Update on NCPT and SCRI Acrylamide Project

NPC Summer Meeting

SCRI SCPT Subcommittee meeting

Walla, Walla, WA, June 25, 2013

Update on acrylamide and human health

- Neurotoxicity
- Carcinogenesis
- Reproductive and developmental defects

Expanded proposition 65 warning

OEHHA
Office of Environmental Health Hazard Assessment

Acrylamide
[2011]

Acrylamide is on the Proposition 65 list of chemicals known to the state to cause cancer or reproductive toxicity (such as birth defects and other reproductive harm).

Research on prenatal development and acrylamide

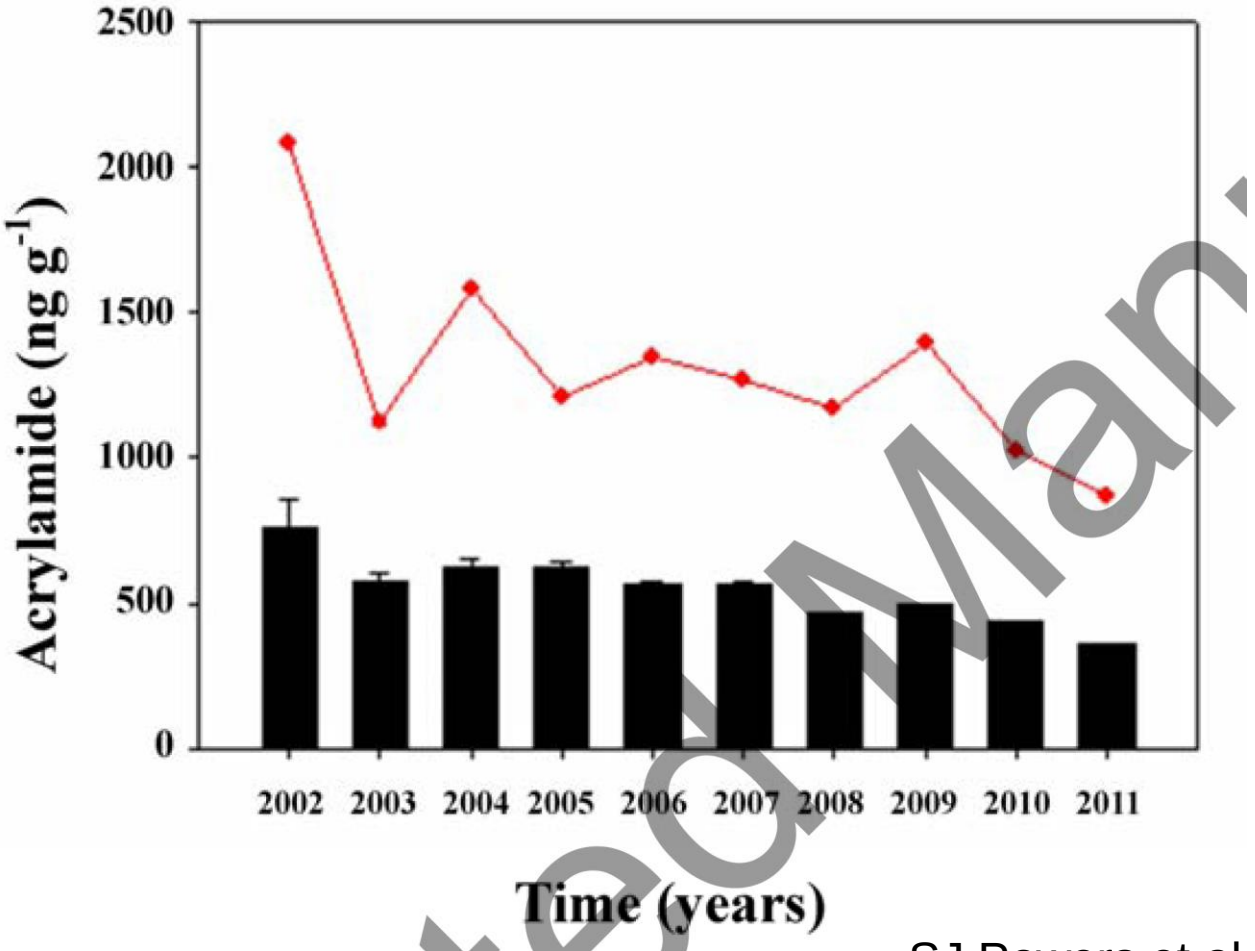
Birth Weight, Head Circumference, and Prenatal Exposure to Acrylamide from Maternal Diet: The European Prospective Mother–Child Study (NewGeneris)

Environmental Health Perspectives
2012 vol. 120 (12) pp. 1739-1745

Conclusions of the authors:

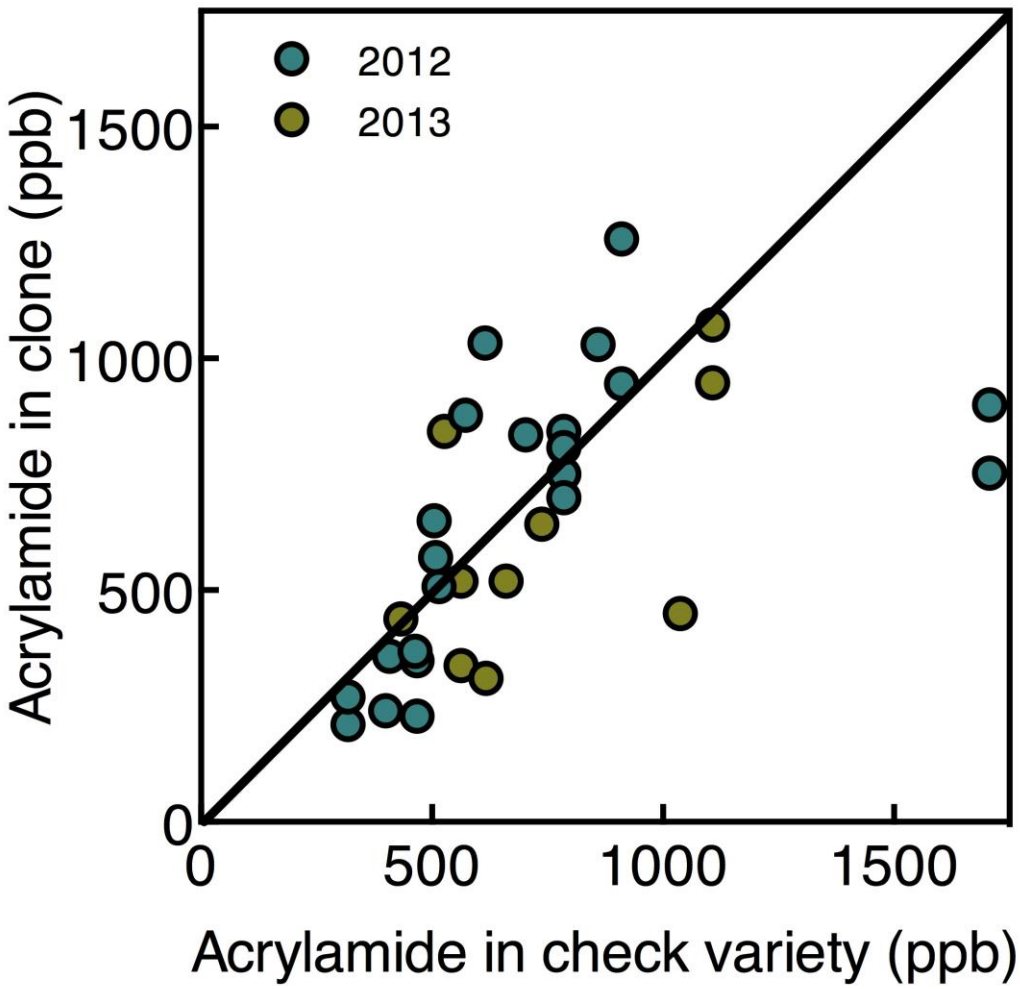
- Dietary exposure to acrylamide was associated with reduced birth weight and head circumference.
- Consumption of specific foods during pregnancy was associated with higher acrylamide exposure *in utero.*
- If confirmed, these findings suggest that dietary intake of acrylamide should be reduced among pregnant women.

