait for new varieties
- Identified need for database of results

Progress since Caldwell

- Began moving select lines to pivot-scale trials
- SCRI trials initiated to generate additional data on promising clones
- Conducted late-season QSR tests
- Developed a database of results
  - http://acrylamide.vegetables.wisc.edu/

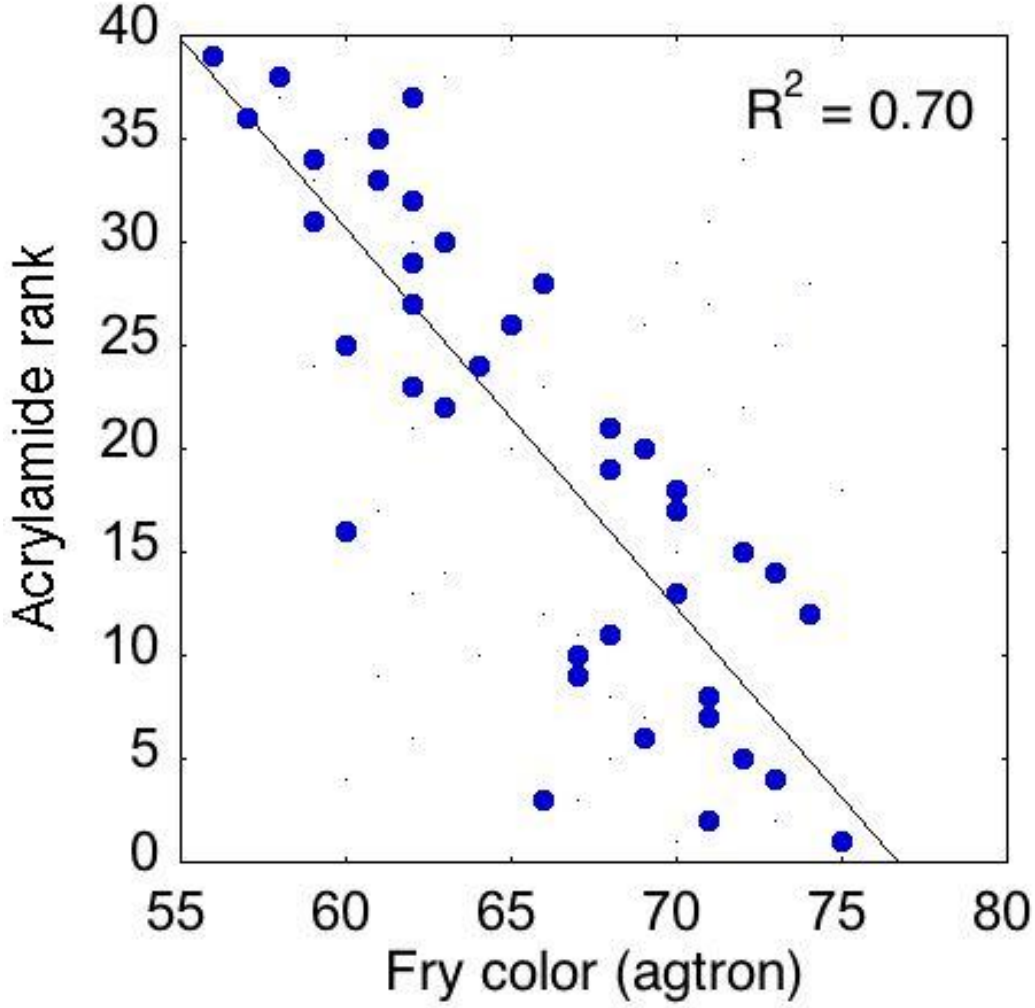
Consumer Attribute Testing

- Conducted 2 series of testing following 2011 and 2012 production seasons
- Engineering attributes
  - Color
  - Internal texture
  - Limp units
- Sensory attributes
- Potential to improve selection of clones for consumer attributes
- Increase potential to select clones with sensory attributes

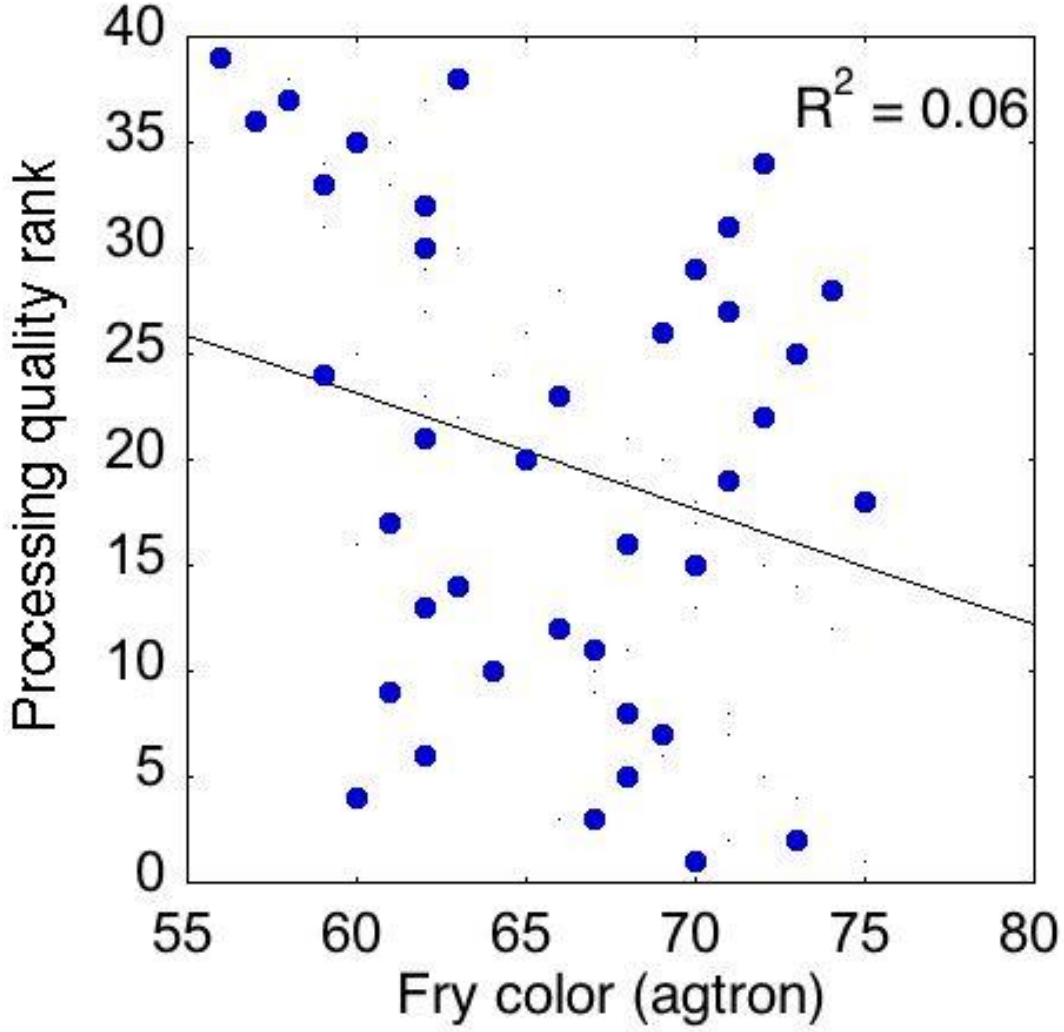
Developing an estimate for fry processing quality

