UMHDI 1st Generation Selections

March 9, 2019

Hazelnut Improvement Program

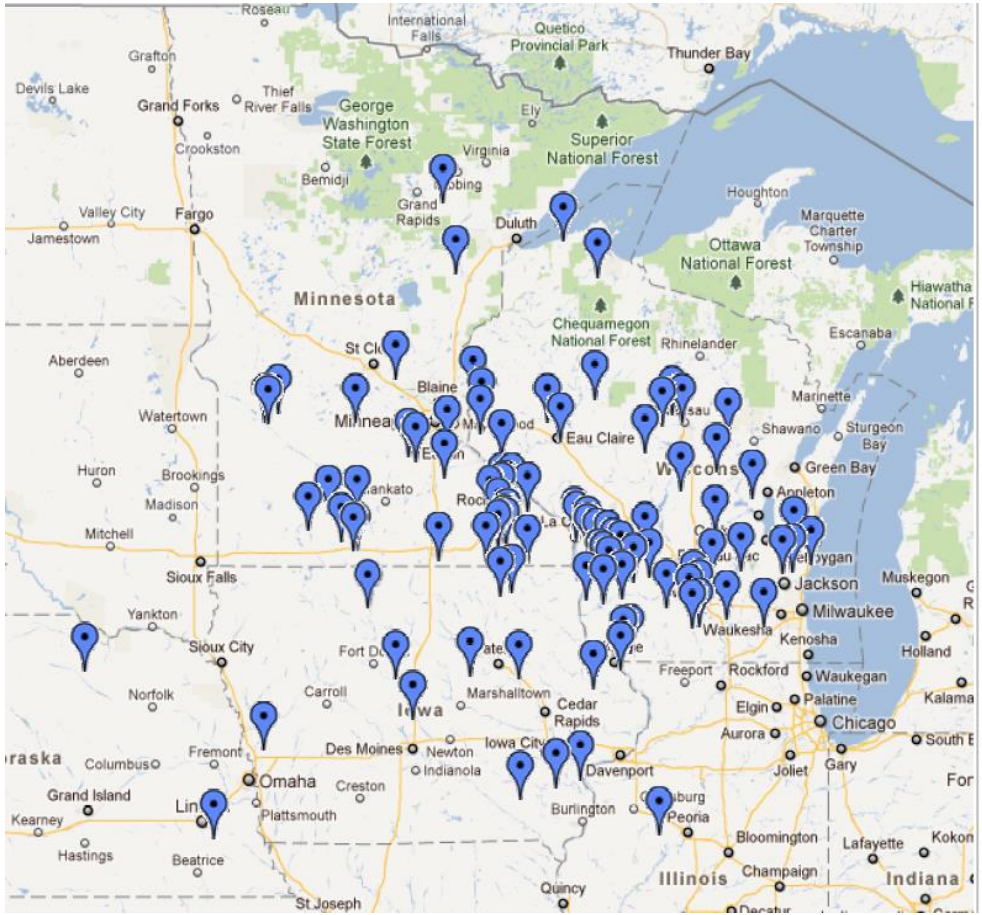
Upper Midwest Hazelnut Development Initiative

Today’s Presentation

- Our 1st Generation Selections
- Our Commercialization Plan
- Propagation Timeline
- 2nd Generation Pipeline

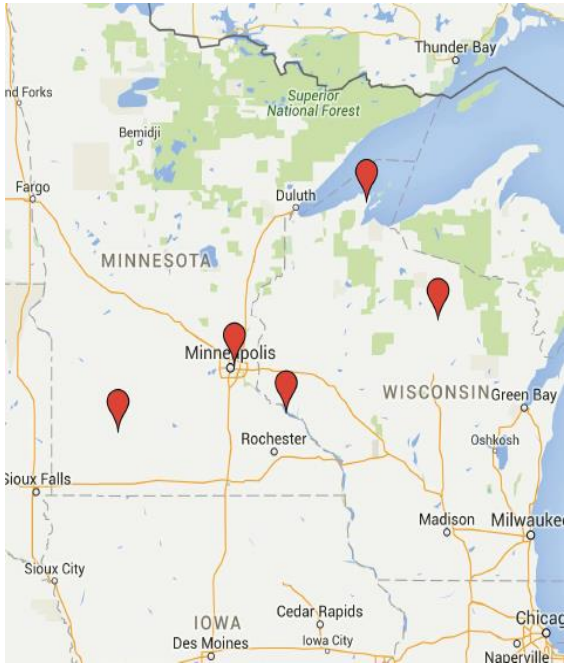
On-Farm Hybrid Seedling Populations (2010)

State	Plants	Growers
IA	4044	16
IL	319	1
MN	22403	30
WI	39064	82
Total	**65830**	**129**



UMHDI Performance Trials

- Evaluation of promising hybrid genotypes selected from on-farm plantings in the Upper Midwest since 2008/2009