Chip acrylamide content in 20 European countries

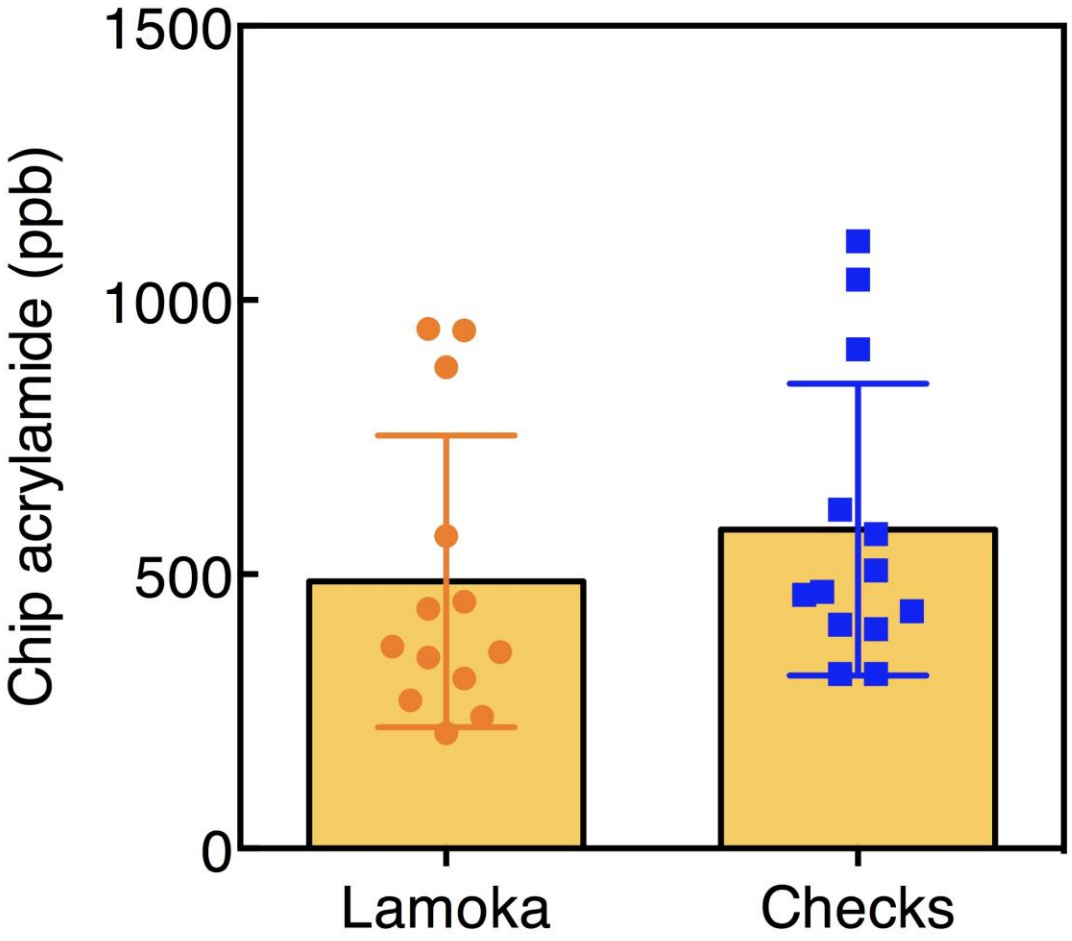


SJ Powers,et al
Food Addit Contam A, 2013

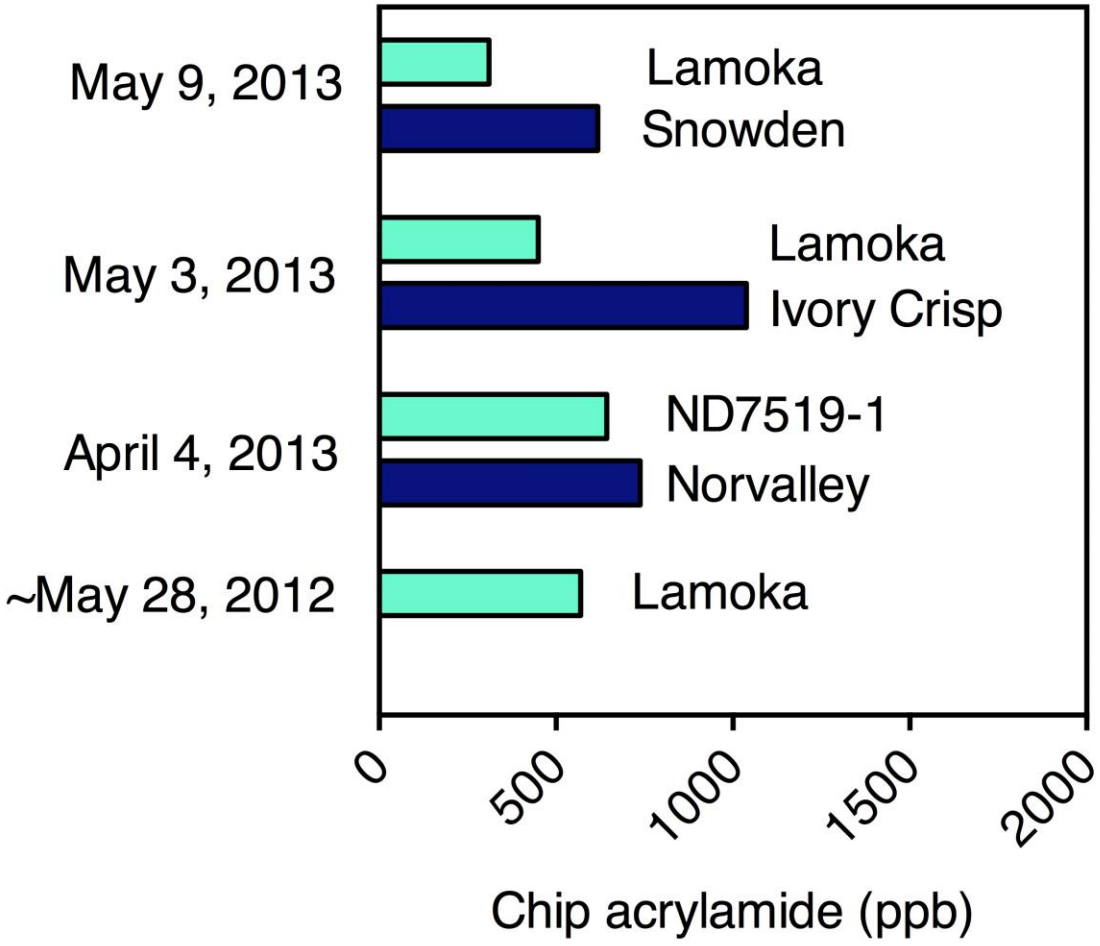
Chip acrylamide content in trial lines and in checks