- Useful for assessing trial clones
- Minimal training requirements
- Uses available facilities
- Incorporate processor and end-user criteria sooner in the decision making process

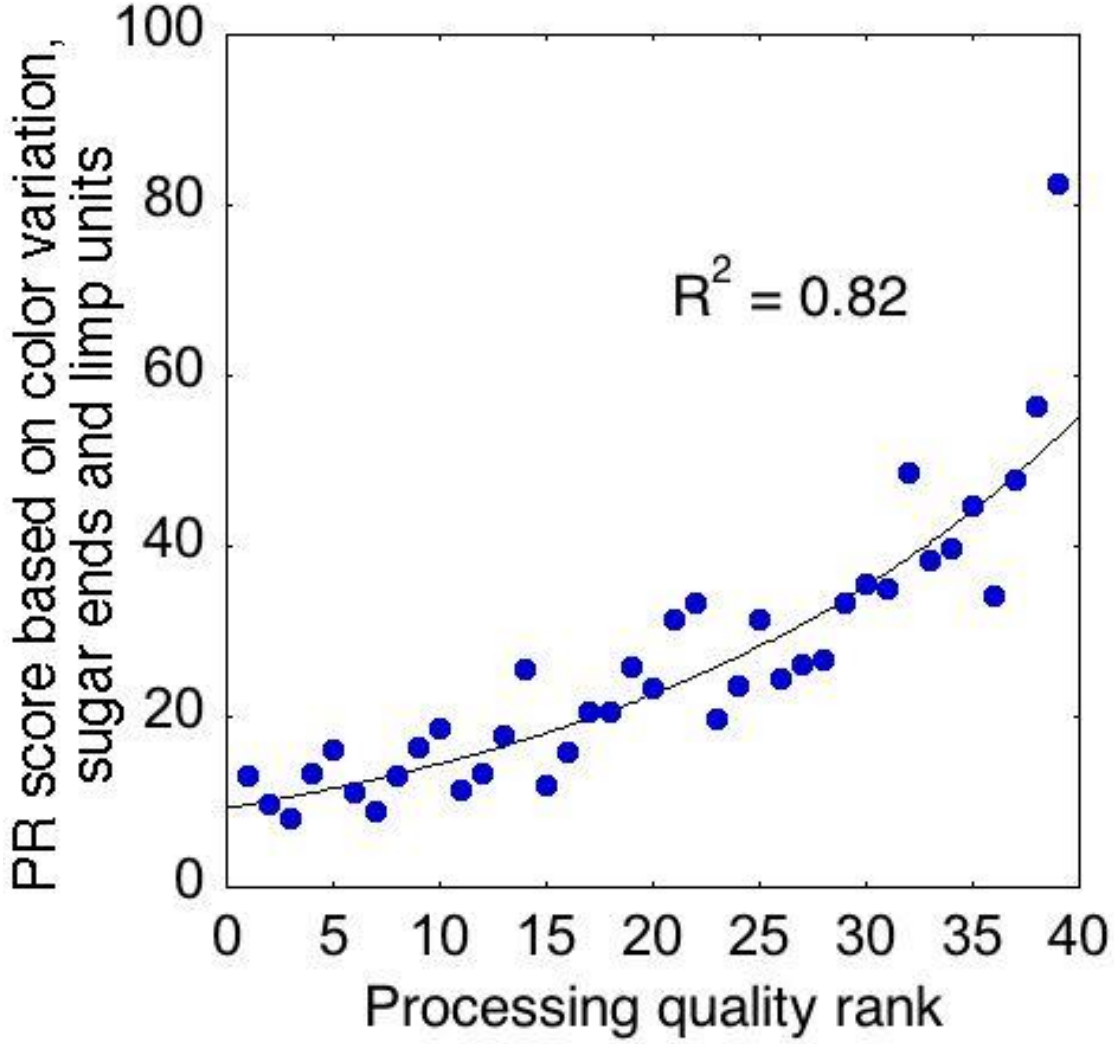
Fry color is a good predictor of acrylamide rank…