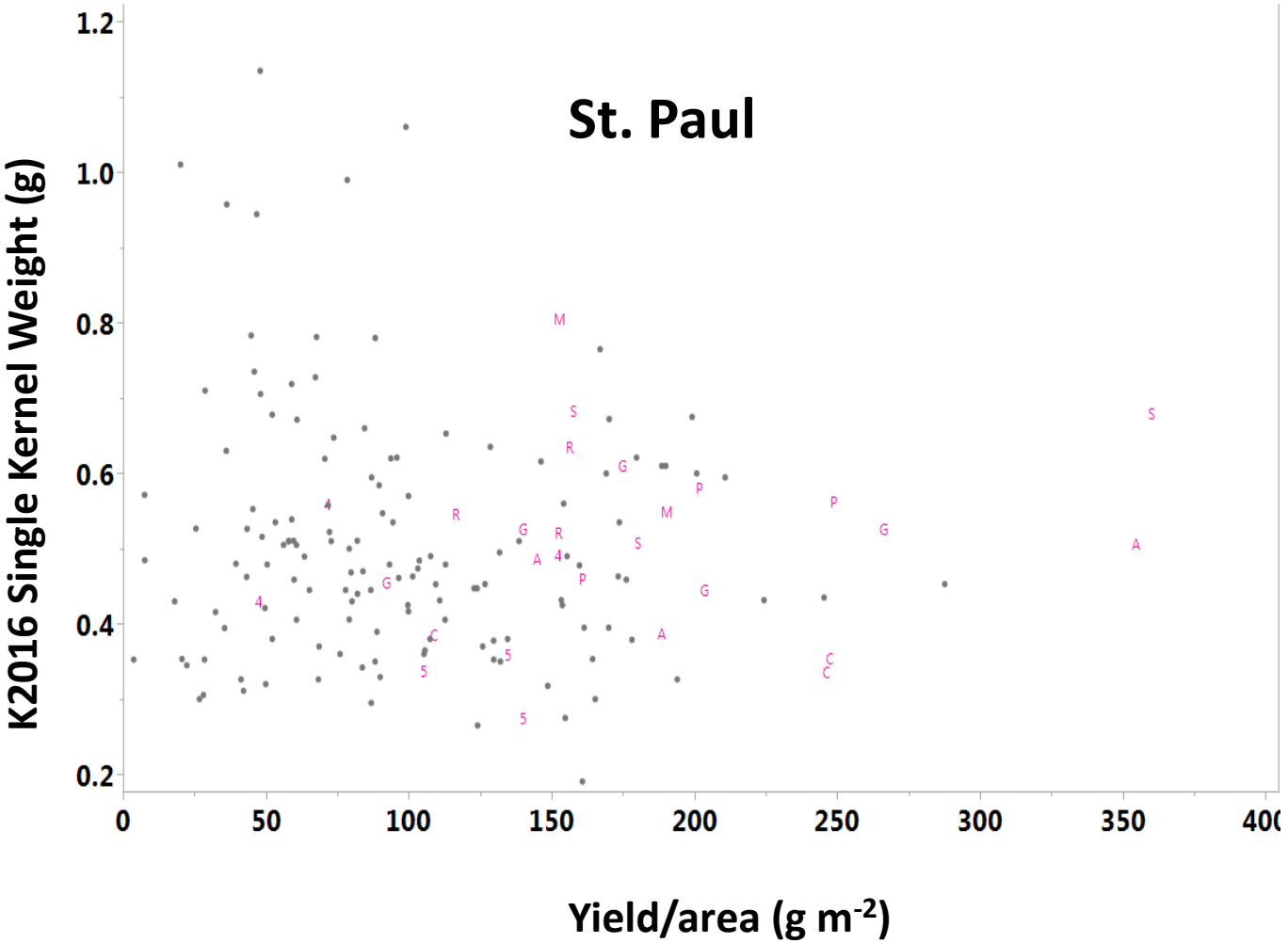
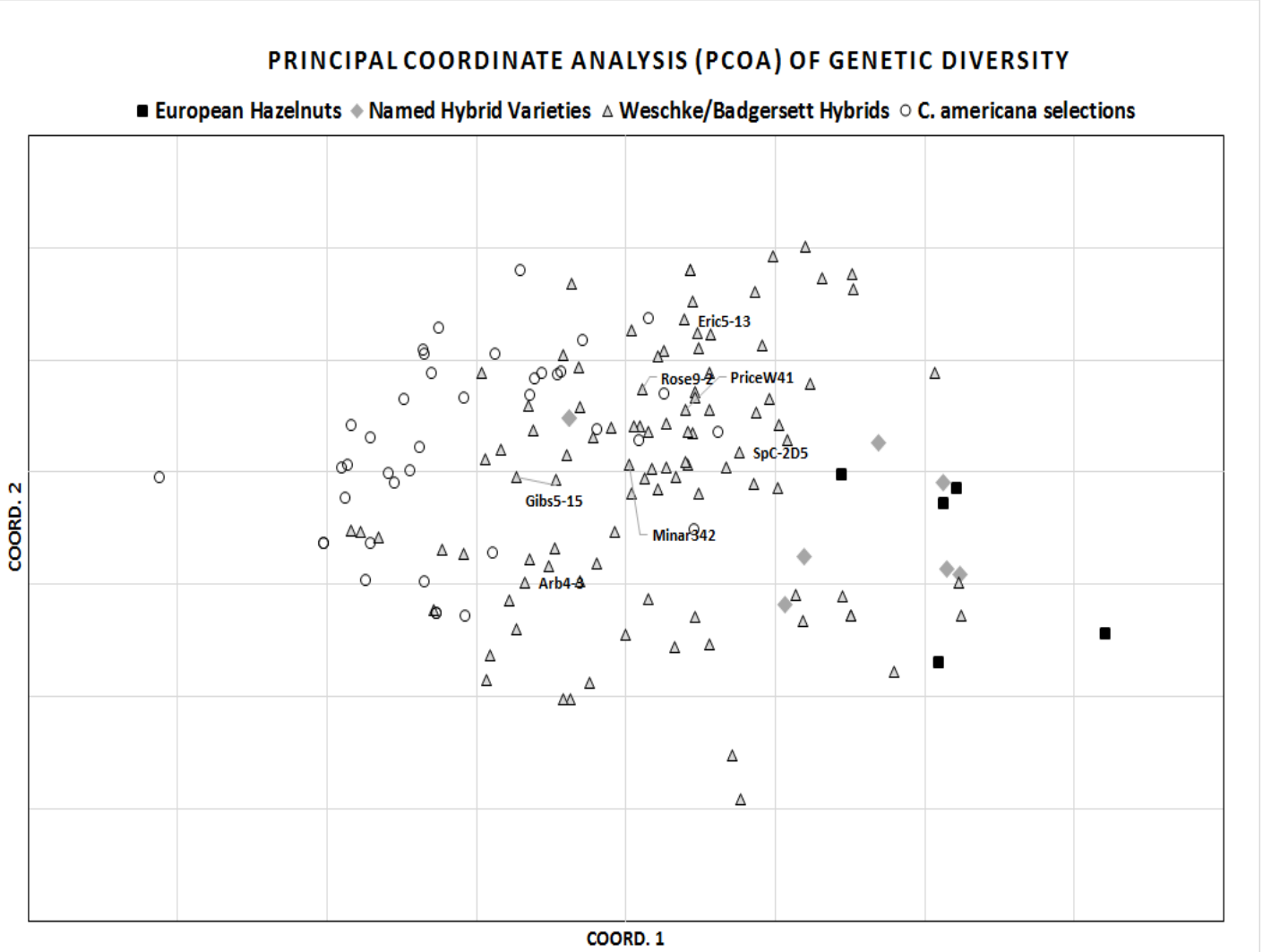

St. Paul
K2016 Single Kernel Weight (g)
1.2
1.0
0.8
0.6
0.4
0.2
0
50
100
150
200
250
300
350
400
Yield/area (g m-2)

Table 2 Variety names, parentage, source and putative EFB resistance of accessions presented in Fig. 1

	N[a]	Parentage	Source (name of breeder)	EFB resistance
Named European varieties	5			
Barcelona		*C. avellana*	France	Susceptible
Jefferson		*C. avellana*	Oregon State U. (Mehlenbacher)	R gene (Gasaway)
Lewis		*C. avellana*	Oregon State U. (Thompson)	Quantitative
Tonda di Giffoni		*C. avellana*	Italy	Quantitative
York		*C. avellana*	Oregon State U.	R gene (Gasaway)
Hybrids from Other Sources	8			
Gellatly hybrid		*C. cornuta* × *C. columa*	British Columbia (Gellatly)	Susceptible
Grand traverse		*C. cornuta* × *C. columa*	Michigan (Farris)	Quantitative
Slate hybrid		*C. americana* × *C. avellana*	Pennsylvania (Slate)	Unknown
Het 1 (Andrew)		*C. cornuta* × *C. heterophylla*[b]	Quebec and Ontario (Grimo)[c]	Unknown
Het 3 (Aldara)				Unknown
Het E				Unknown
Manitoba 202C (Joanne)		*C. americana* × *C. avellana*[b]	Saskatchewan, Manitoba (Kerr) and Ontario (Grimo)[d]	Unknown
Manitoba 204E (Marion)				Unknown
Weschke/Badgersett progeny	98	*C. americana* × *C. avellana*	Wisconsin (Weschcke) and Minnesota (Rutter)[e]	Presumed quantitative
C. americana selections	39	*C. americana*	Wild collected in Wisconsin and Minnesota	Presumed quantitative