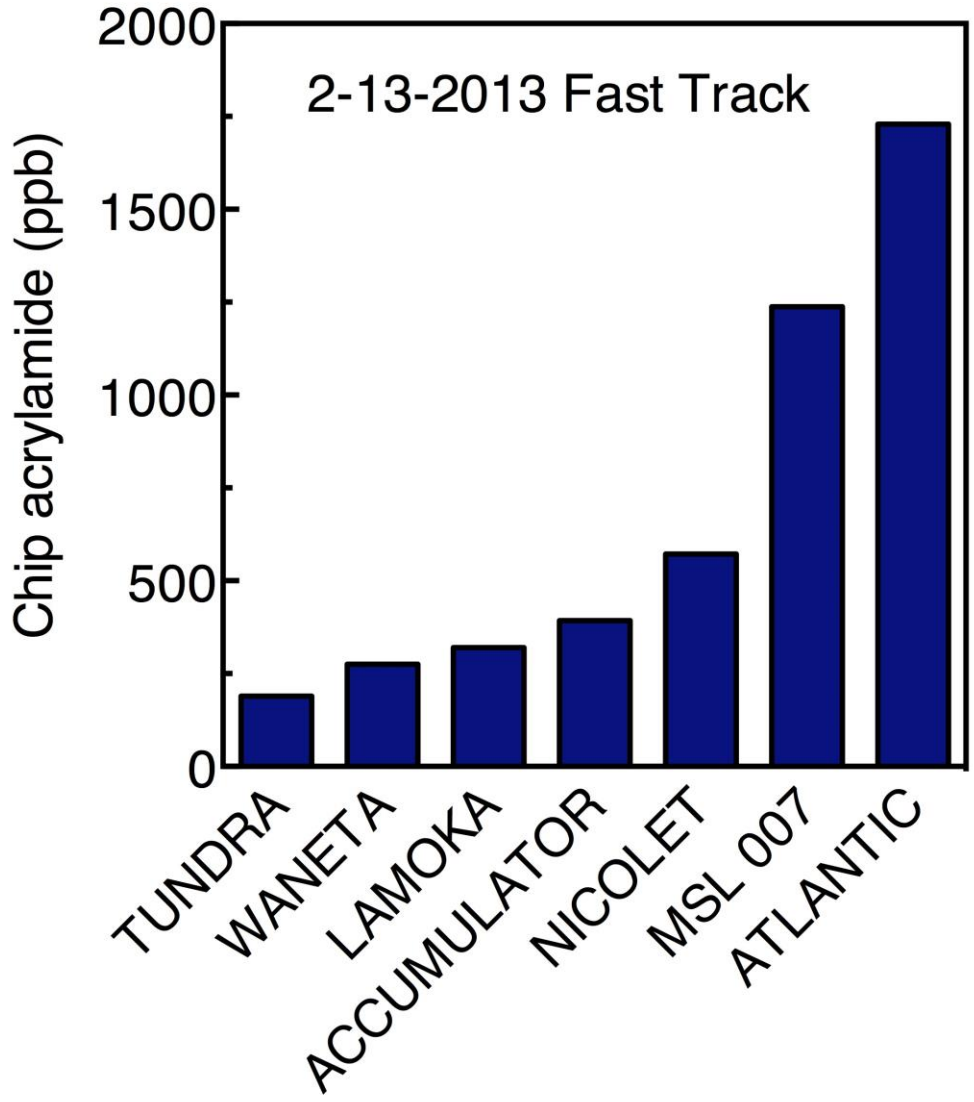
Chips made from Lamoka had reduced amounts of acrylamide



Long-term storage potential of advanced chip clones



Fast Track Chip acrylamide



Fry Protocol

- 340 F for 2 min 15 s
- Test moisture content
  - Fluctuations sample to sample in moisture content
  - Time has proven more accurate method for determining moisture content
- Still processing 2013 SFA
- Merge storage data into single database

Bin-scale evaluation of Fast Track clones

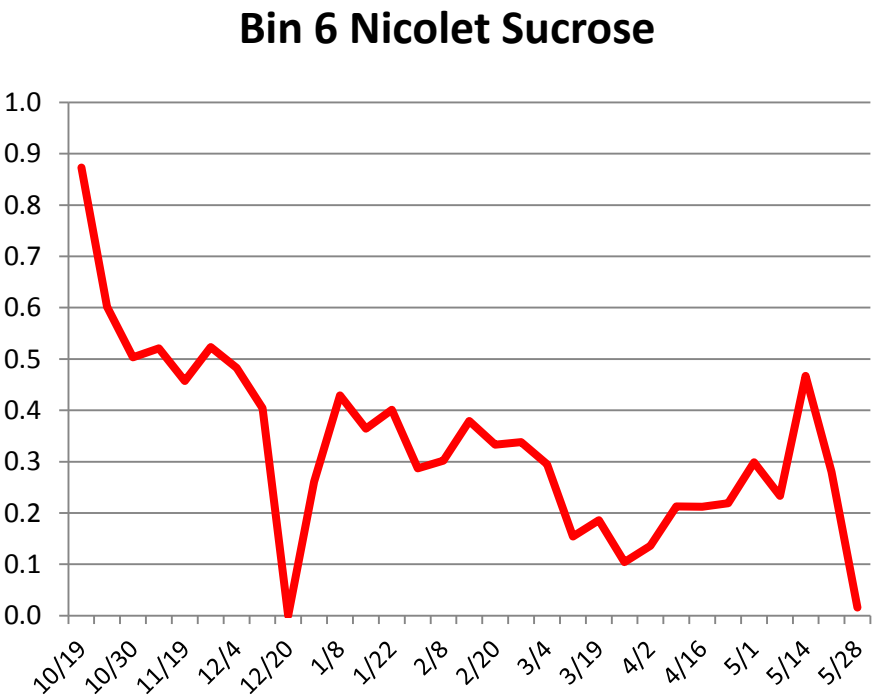
- **Lamoka**
  - Bin 4, stored at 48.5F until 6/4
  - Bin 5, Stored at 48F until 3/15
  - Both processed better than standards
  - Issues with bubbling
  - Issues with black heart and soft rot (manageable)