…but not a good predictor of processing quality rank



A QA estimate based on three easily scored parameters



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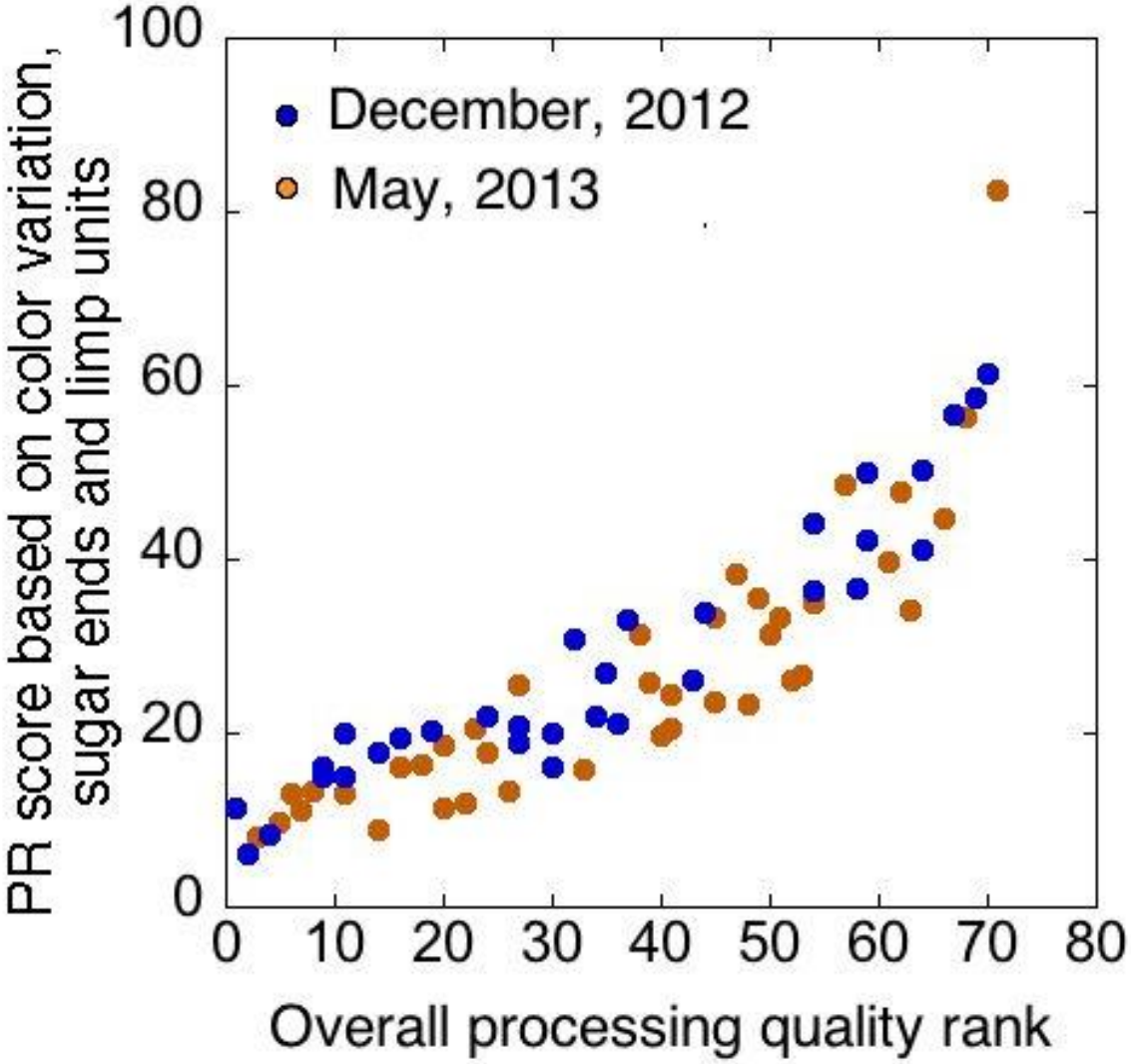
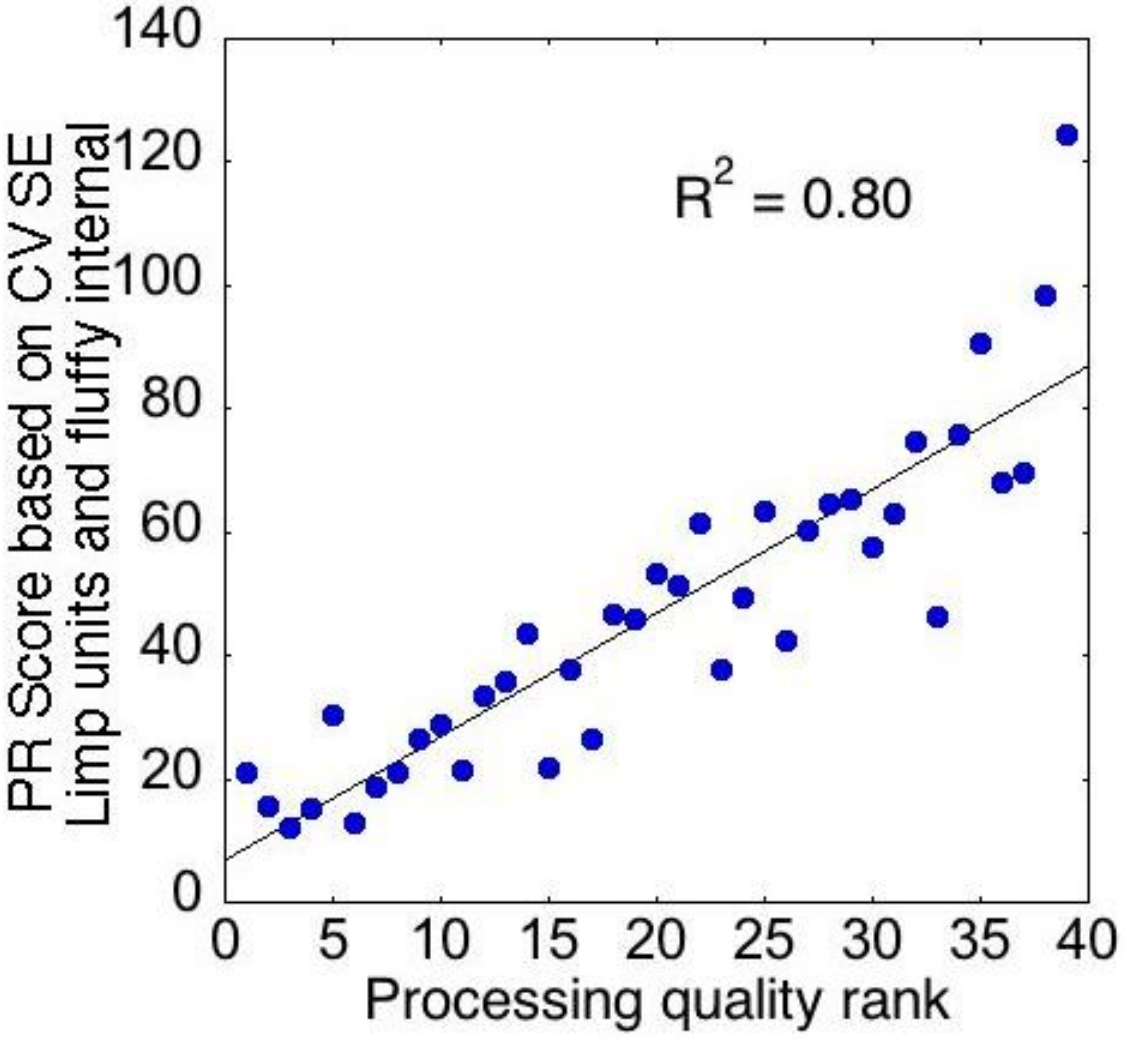