PRINCIPAL COORDINATE ANALYSIS (PCOA) OF GENETIC DIVERSITY
European Hazelnuts
Named Hybrid Varieties
Weschke/Badgersett Hybrids
C. americana selections
Eric5-13
Rose9-2
PriceW41
SpC-2D5
Gibs5-15
Minar342
Arb4-3
COORD. 2
COORD. 1

The Stats

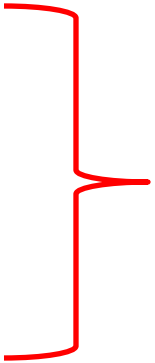
- Planted fall 2010
- Year 5
- 5 ft tall
- 5 ft wide
- 1142 g in-shell
- 2.51 lbs in-shell
- 37% kernel
- 422 g kernel
- 0.9 lb kernel
- 6’x15’ = 484 plants/ac
- 1215 lbs in shell/ac
- 450 lbs kernel/ac
- 19.5 g kernel/sq ft
- 50% canopy cover
- 930 lbs kernel/ac

Selection[a]	Overall Rank	Origin	Bush Shape	Suckering[b]	In-Shell Nut Width (mm)[c]	Kernel Width (mm)	Kernel Weight (g)	% Kernel	Nut Sphericity[d]	Kernel Sphericity[d]	Fiber[e]	EFB[f]	Kernel Yield (g/plant)[h]	St. Paul Yield Density[i]
Rose9-2	1	Rosemount, MN	narrow/upright	3.0	14.9	10.4	0.62	45.5	88	87	2.7	0.0	412	9.0
PriceW41	2	Northfield, MN	narrow/upright	3.0	15.3	10.1	0.58	39.4	92	87	2.0	0.0	226	11.0
Minar342	3	New Prague, MN	narrow/upright	3.5	18.6	10.6	0.75	38.0	95	82	1.3	2.0	256	6.5
Rose18-10	4	Rosemount, MN	narrow/upright	3.0	15.6	11.0	0.68	41.9	94	95	2.0	0.0	168	6.9
SpC-2D5	5	St. Paul, MN	narrow/upright	3.0	15.9	11.3	0.65	37.4	85	80	1.3	0.0	302	12.9
StapN2-7	6	Staples, MN	wide	4.5	16.9	9.3	0.66	39.4	90	79	1.0	0.0	291	9.0
ShepRosy	7	Viola, WI	narrow/upright	1.5	17.9	10.6	0.77	42.0	92	82	0.3	0.0	178	5.4
Cuddy2-28	8	Maiden Rock, WI	narrow/upright	2.0	14.4	9.4	0.48	35.3	92	88	0.3	0.0	141	10.6
Arb4-3	9	Chanhassen, MN	wide	2.5	14.3	9.8	0.50	38.5	89	85	2.0	0.0	211	13.2
Gibs5-15	10	Montevideo, MN	wide	4.0	16.2	9.9	0.54	29.1	95	92	2.0	0.0	405	9.0
Eric4-21	11	Lake City, MN	narrow	3.5	16.2	9.0	0.57	31.0	96	94	0.7	0.0	171	5.2
HandFats	12	Montevideo, MN	variable	4.0	15.7	12.0	0.81	42.7	91	94	2.0	1.0	243	6.6
Arb7-1	13	Chanhassen, MN	variable	3.0	15.5	10.7	0.49	37.5	91	87	1.5	0.0	162	8.2
Arb7-21	14	Chanhassen, MN	wide	3.5	16.0	11.1	0.54	36.9	90	85	1.3	0.0	153	6.2
HeasB	15	Plainview, MN	narrow	3.0	14.7	10.2	0.48	31.5	95	96	1.7	0.0	181	9.9
StapS2-7	16	Staples	intermediate	4.5	15.9	8.7	0.54	34.3	87	77	1.0	0.0	184	5.9
Gunth PC	17	Osceola, WI	intermediate	3.0	15.0	10.3	0.43	28.9	92	98	2.0	0.0	134	6.1
StapN7-6	18	Staples, MN	v wide	5.0	15.8	10.8	0.56	34.3	91	87	2.3	0.0	294	8.3
Gibs6-23	19	Montevideo, MN	wide	4.0	13.1	10.0	0.49	37.4	86	87	2.0	0.0	164	6.5
MuntBD	20	Warba, MN	variable	3.0	14.2	9.7	0.47	41.0	86	81	1.5	1.3	237	7.1