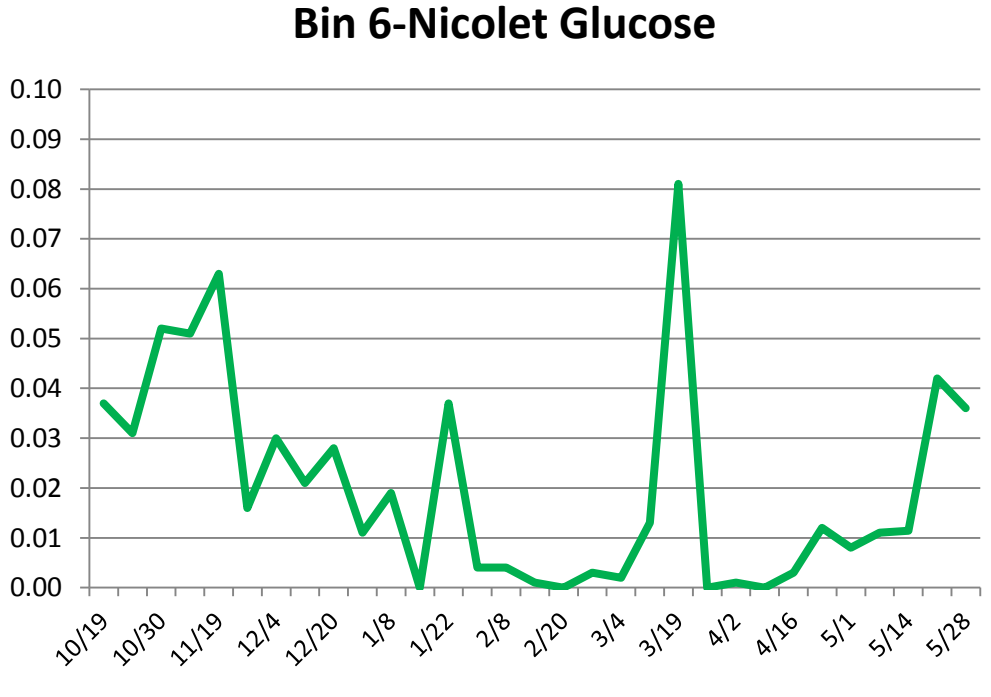
Lamoka 

 Standard

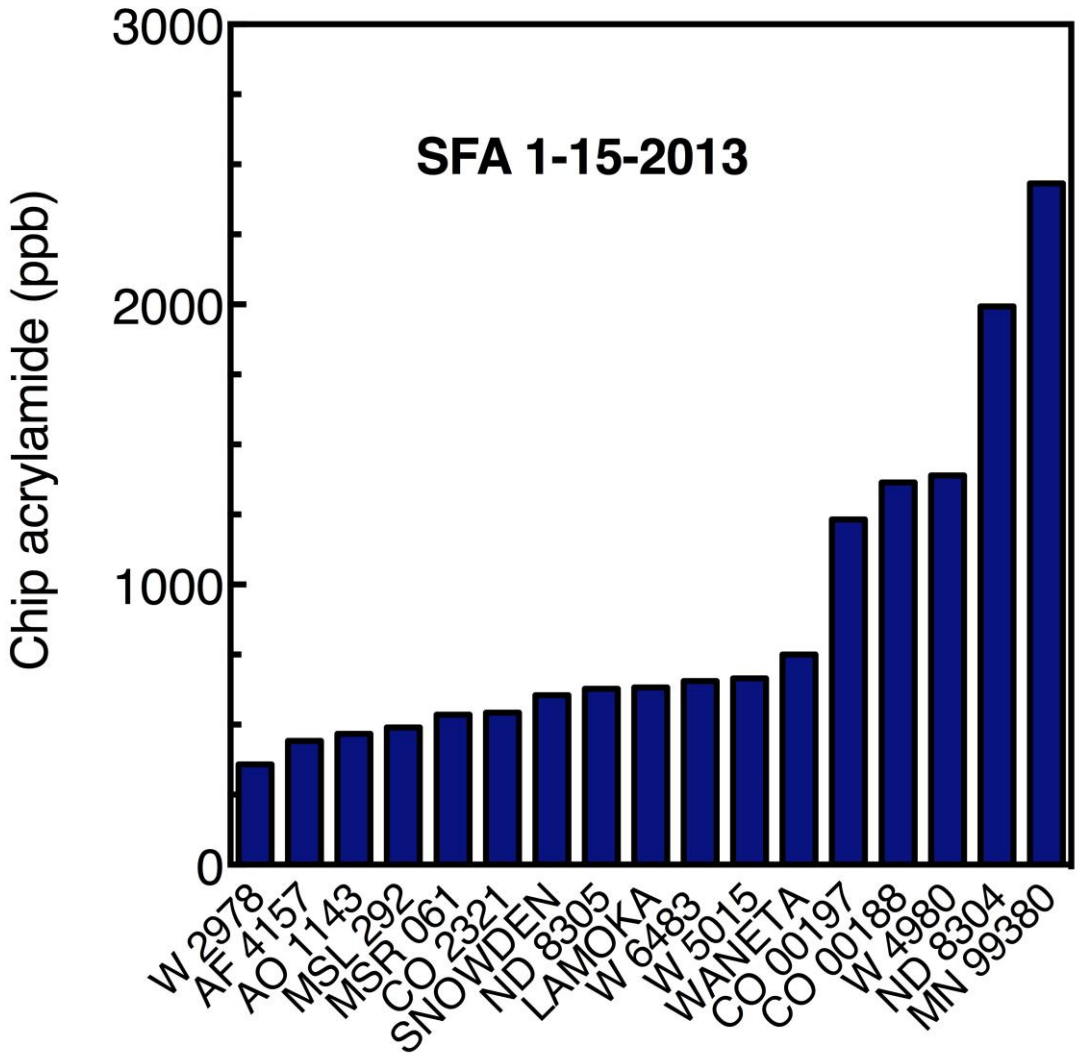
Bin-scale evaluation of Fast Track clones (cont)

- Nicolet
  - Bin 6, stored at 48.5 until 6/4
  - Processed better than standards
  - Less consistent long-term storage
  - Stem end resistant