A QA estimate based on four parameters



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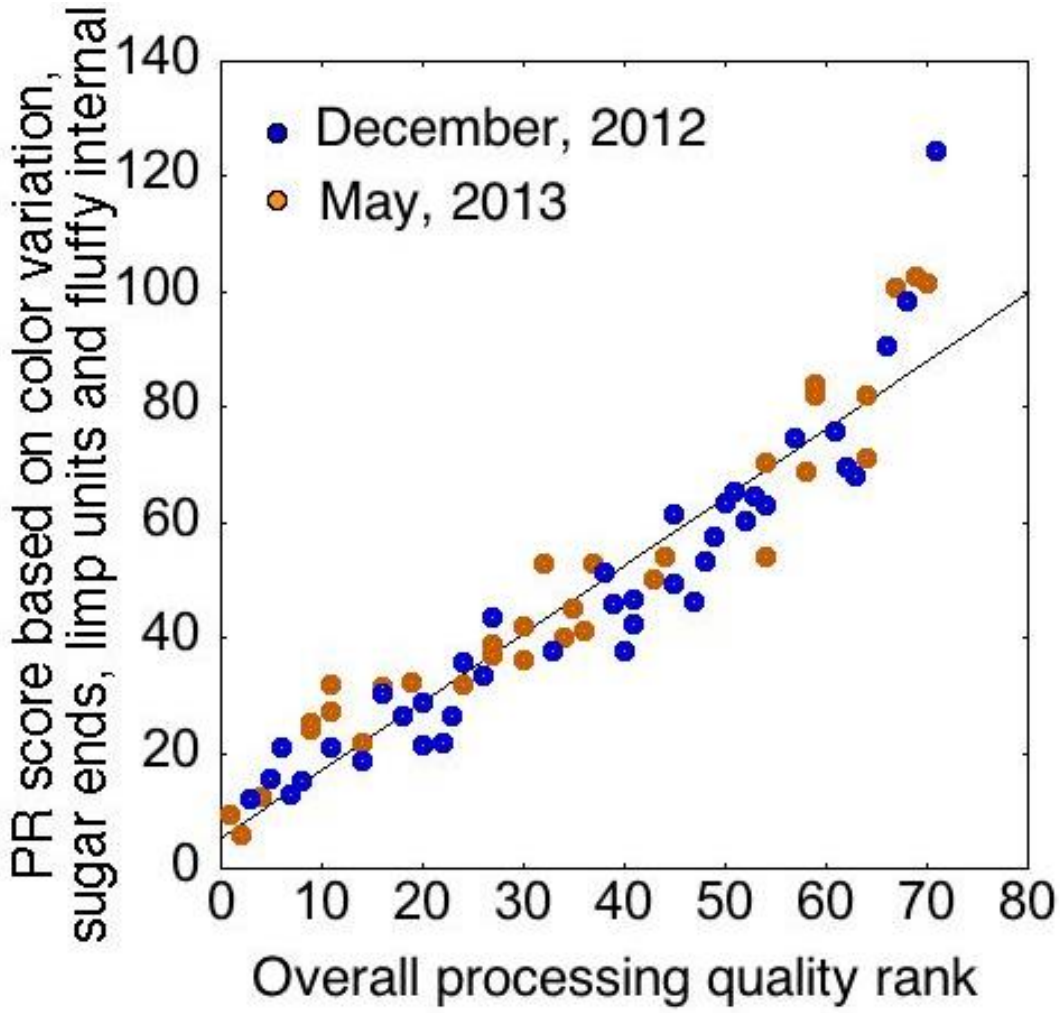


Top ten priority traits

Attribute	Total votes	QSR	Processor	Grower
% Sugar ends	14	2	4	8
Bruise free	9	0	4	5
Acrylamide	9	1	5	3
Resist Cold-sweetening	9	1	0	8
Specific gravity	8	2	5	1
Yield	8	1	4	3
Consistent solids	8	2	5	1
Size profile	7	1	4	2
% high sugar	6	2	2	2
Stores to summer	5	1	3	1

Sugar-end defect screening

- A method to assess sugar ends in material fried at East Grand Forks is being developed
- Lightness of fried slabs from replicated SCRI Agronomic trials will he quantified at bud and stem end

Moving Forward

- Wide-scale consumer attribute testing
- Limp units, sugar end, and fluffy internal characteristics
- 2013 summary
  - Every variety x site is par fried at USDA-EGF
  - Pull sample ~5 lbs
  - Finish fry within breeding/agronomic programs
  - Train each program on evaluation techniques
    - EGF, Caldwell, ME
- Focus on varieties meeting physical attributes prior to sensory evaluations

How likely is it that one variety will meet industry requirements across locations?

- NFPT data from 2011 and 2012
- 3 locations in 2011; 5 locations in 2012
- Traits determined by genetics: specific gravity, glucose, acrylamide (gluc & acryl highly correlated)
- Traits determined by agronomic practice: % >6 oz weight, % >10 oz weight (highly correlated)
- Separate tests for the two categories: acryl and % >10 oz were removed

Method to Conduct Maximum Likelihood test

- Criteria used:
  - Agronomic traits
    - % >6oz weight: 0.68-0.74 (for calculating P and ranking)
    - % >10oz weight: 0.28-0.40
  - Genetic traits
    - Specific gravity: 1.080-1.095
    - Glucose: 0-0.5 mg/g FW
    - Acrylamide: 0-250 ppb

} (for calculating Joint P and ranking)

Clone	% > 6 oz					
	ID	ND	WA	Mean	Stdev	P
AND97279-5Russ	0.5988	0.2750	0.5080	0.4606	0.1670	0.0473
AND99362-1Russ	0.7323	0.5560	0.6888	0.6591	0.0918	0.2207
AOND95292-3Russ	0.7817	0.5249	0.6607	0.6558	0.1284	0.1692

Success Probability of Agronomic Traits

2011	Line #	P of > 6 oz
1	Ranger	0.549
2	Dakota Trailblazer	0.413
3	CO99053-3RU	0.320
4	AF4260-2	0.319
5	AF4113-2	0.266
6	A02424-83LB	0.265
7	A02507-2LB	0.257
8	A0073-2	0.223
9	AND99362-1Russ	0.221
10	AF4198-2	0.219
11	Sage Russet	0.213
12	A01010-1	0.190
13	AF4281-3	0.183
14	Alpine Russset	0.175
15	AC99375-1RU	0.175
16	AF3317-15	0.173
17	AOND95292-3Russ	0.169
18	MN18747	0.168
19	W7449-1rus	0.166
20	Clearwater Russet	0.159

2012	Line #	P of > 6 oz
1	AF4113-2	0.248
2	A02507-2LB	0.240
3	Teton Russet (A0008-1TE)	0.237
4	AO02183-2	0.207
5	W8152-1rus	0.189
6	AO00057-2	0.177
7	Sage Russet	0.172
8	Premier Russet	0.170
9	AF3362-1	0.167
10	AF4040-2	0.162
11	GemStar Russet	0.155
12	AF4198-2	0.148
13	W6360-1rus	0.147
14	ND081476B-11Russ	0.143
15	AF4320-7	0.140
16	AF4281-3	0.140
17	W9162-1rus	0.137
18	Dakota Trailblazer	0.134
19	A02062-1TE	0.130
20	AF4222-5	0.126

Success Probability of Genetic Traits 2011

Mid-season

	Line #	Joint P
1	ND060735-4Russ	0.990
2	A02507-2LB	0.958
3	AF4320-17	0.918
4	A0073-2	0.893
5	W8152-1rus	0.829
6	ND8068-5Russ	0.796
7	W9604-1rus	0.749
8	AC99375-1RU	0.725
9	A02138-2	0.680
10	ND8229-3	0.652
11	ND060742C-1Russ	0.613
12	ND049517B-1Russ	0.604
13	AF4281-3	0.584
14	W7449-1rus	0.582
15	A03921-2	0.578
16	AF3001-6	0.563
17	W6234-4rus	0.543
18	MN02467	0.535
19	MonDak Gold	0.471
20	AC96052-1RU	0.446