UMHDI 1st Generation Selections

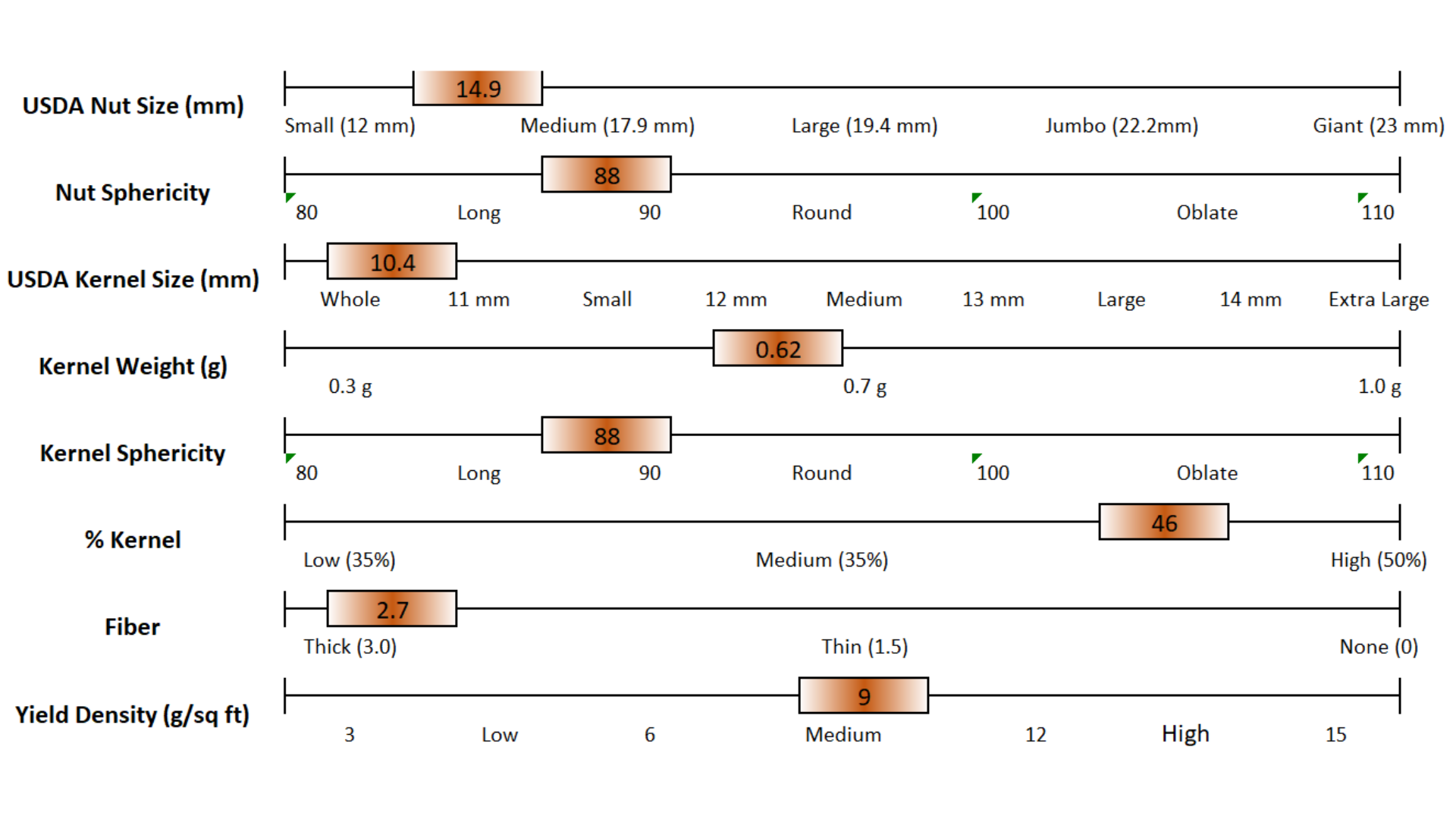
Size Classes for Oregon Kernels

- Extra Large (14+ mm)
- Large (13-15 mm)
- Medium (12-14 mm)
- Small (11-13 mm)
- Whole and Broken