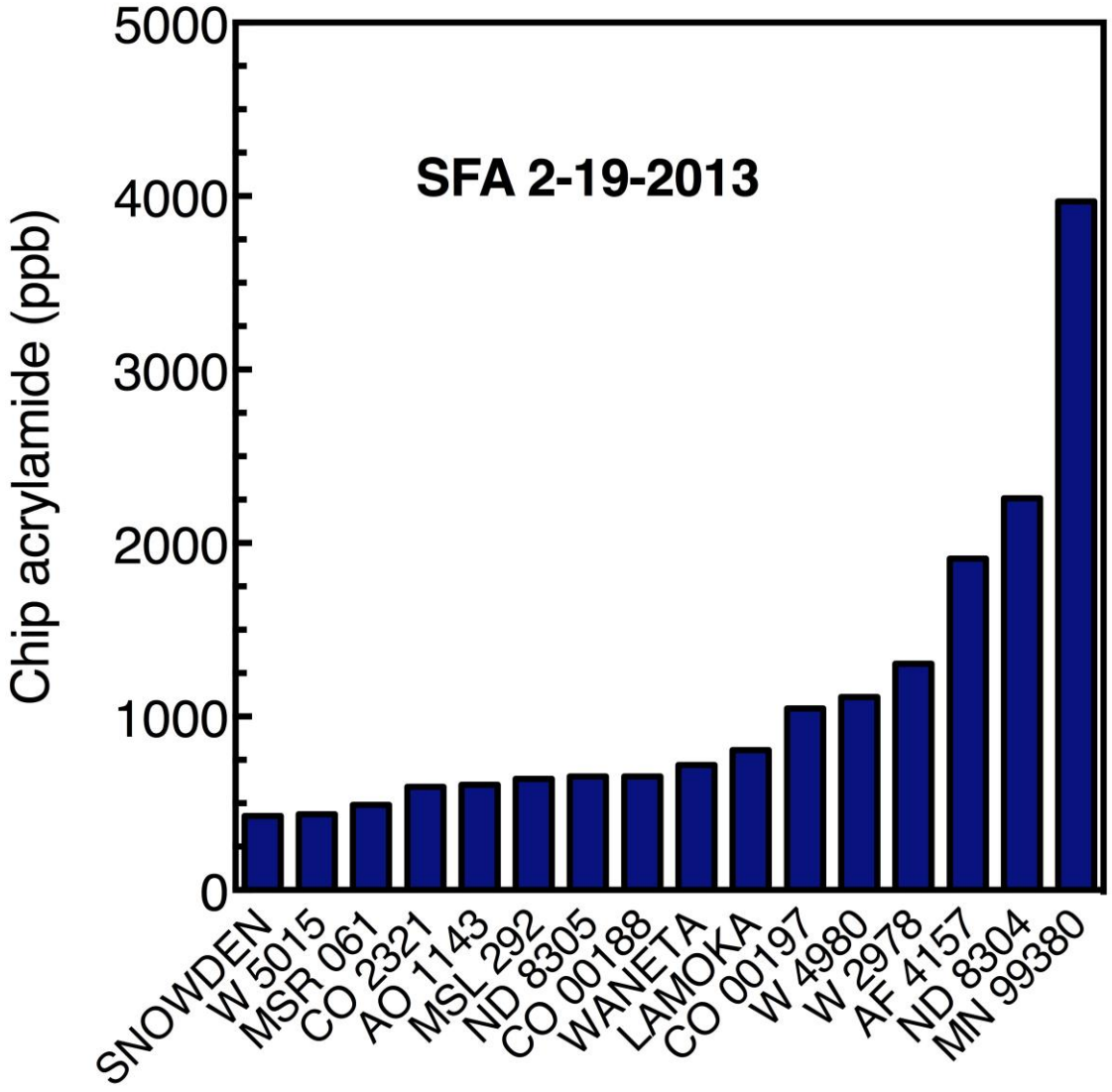




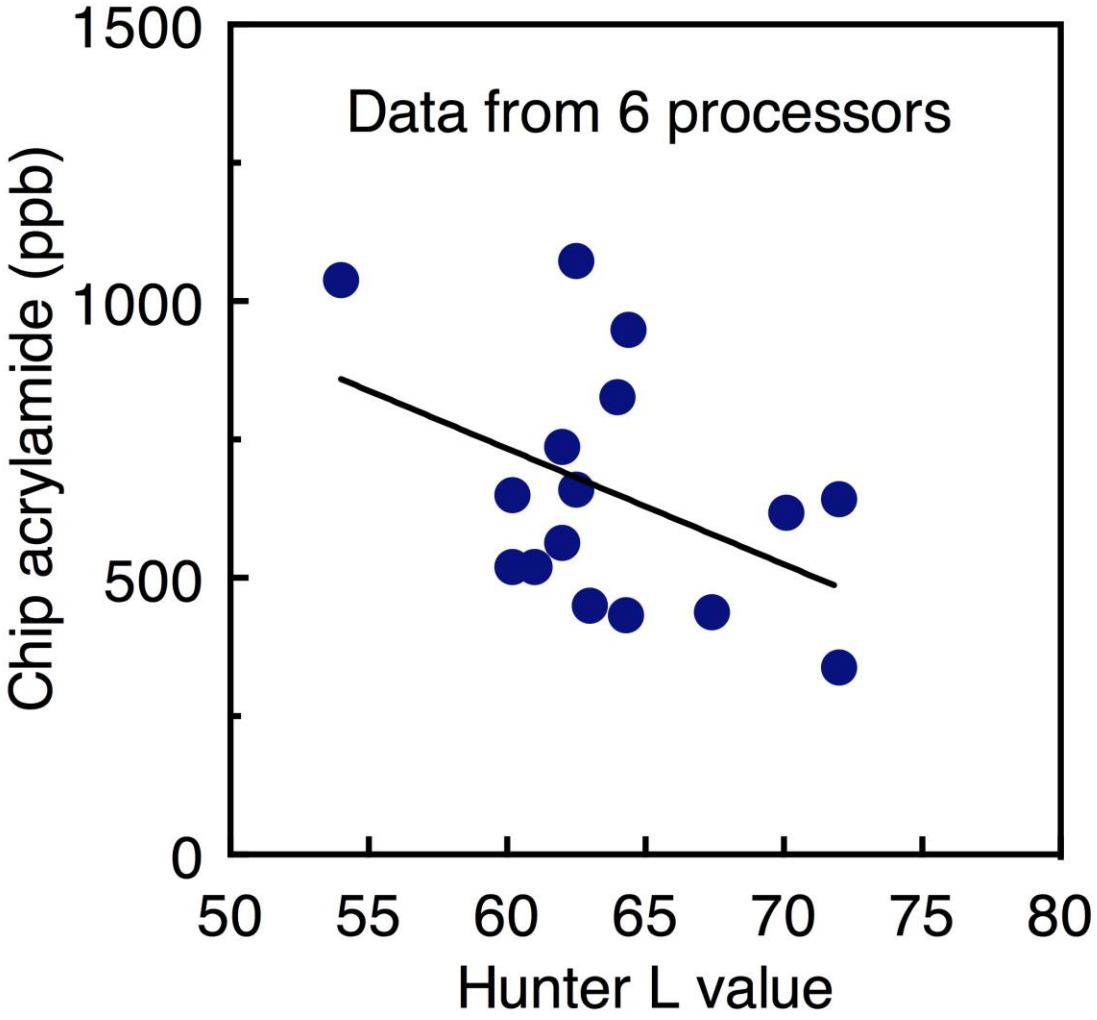
SFA Chip acrylamide



SFA Chip acrylamide



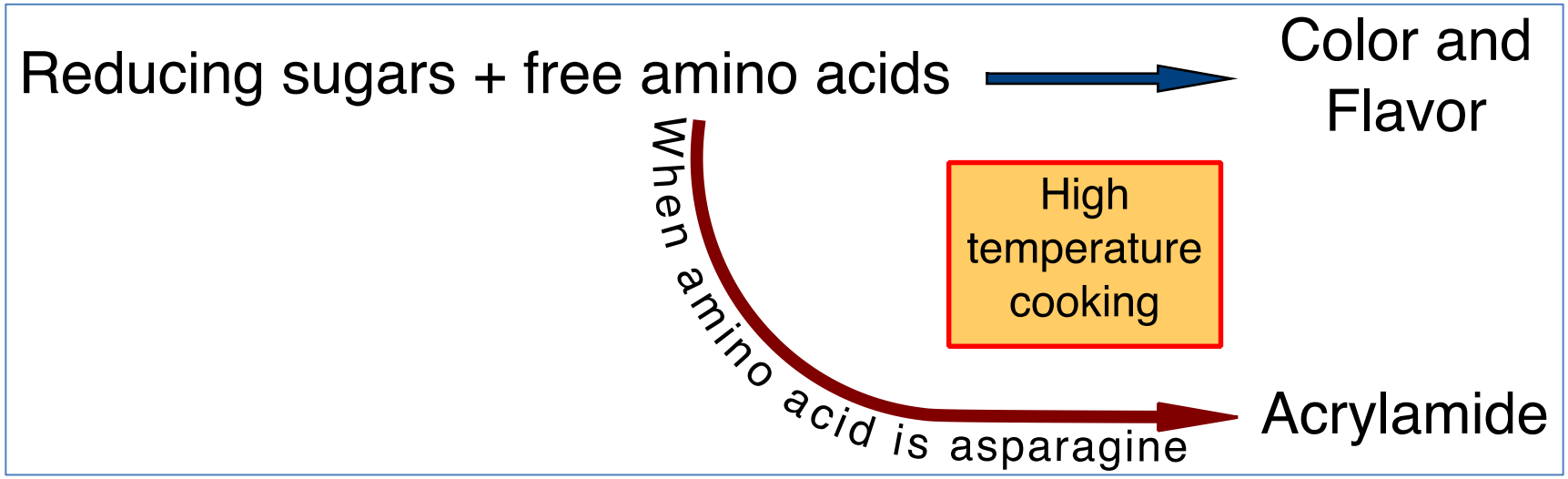
Chip acrylamide decreases as chip lightness increases



Low acrylamide in chips may require low asparagine in tubers

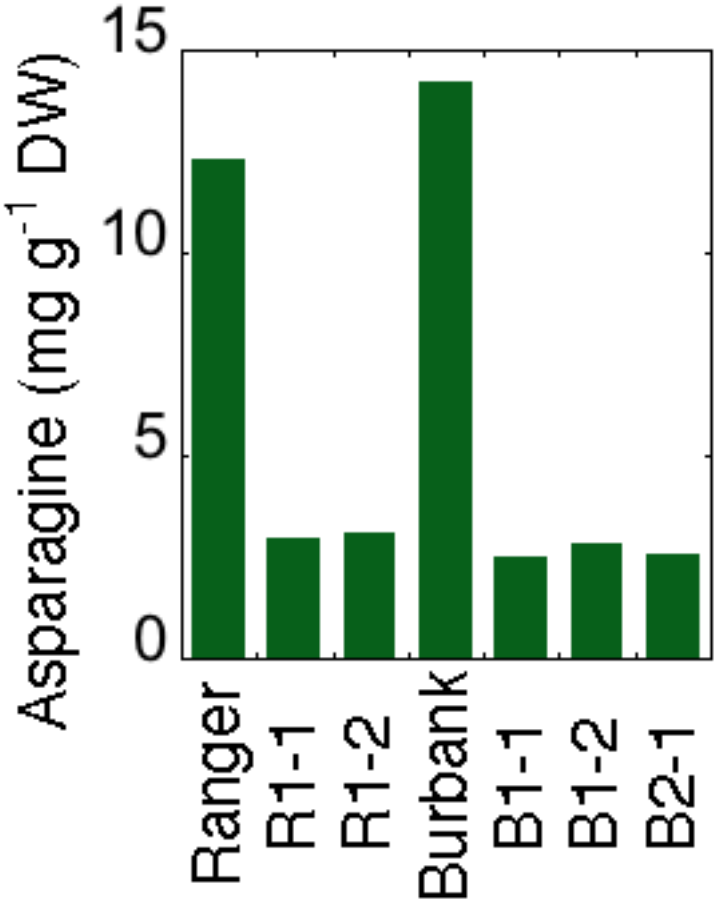
- Reducing sugars are already very low in chip-processing lines
- Asparagine is a new breeding target
- First crosses to introduce the low-asparagine trait have been made