Late-season

	Line #	Joint P
1	A02507-2LB	0.999
2	W9604-1rus	0.992
3	MN02467	0.765
4	AC96052-1RU	0.654
5	AF4281-3	0.642
6	W6234-4rus	0.637
7	ND049517B-1Russ	0.606
8	W8152-1rus	0.557
9	ND060735-4Russ	0.544
10	AOND95292-3Russ	0.541
11	AC99375-1RU	0.524
12	ND8229-3	0.463
13	W6360-1rus	0.448
14	CO97087-2RU	0.419
15	Premier Russet	0.402
16	A0073-2	0.365
17	AF3001-6	0.353
18	A03921-2	0.312
19	A0012-5	0.301
20	AF3008-3	0.300

Success Probability of Genetic Traits 2012

Mid-season

	Line #	Joint P
1	AO02183-2	0.756
2	W7449-1rus	0.552
3	W10676-1rus	0.543
4	ND049517B-1 Rus	0.484
5	A0073-2	0.457
6	W6234-4rus	0.449
7	ND071387C-2Russ	0.442
8	W8946-1rus	0.424
9	W9604-1rus	0.415
10	GemStar Russet	0.413
11	AC99375-1RU	0.397
12	ND049423b-1Russ	0.346
13	ND060735-4Rus	0.338
14	ND8229-3	0.335
15	AC96052-1RU	0.326
16	AF3001-6	0.312
17	Premier Russet	0.307
18	W9162-3rus	0.295
19	ND8068-5Rus	0.294
20	A03921-2	0.288

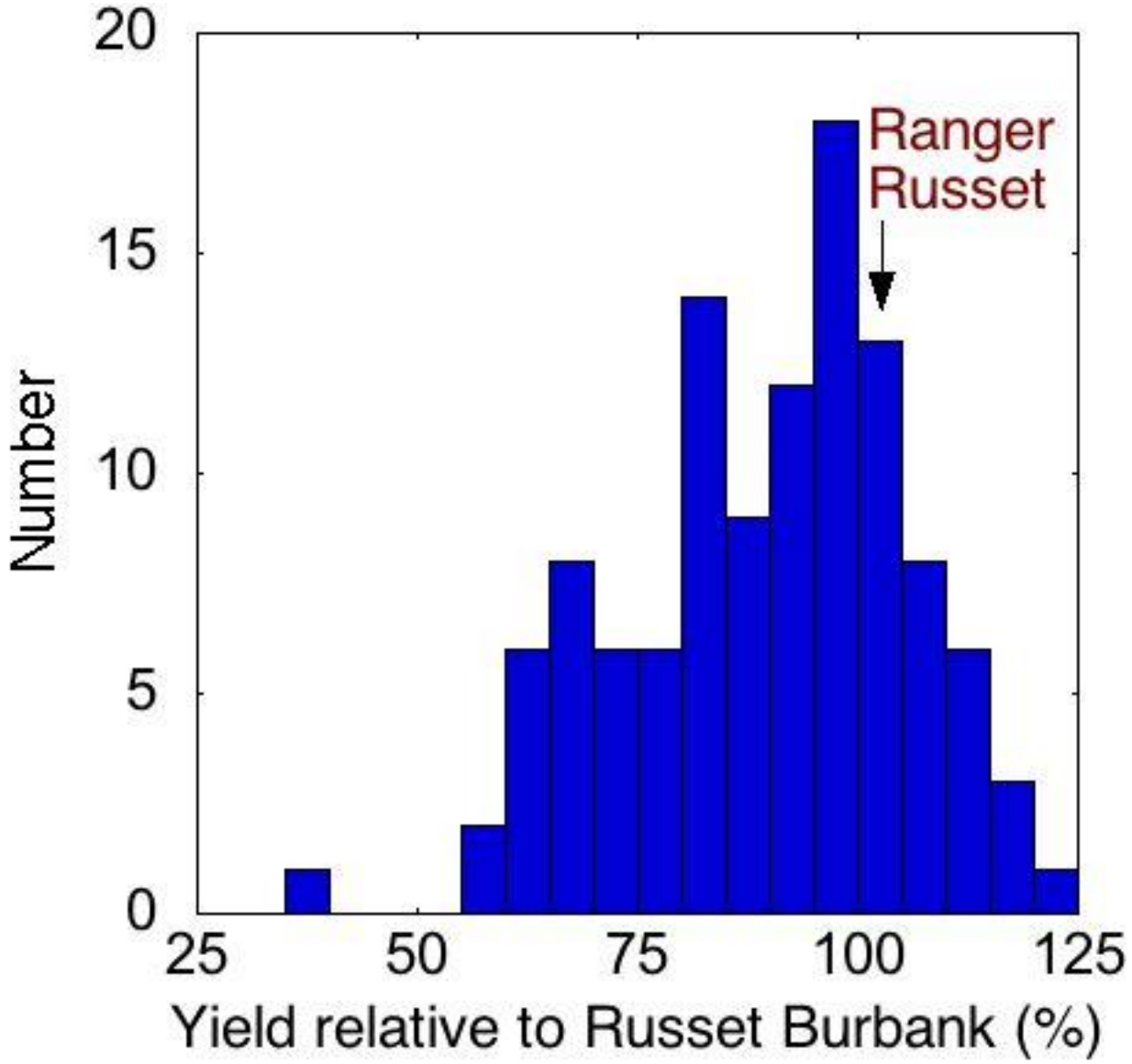
Late-season

	Line #	Joint P
1	A02507-2LB	0.568
2	Premier Russet	0.490
3	A03921-2	0.447
4	AF3001-6	0.443
5	Clearwater Russet	0.425
6	ND049517B-1 Rus	0.421
7	W6234-4rus	0.375
8	W8152-1rus	0.324
9	GemStar Russet	0.314
10	A0073-2	0.292
11	ND060735-4Rus	0.288
12	A0012-5	0.275
13	W7449-1rus	0.270
14	AF4342-3	0.212
15	W6360-1rus	0.202
16	W9162-3rus	0.193
17	AO02183-2	0.145
18	AC96052-1RU	0.141
19	AF4296-3	0.127
20	Alpine Russset	0.125

Refining yield estimations to more efficiently screen clones

- Data from replicated plots in SCRI Agronomic trials
- Do NFPT data provide useful estimates of yield?