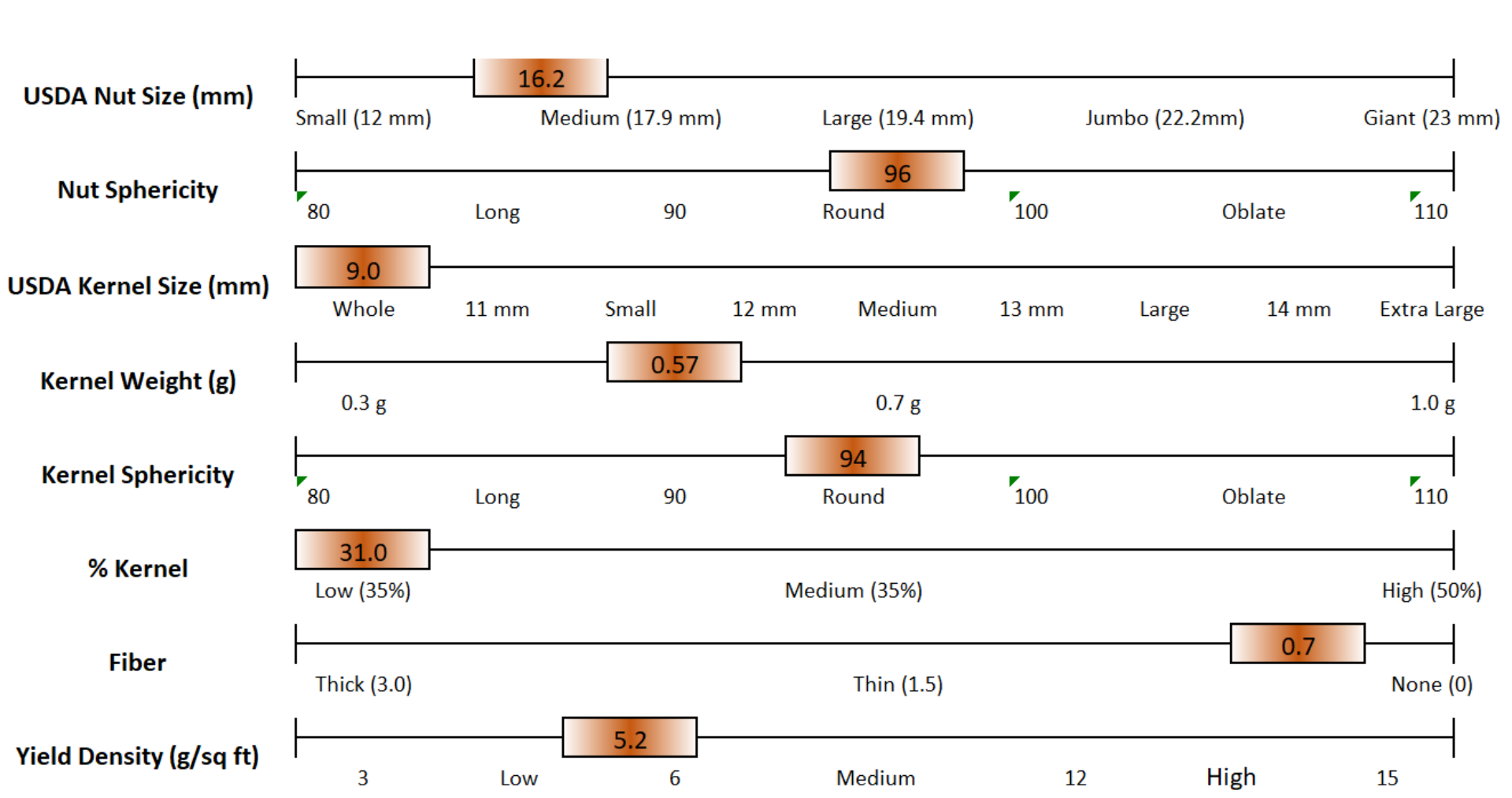


Top selection range
8-12 mm

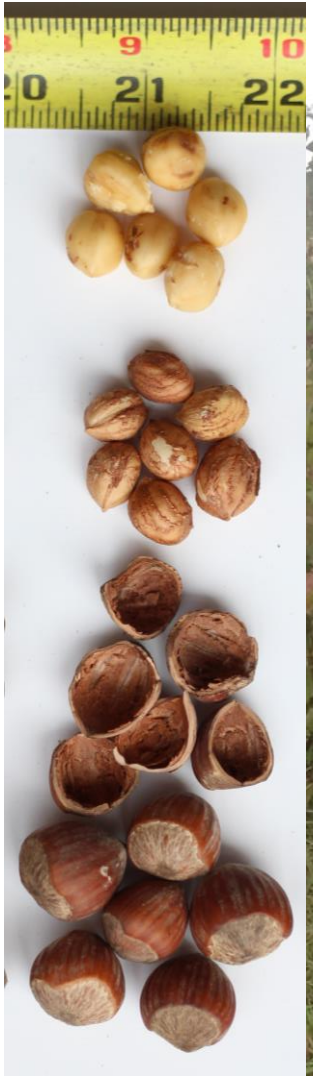
Rose 9-2

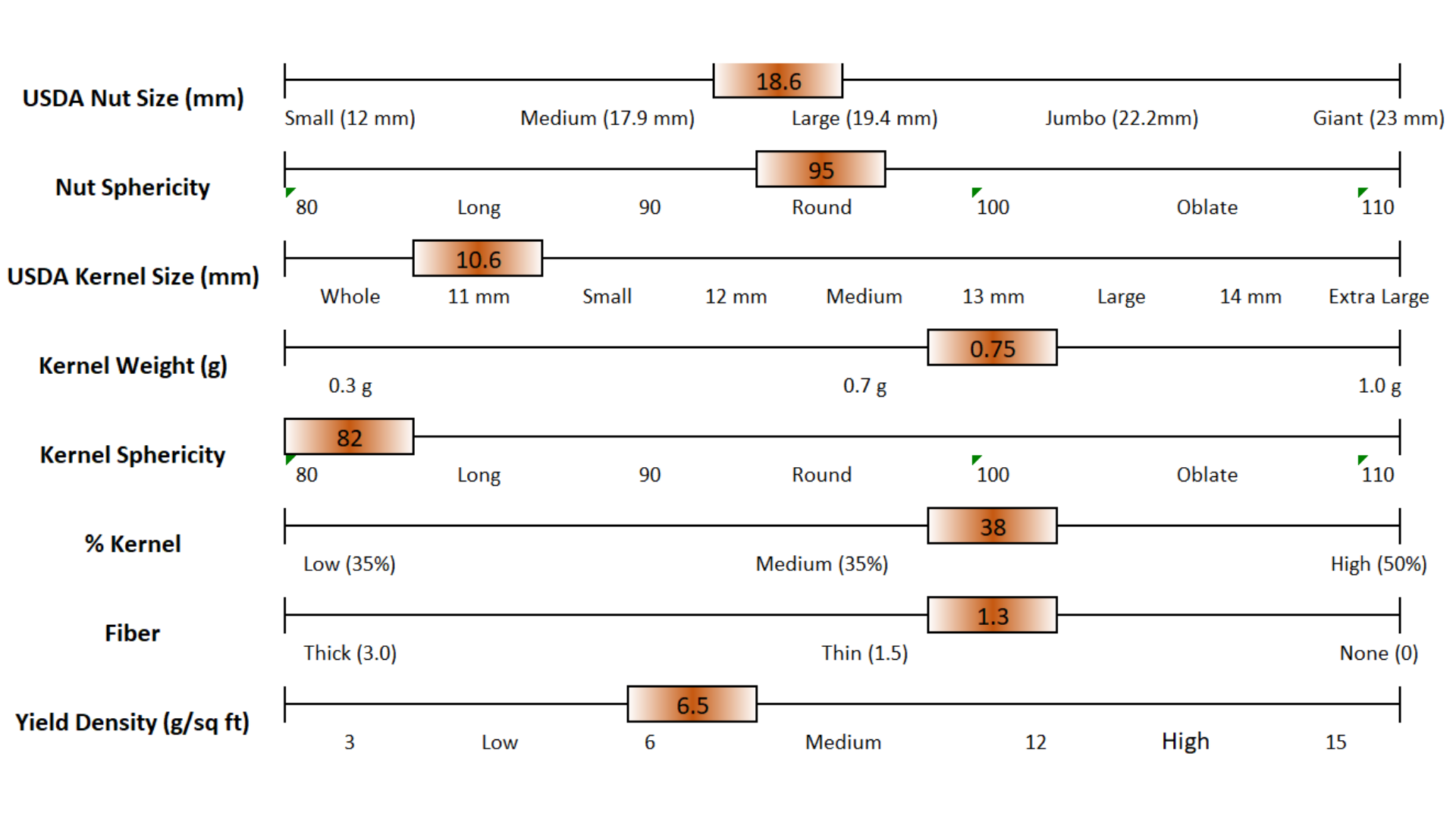

USDA Nut Size (mm)
14.9
Small (12 mm)
Medium (17.9 mm)
Large (19.4 mm)
Jumbo (22.2mm)
Giant (23 mm)
Nut Sphericity
88
80
Long
90
Round
100
Oblate
110
USDA Kernel Size (mm)
10.4
Whole
11 mm
Small
12 mm
Medium
13 mm
Large
14 mm
Extra Large
Kernel Weight (g)
0.62
0.3 g
0.7 g
1.0 g
Kernel Sphericity
88
80
Long
90
Round
100
Oblate
110
% Kernel
46
Low (35%)
Medium (35%)
High (50%)
Fiber
2.7
Thick (3.0)
Thin (1.5)
None (0)
Yield Density (g/sq ft)
9
3
Low
6
Medium
12
High
15