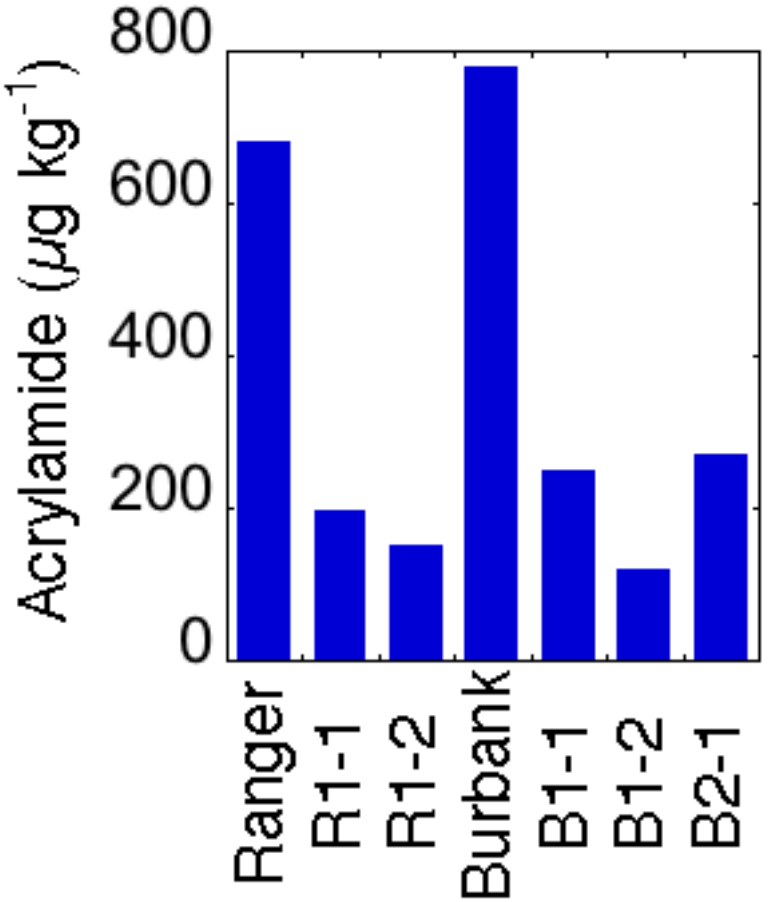
Acrylamide is formed from reducing sugars and asparagine



Define the landscape of reducing sugars and amino acids that produce low acrylamide products

Requirements for asparagine in low-acrylamide potato





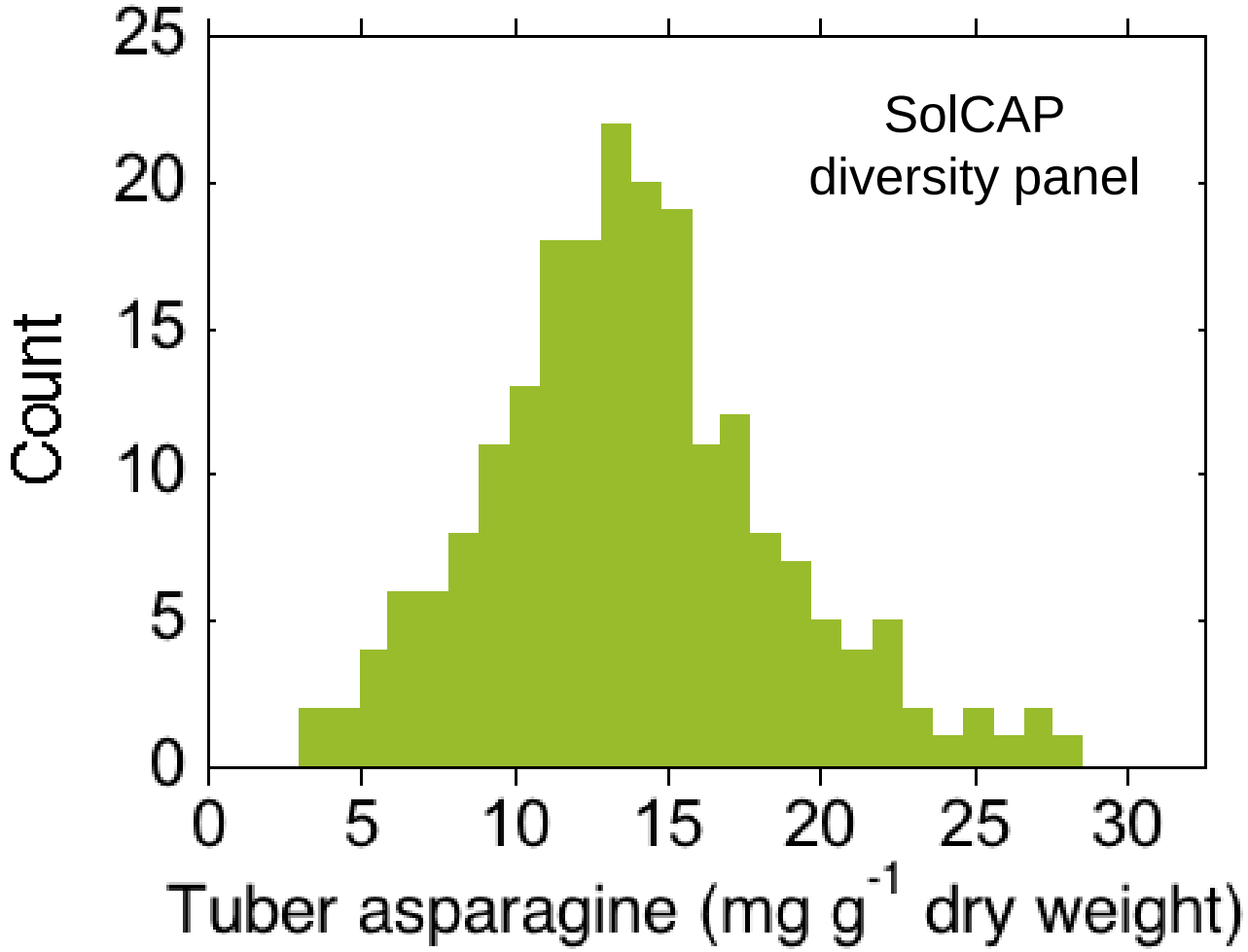
Chawla et al 2012, Plant Biotech J

Asparagine targets

Tuber asparagine of 2.5 mg g^{-1} dry weight

Asparagine ~10% of total amino acids

Asparagine in US potatoes



Markers are being identified in multiple mapping populations

Increase likelihood of identifying widely applicable markers linked to high value traits

Developing markers for low asparagine in tubers

- Tundra x Kalkaska mapping population developed in SolCAP
- Increased priority for research on tuber asparagine
- Quantified asparagine in 200 clones x 2 replicates for use in developing breeding targets

Genetic Assessment of Trial Clones

- Genotype every clone in the trials
  - $80-100 per clone
  - Price is dropping
  - 5,000 + molecular markers
- Analyze relationship of markers to key traits
  - Qualitative traits – strong signal
  - Quantitative traits – low signal across numerous clones
- Most rapidly evolving genetic research

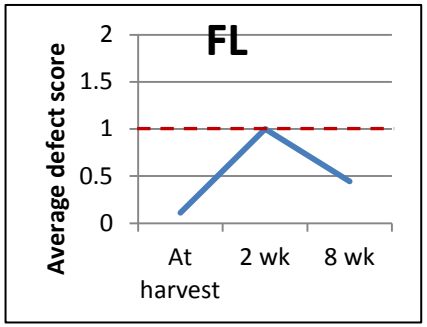
Update on stem-end chip defect research

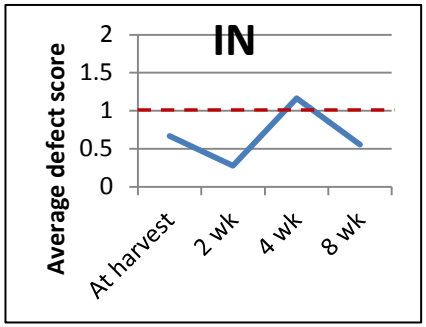
- Multi-location field trials
- Controlled environment trials

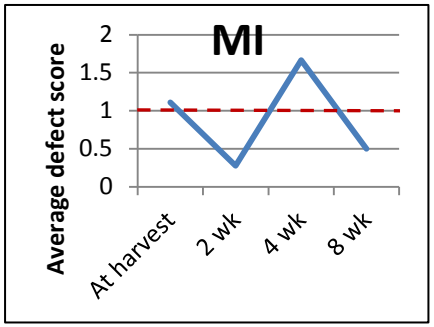
Sensitivity to stem-end defects

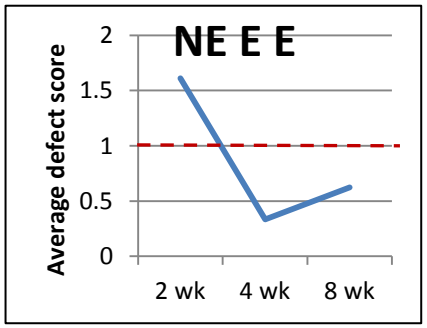
Variety	Average defect score	Letters
Atlantic	0.73	A
Megachip	0.59	AB
Snowden	0.50	ABC
Lamoka	0.45	ABC
Pike	0.41	BC
Nicolet	0.41	BC
Harley	0.37	BC
MSL292-A	0.31	C
Accumulator	0.28	C