Total yield of clones in NFPT



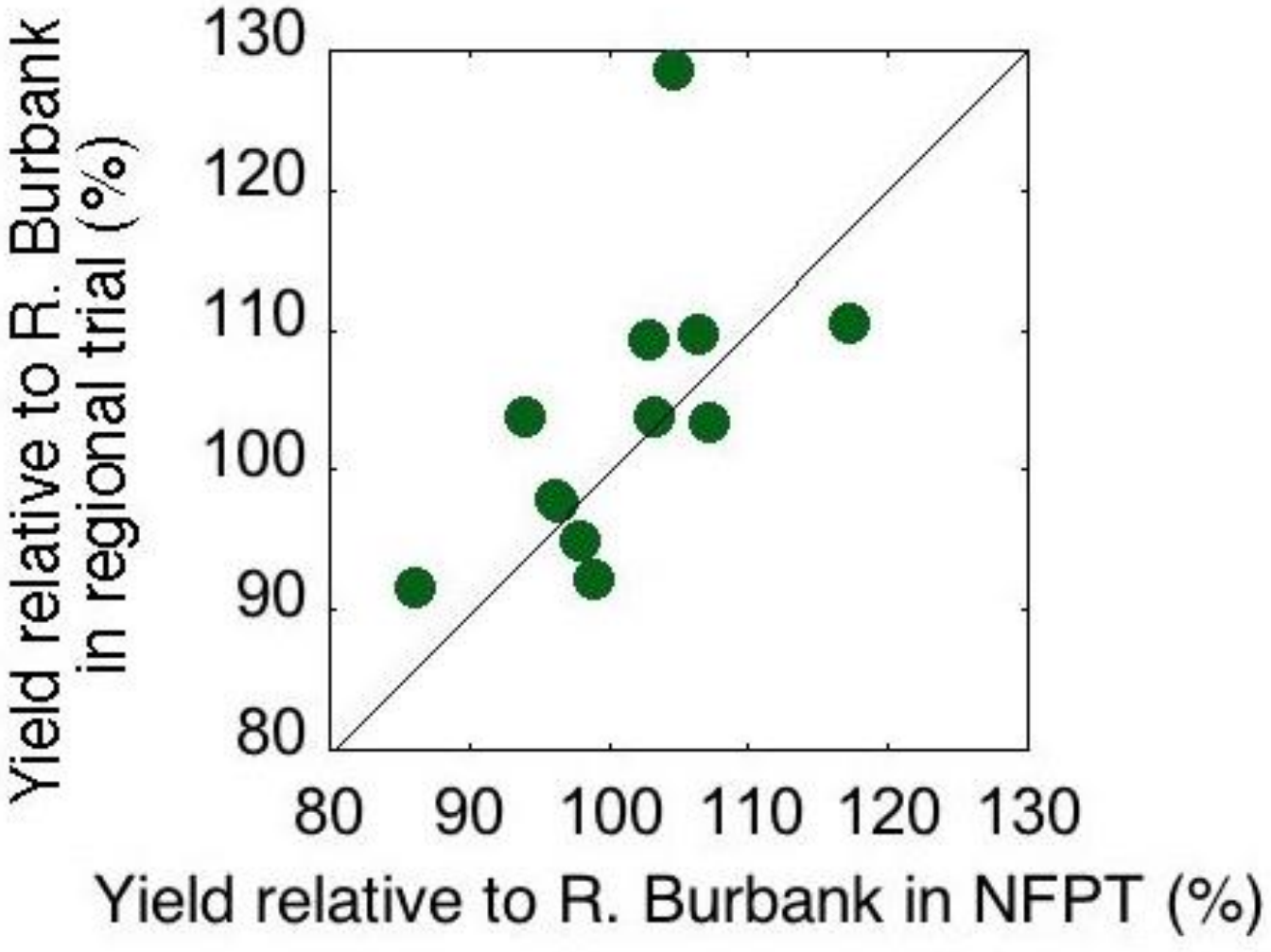
Highest yielding clones in NFPT

Breeder ID number	Average Yield
AC99375-1RU	119
AO02183-2	119
A9305-10	116
ND060742C-1Russ	115
ND049289-1Russ	112
AF4347-1	112
AF3001-6	112
AF4342-3	111
AO96141-3	110
A01325-1	110
Agila	109
CO97087-2RU	109
AO82611-7	108
A01025-4	108
W1836-3rus	107
AF4296-3	107
ND049423b-1Russ	106
AC00395-2RU	105
A03921-2	105
A82360-7	104
AR98-9	104
ND071078B-1Russ	103
A01010-1	103
A7411-2	102
A02424-83LB	102
AND99362-1Russ	101
AF4124-7	101
A9045-7	100
MN15620	99
W9604-1rus	99
AOA95154-1	99
Russet Burbank	99

Highest yielding clones in NFPT

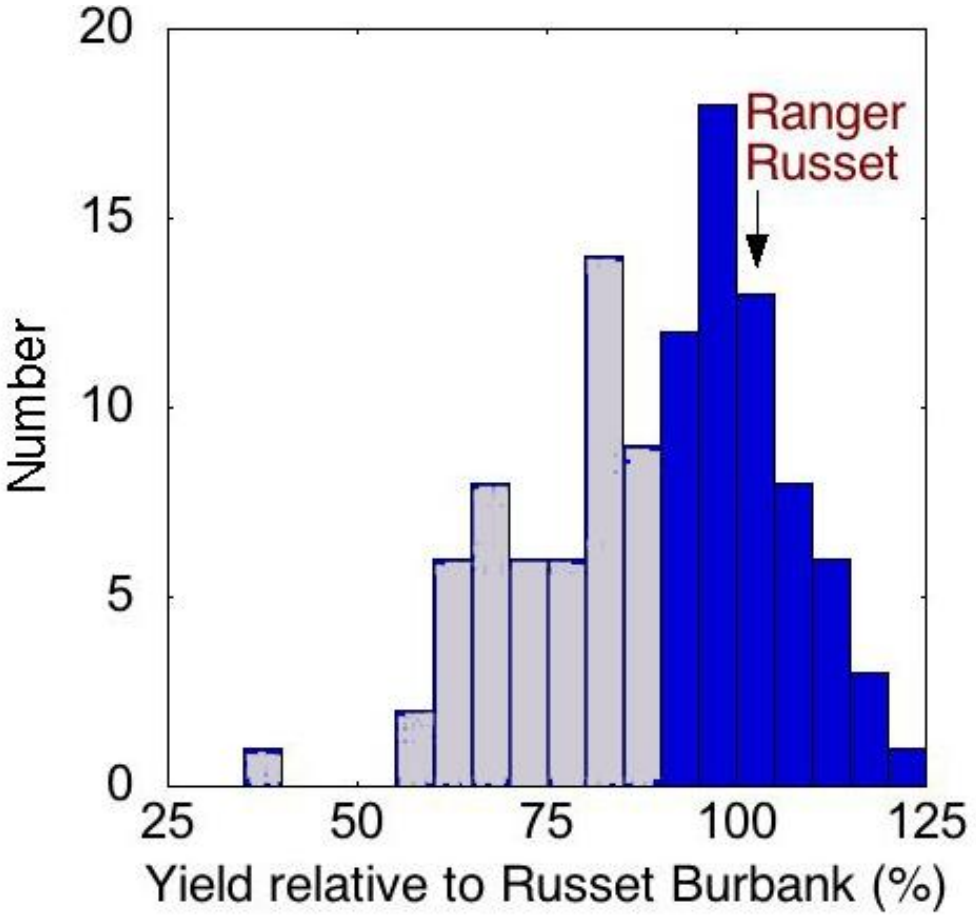
	Breeder ID number	Average Yield
	AC99375-1RU	119
	AO02183-2	119
*	A9305-10	116
	ND060742C-1Russ	115
	ND049289-1Russ	112
	AF4347-1	112
	AF3001-6	112
	AF4342-3	111
	AO96141-3	110
	A01325-1	110
	Agila	109
	CO97087-2RU	109
*	AO82611-7	108
	A01025-4	108
*	W1836-3rus	107
	AF4296-3	107
	ND049423b-1Russ	106
	AC00395-2RU	105
	A03921-2	105
*	A82360-7	104
	AR98-9	104
	ND071078B-1Russ	103
	A01010-1	103
*	A7411-2	102
	A02424-83LB	102
	AND99362-1Russ	101
	AF4124-7	101
*	A9045-7	100
*	MN15620	99
	W9604-1rus	99
*	AOA95154-1	99
	Russet Burbank	99