Eric 4-21

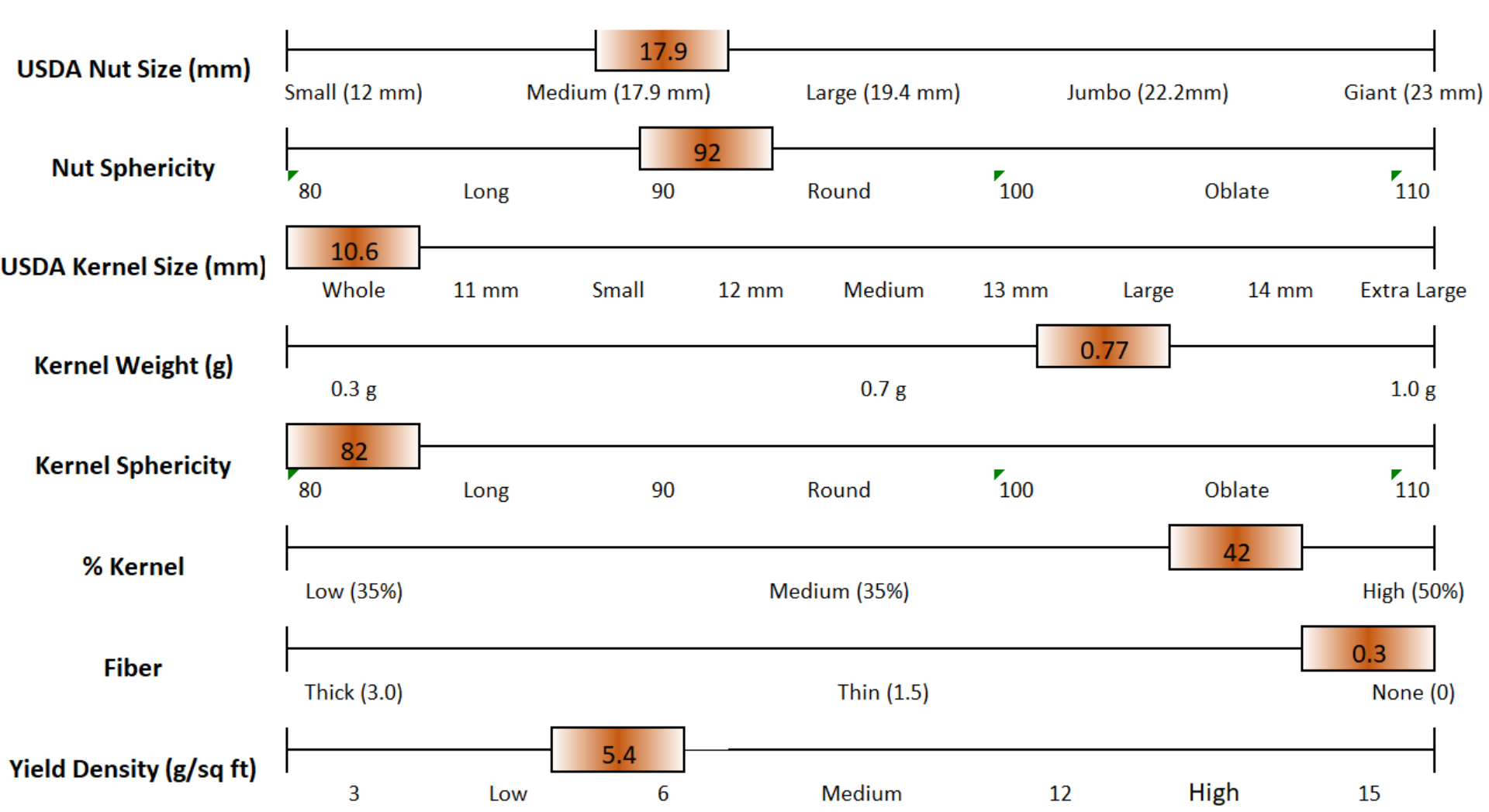

USDA Nut Size (mm)
16.2
Small (12 mm)
Medium (17.9 mm)
Large (19.4 mm)
Jumbo (22.2mm)
Giant (23 mm)
Nut Sphericity
96
80
Long
90
Round
100
Oblate
110
USDA Kernel Size (mm)
9.0
Whole
11 mm
Small
12 mm
Medium
13 mm
Large
14 mm
Extra Large
Kernel Weight (g)
0.57
0.3 g
0.7 g
1.0 g
Kernel Sphericity
94
80
Long
90
Round
100
Oblate
110
% Kernel
31.0
Low (35%)
Medium (35%)
High (50%)
Fiber
0.7
Thick (3.0)
Thin (1.5)
None (0)
Yield Density (g/sq ft)
5.2
3
Low
6
Medium
12
High
15

Minar 3-42

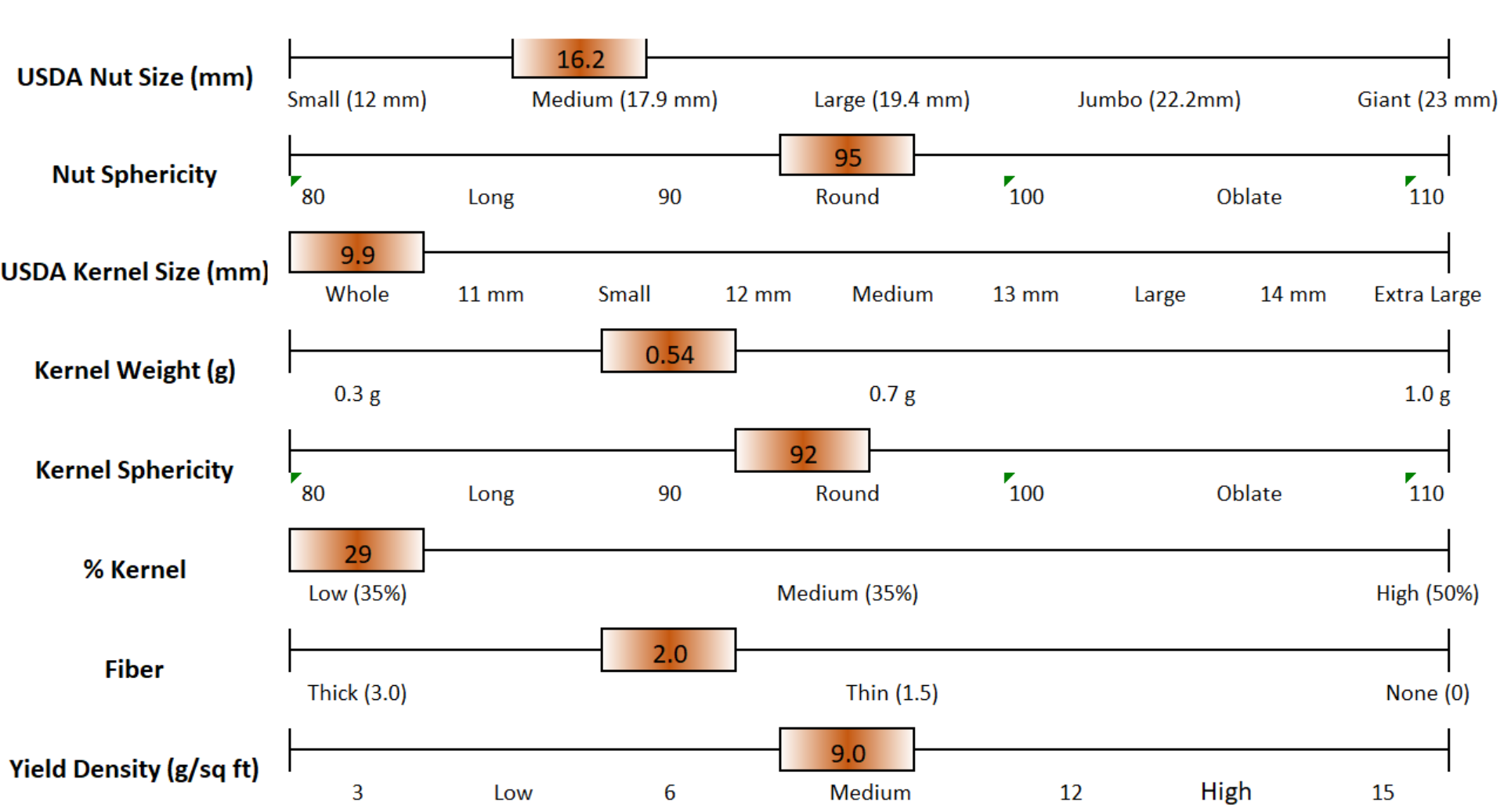



USDA Nut Size (mm)
18.6
Small (12 mm)
Medium (17.9 mm)
Large (19.4 mm)
Jumbo (22.2mm)
Giant (23 mm)
Nut Sphericity
95
80
Long
90
Round
100
Oblate
110
USDA Kernel Size (mm)
10.6
Whole
11 mm
Small
12 mm
Medium
13 mm
Large
14 mm
Extra Large
Kernel Weight (g)
0.75
0.3 g
0.7 g
1.0 g
Kernel Sphericity
82
80
Long
90
Round
100
Oblate
110
% Kernel
38
Low (35%)
Medium (35%)
High (50%)
Fiber
1.3
Thick (3.0)
Thin (1.5)
None (0)
Yield Density (g/sq ft)
6.5
3
Low
6
Medium
12
High
15