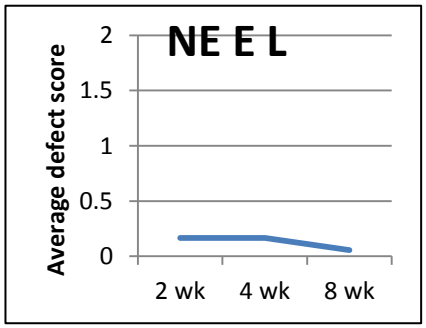
Lamoka

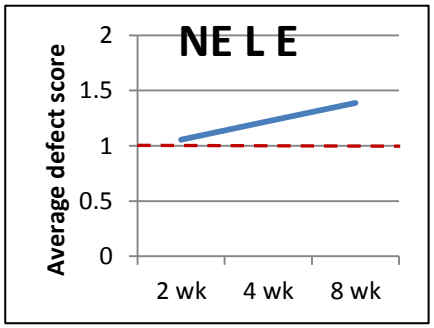

FL
Average defect score
2
1.5
1
0.5
0
At harvest
2 wk
8 wk

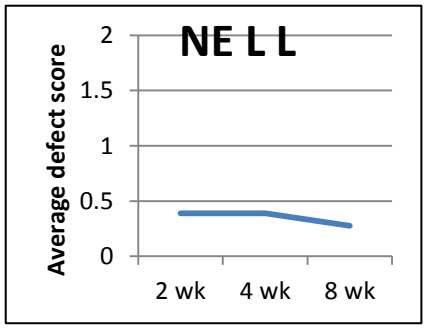

IN
Average defect score
2
1.5
1
0.5
0
At harvest
2 wk
4 wk
8 wk

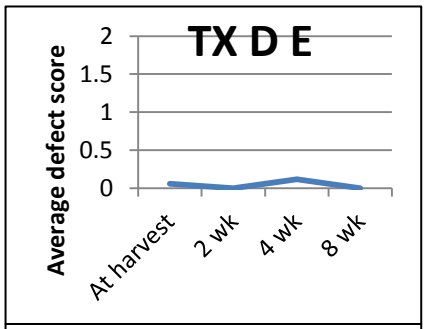

MI
Average defect score
2
1.5
1
0.5
0
At harvest
2 wk
4 wk
8 wk

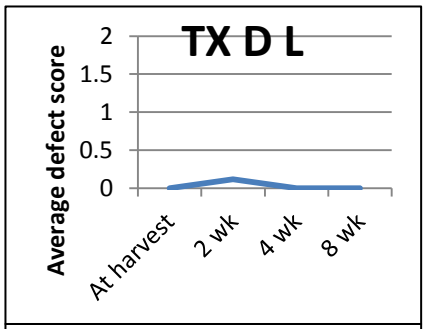

NE E E
Average defect score
2
1.5
1
0.5
0
2 wk
4 wk
8 wk


NE E L
Average defect score
2
1.5
1
0.5
0
2 wk
4 wk
8 wk


NE L E
Average defect score
2
1.5
1
0.5
0
2 wk
4 wk
8 wk


NE L L
Average defect score
2
1.5
1
0.5
0
2 wk
4 wk
8 wk


TX D E
Average defect score
2
1.5
1
0.5
0
At harvest
2 wk
4 wk
8 wk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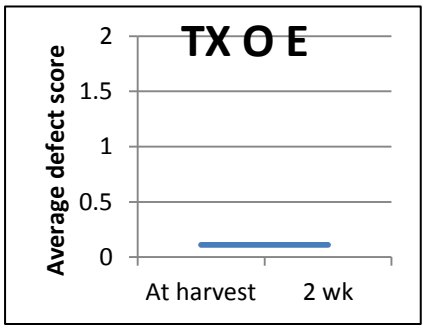
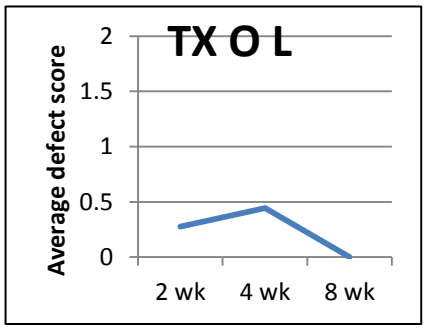
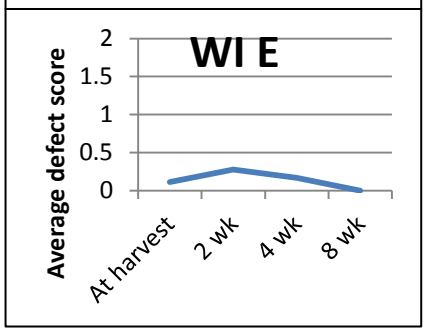
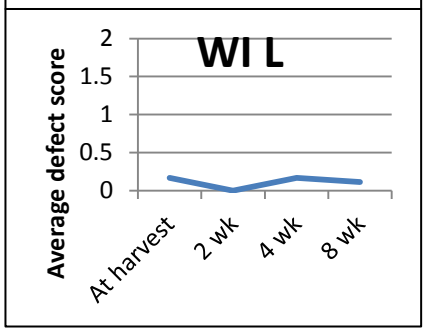
At harvest
2 wk
4 wk
8 wk


TX O E
Average defect score
2
1.5
1
0.5
0
At harvest
2 wk


TX O L
Average defect score
2
1.5
1
0.5
0
2 wk
4 wk
8 wk


WI E
Average defect score
2
1.5
1
0.5
0
At harvest
2 wk
4 wk
8 wk


WI L
Average defect score
2
1.5
1
0.5
0
At harvest
2 wk
4 wk
8 wk

Tuber disease susceptibility screens

- 3 Diseases:
  - Late Blight (*Phytophthora infestans*)
  - Pink Rot (*Phytopthora erythroseptica*)
  - Soft Rot (*Pectobacterium carotovorum* var. *carotovora*)
- Tubers wounded, inoculated, and placed in humidity chambers with unique conditions favorable for the development of each disease
- After an appropriate length of time based on disease, tubers were cut in half through the inoculation sites
- The amount of infection of the inner tissue was measured as a percent of the cut inner surface area

Spacing Trials

- Evaluated effects of spacing on yield and size distribution
  - Targeted 2 – 4” range
  - Relationship to yield
- 4 replications
- 6, 9, 12” in row spacing for most clones