Relative yield of varieties in NFPT compared with other regional trials



Low yields increase costs and decrease profit potential

Should we invest resources in clones that yield less than 90% of Russet Burbank?



Moving Forward

- Year 1: WA, ID, and ND
- Year 2 and 3: WA, ID, ND (NFPT) and WI and ME (SCRI)
  - One more year of funding
  - Further project screening
- Value in multi-state testing
  - Are the right sites in the trial

Seed Production for Commercial Scale Testing

- Budgeted through SCRI
- Produce disease free tissue culture plantlets
  - 10 to 15 clones per year
- Produce NFT mini-tubers
  - Produce 200-500 NFTs for each clone
  - Make available for production and storage trials
- Commercial scale testing
- Is it possible for disease free tubers for all trials?
- Mechanisms for selection of clones need to be established

Disease Free Tissue Culture Plantlets

- Clean up 10 to 15 clones per year
- Produce 200 to 500 NFT minitubers
  - Greenhouse costs
- Grow first generation plants
  - Make first field generation seed available
- Need mechanism to identify clones of interest
  - Selection committee

Moving select lines to pivot-scale trials in SCRI

- Identified clones for NFT minituber production
- Targeting 2014 as first seed field year
- Large trials begin in 2015

Minituber production is underway for five clones

- Sklarczyk Seed Farms: AF4296-3, ND8229-3
- CSU: AC96052-1RU (13,087)
- CSS: A02507-2LB (3,600), A02138-2 (15,000+)
- Seed is available for W6234

Commercialization Trials

- Agronomic Trials
  - Do we have seed?
  - What 3-4 clones
    - Good consumer attributes
    - High agronomic potential
- Commercial Scale Trials
  - W6234-4 rus
  - 2,000 – 5,000 cwt to place in storage
  - ~40 acres for commercial run

Procedures for initiating seed production need to be streamlined

- Resources are needed for contractual seed production
- Variety protection
- Many institutions have a stake
- Delays have cost us a year for some clones

Future NFPT and SCRI trials

- Where can we make improvements?
- Where can we reduce expenditures or decrease effort?
- Where is greater effort needed?
- Can we maximize value from existing data by including regional trials in assessments

Generate expanded data set using replicated trials

SCRI Agronomic trials are out of the ground

- 6 sites (ID, WA, OR, MN, WI, ME)
- 14 clones plus Russet Burbank check
- Replicated plots
- Provide material for multiple QSR sample time periods