Shep Rosy


USDA Nut Size (mm)
17.9
Small (12 mm)
Medium (17.9 mm)
Large (19.4 mm)
Jumbo (22.2mm)
Giant (23 mm)
Nut Sphericity
92
80
Long
90
Round
100
Oblate
110
USDA Kernel Size (mm)
10.6
Whole
11 mm
Small
12 mm
Medium
13 mm
Large
14 mm
Extra Large
Kernel Weight (g)
0.77
0.3 g
0.7 g
1.0 g
Kernel Sphericity
82
80
Long
90
Round
100
Oblate
110
% Kernel
42
Low (35%)
Medium (35%)
High (50%)
Fiber
0.3
Thick (3.0)
Thin (1.5)
None (0)
Yield Density (g/sq ft)
5.4
3
Low
6
Medium
12
High
15

Gibs 5-15


USDA Nut Size (mm)
16.2
Small (12 mm)
Medium (17.9 mm)
Large (19.4 mm)
Jumbo (22.2mm)
Giant (23 mm)
Nut Sphericity
95
80
Long
90
Round
100
Oblate
110
USDA Kernel Size (mm)
9.9
Whole
11 mm
Small
12 mm
Medium
13 mm
Large
14 mm
Extra Large
Kernel Weight (g)
0.54
0.3 g
0.7 g
1.0 g
Kernel Sphericity
92
80
Long
90
Round
100
Oblate
110
% Kernel
29
Low (35%)
Medium (35%)
High (50%)
Fiber
2.0
Thick (3.0)
Thin (1.5)
None (0)
Yield Density (g/sq ft)
9.0
3
Low
6
Medium
12
High
15

Joint Performance Trials

- 1st Gen Selections from:
  - UMHDI
  - Rutgers
  - Grimo
  - Nebraska
  - Oregon St.
  - Z's Nutty Ridge
  - Butternut Farms

To Date

Arb 4-3
Shep Rosy
Rose 9-2
SPC-2D5
Cuddy 2-28
Gibs 5-15
Price W41
OSU 541.147
Grand Traverse
Frank
Marion
Aldara
Andrew
Northern Blais

Commercialization Plan

- Patented in order to collect royalties to support the industry (the wish of the co-owners)
- Negotiating licenses with propagators
- 2020/2021 target, taking orders fall 2019?
- Decided against grower licenses

Planting Recommendation

- At least 5 cultivars (more if available), locally adapted if there is information to support it
- Seedling border rows (interior/exterior) for pollen and participatory plant breeding

Progress with Backcross Seedlings

Lois Braun,

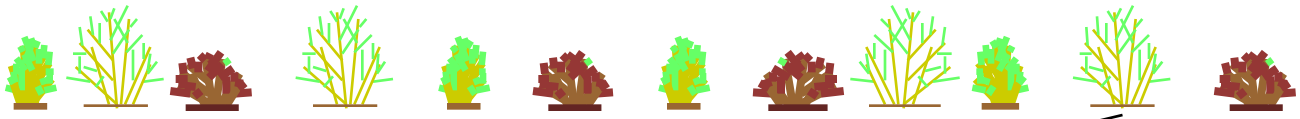
University of Minnesota

Upper Midwest Hazelnut Development Initiative

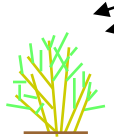
University of Minnesota
Driven to Discover℠

2nd Generation

C. americana x *C. avellana* hybrid seedlings



Select the best (1st Generation Selections)



X

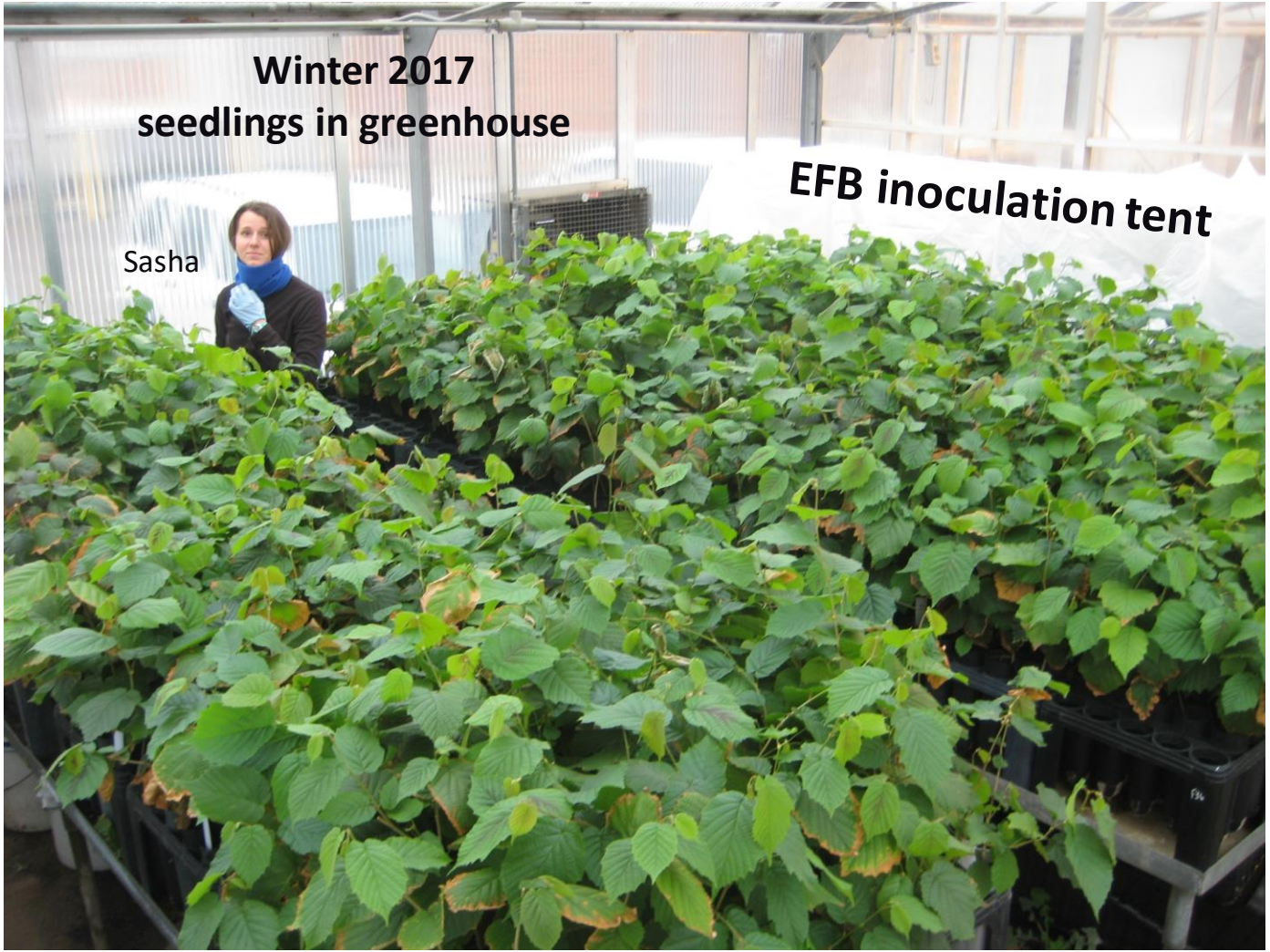
Standard EFB-susceptible varieties of *C. avellana*.