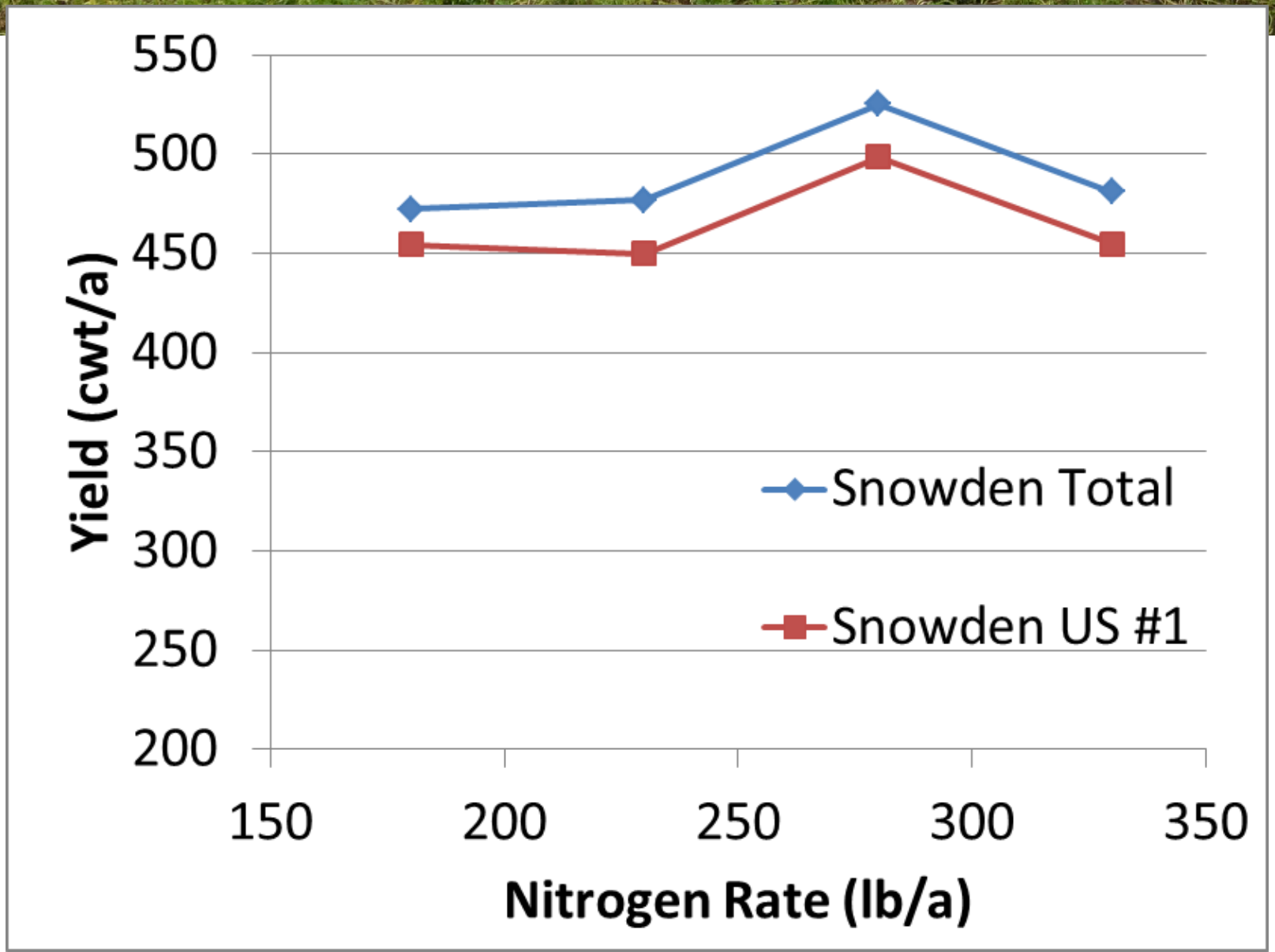
W2324-1 Yields 2005

Treatment		Total yield	US #1	B (< 2 oz)	Cull
Variety & In-row spacing		(Cwt/acre)	Cwt/A	Cwt/A	Cwt/A
Atlantic	9"	605.6	541.6	12.7	51.4
Atlantic	12"	583.8	512.2	7.5	64.0
Atlantic	16"	576.1	488.1	9.3	78.7
W2324-1	9"	607.9	558.5	11.9	37.5
W2324-1	12"	590.6	528.9	8.4	53.2
W2324-1	16"	543.0	496.6	11.5	35.0
	LSD	**NS**	**NS**	**NS**	**NS**

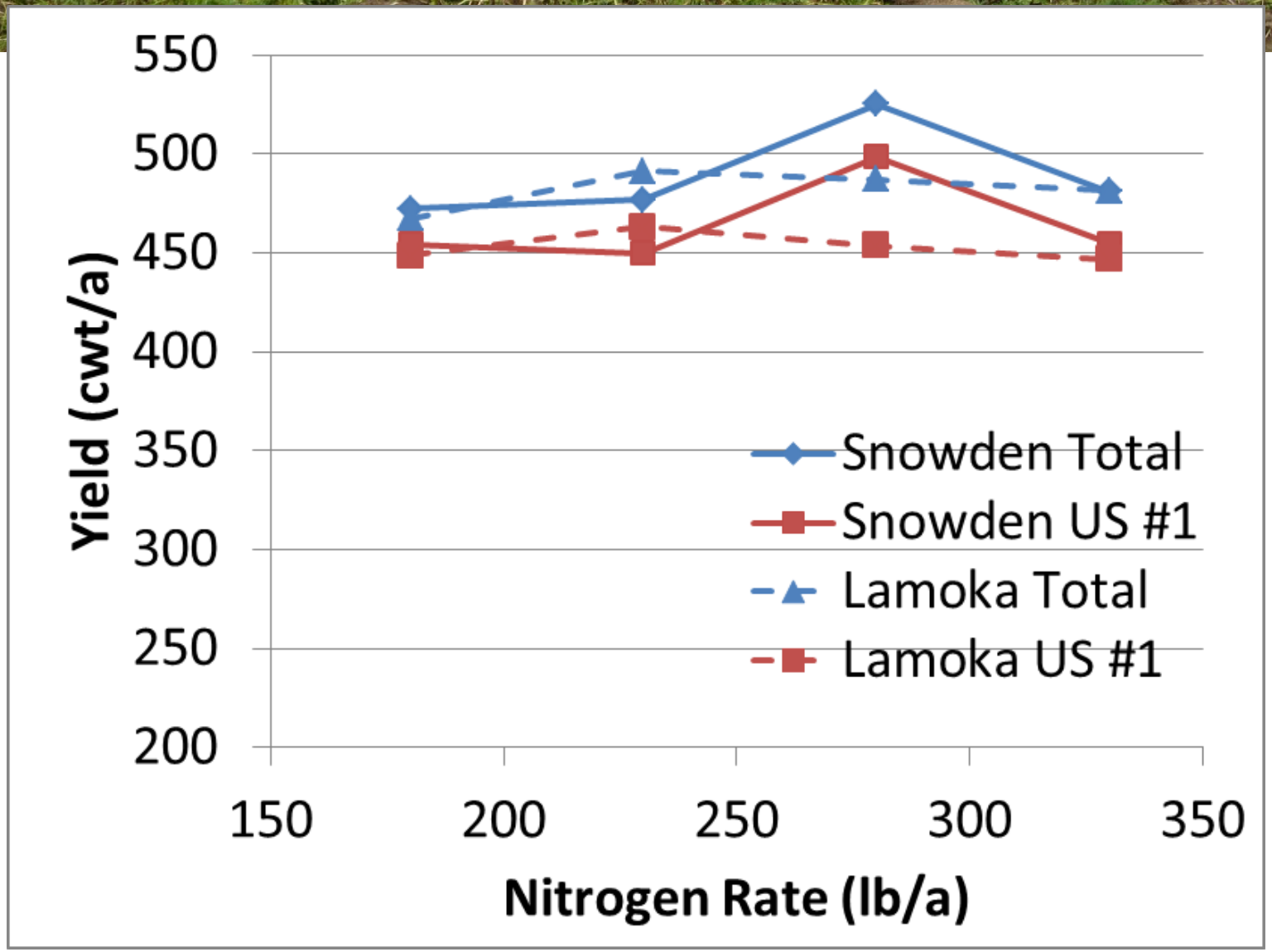
W2324-1 Size Profile

Treatment		Size grade (% of US #1 yield)					
Variety & In-row spacing		2-4 oz	4-6 oz	6-10 oz	10-13 oz	13-16 oz	>16 oz
Atlantic	9"	16.0	23.0	40.3	12.9	4.4	3.4
Atlantic	12"	13.7	19.3	39.0	15.9	7.0	5.2
Atlantic	16"	10.2	14.9	39.5	20.2	9.0	6.3
W2324-1	9"	13.4	16.4	39.2	18.1	8.8	4.2
W2324-1	12"	9.8	12.8	41.6	19.2	9.8	6.9
W2324-1	16"	7.9	12.6	41.6	21.3	10.9	5.8
	LSD	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

Snowden


550
500
450
400
350
300
250
200
Yield (cwt/a)
Snowden Total
Snowden US #1
150
200
250
300
350
Nitrogen Rate (lb/a)

Lamoka


550
500
450
400
350
300
250
200
Yield (cwt/a)
150
200
250
300
350
Nitrogen Rate (lb/a)
Snowden Total
Snowden US #1
Lamoka Total
Lamoka US #1

Southern Harvest Management

- Manage chemical maturity of the potato crop
- Duration of harvest
  - Rate of maturation
  - Delay in over maturation
- Evaluated digs from late bulking through 6 weeks
- Evaluate sucrose and glucose
- 3-4 sites