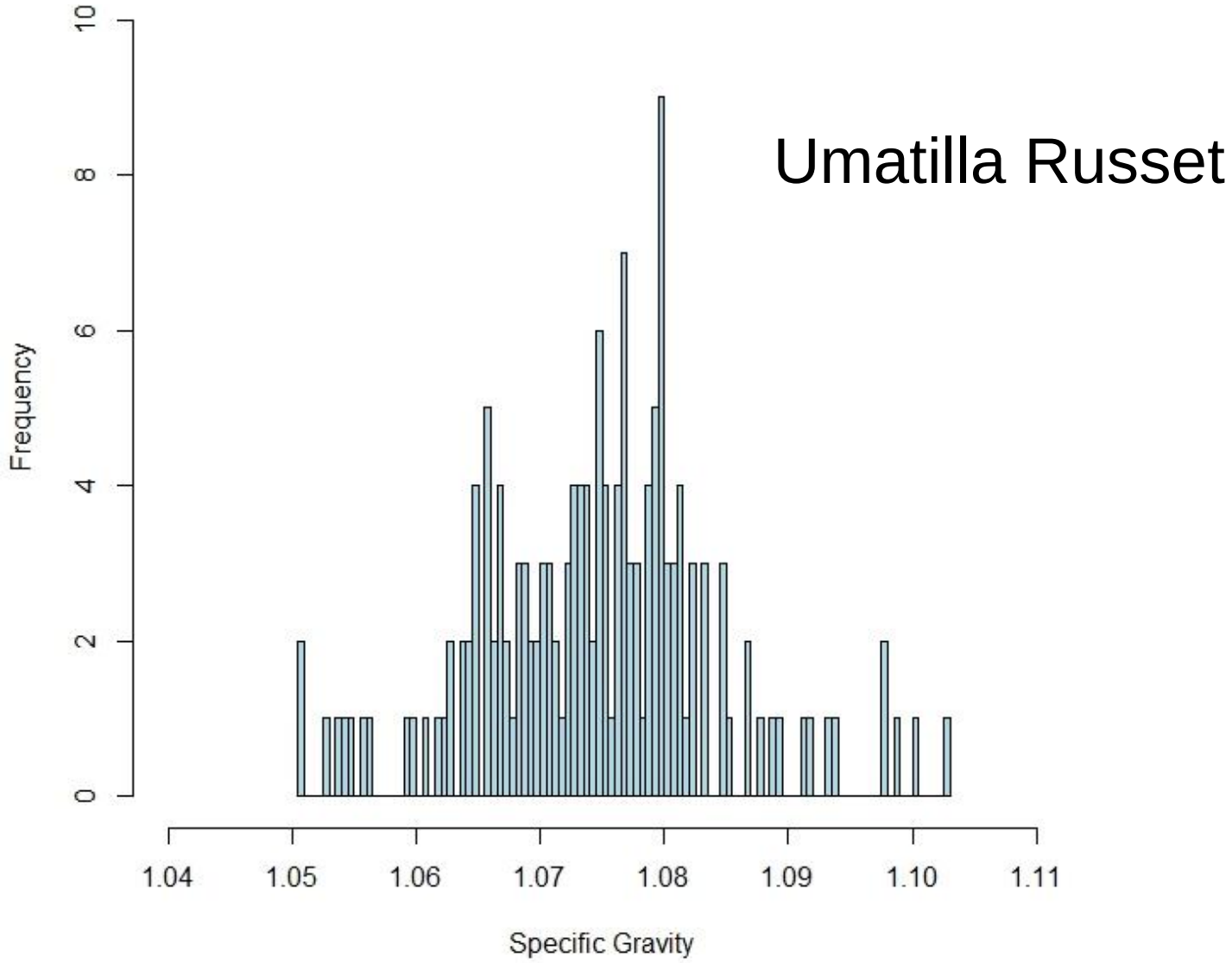
Agronomic Trials

- Improved yield and raw product quality estimates – increased predictive power
- Quality traits
  - Specific gravity variability
  - Sugar end
  - Consumer attributes
- Long term storability
- Several cwt in storage for each clone

In-season and harvest data collection

- **In-season**
  - 50% emergence date, tuber set date, 100% canopy closure date, pre-harvest stem count
  - Vine maturity
- **Harvest**
  - Specific gravity of (6-10 oz tubers)
  - Tuber size/yield distribution
  - Individual tuber specific gravity
  - Internal defects of (10-13 oz) tubers
  - Length to width ratio of (8-10 oz) tubers
  - Fry color and sugar-end defect screening
  - Bud- and stem-end sucrose and glucose
  - **20lb / clone for consumer attribute test**

Assessing consistency of solids in SCRI Agronomic trials



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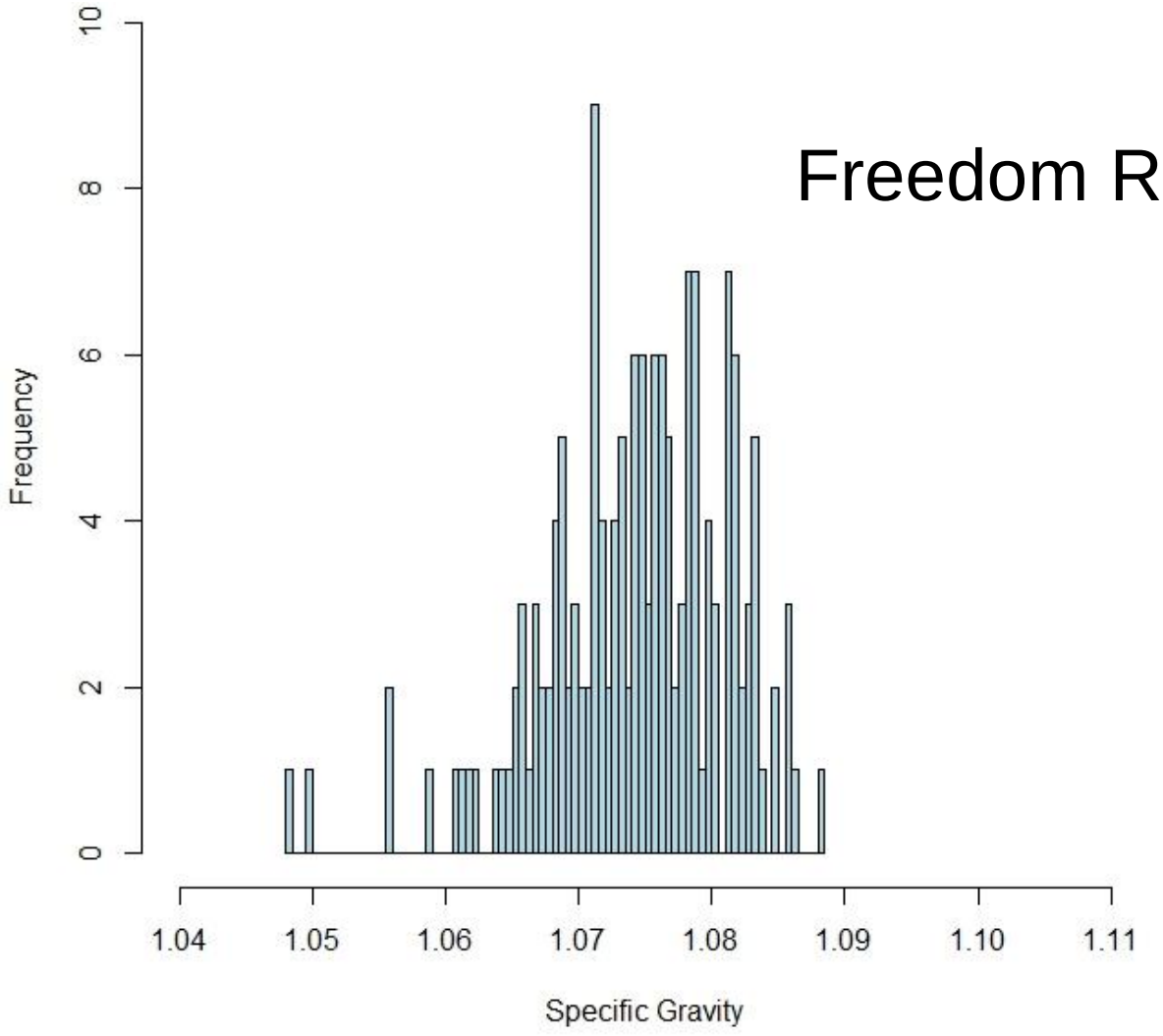

Post-harvest storage data

- Tubers are stored @ 55˚F for three weeks and ramped to 48˚F
- Storage samples will be collected every 16 weeks: 16 wk (Feb), 32 wk (May) post harvest
- Data of fry color, sugar-end defect, bud- and stem-end sucrose and glucose will be collected

Long term storage is a priority. Are we addressing this properly?

- Few options for storage with sprout inhibitor
- Difficulty planning next season based on May-August data
- Restricted choices. Few clones have low sugars in late storage
- How do we breed for long-term storage? Parents, methods, priorities.

Data analysis – using the data we already have for discussion and planning

- What have we learned so far?
- What don’t we know?
- What can we do better?

Budget

	2012	2013	2014	2015
total supplies	197969	249649	289310	258478
commercial eval		33600	33600	33600
bins	10000	10000	10000	10000
Microbios	12000	12000	12000	12000
YSI supplies	12000	12000	12000	12000
land use	2000	2000	2000	2000
seed	84,000	115000	151000	111000
acryl/asp	77,969	65,049	68,710	77,878