2nd Generation

BC1

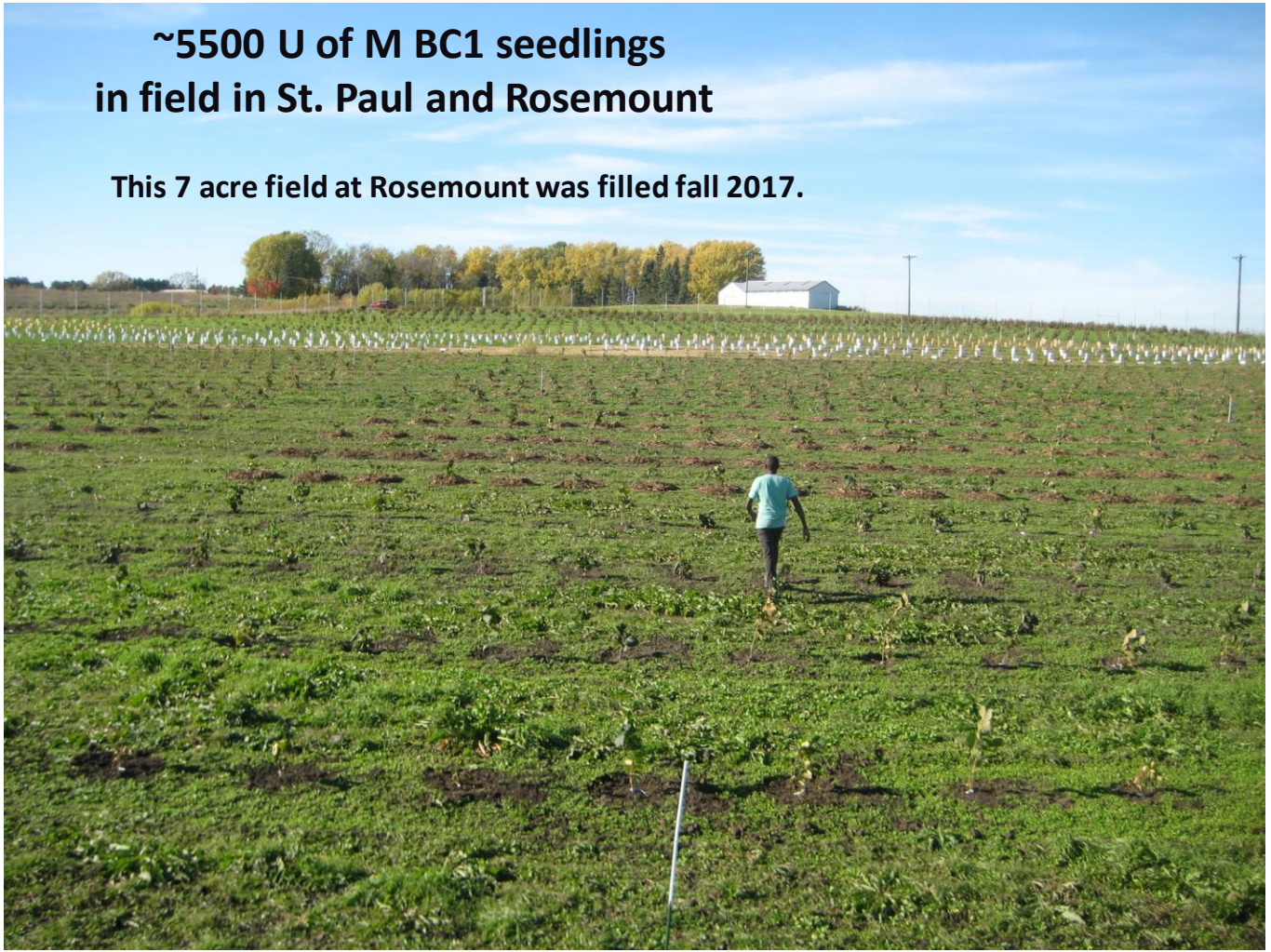
Controlled Pollinations

Objectives:
Larger nuts for confectionary market.


Winter 2017
seedlings in greenhouse
EFB inoculation tent
Sasha

EFB Inoculation Tents


Mario
Du
Sasha
2016
2,000 new F1 and F2 hybrids
from Oregon State
in St. Paul


~5500 U of M BC1 seedlings
in field in St. Paul and Rosemount
This 7 acre field at Rosemount was filled fall 2017.

7 Acre field of BC1 seedlings at Rosemount summer 2018

Fall 2018

~ 2,000 planted at Becker
in one week in November

Hugo, Connor, Erika, and Les

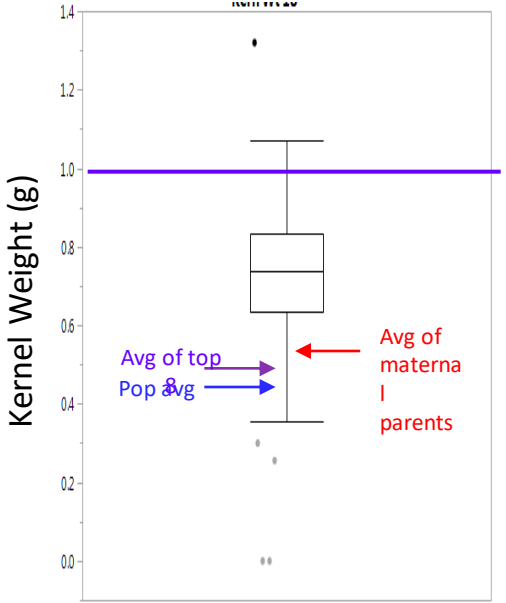
Total Controlled Cross Seedlings Planted
From 2013 through 2018:

- 7500 Minnesota BC1s
- 2000 F1s

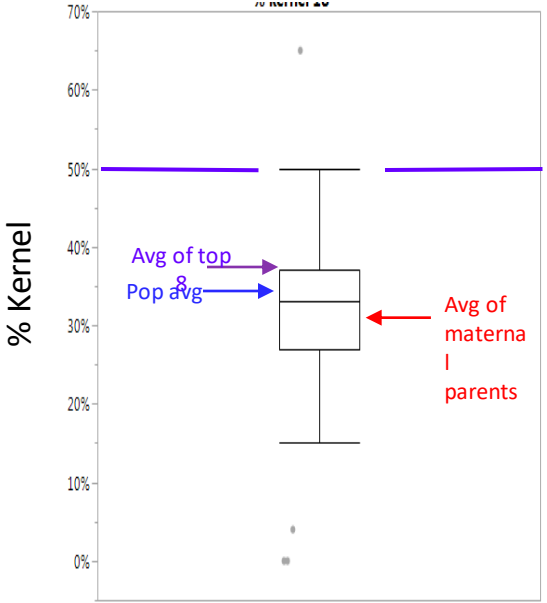
= 9500

BC1 Population Nut Size and Shell-out Rate Distribution (2018 data on 2012 and 2013 crosses)

Kernel Weight

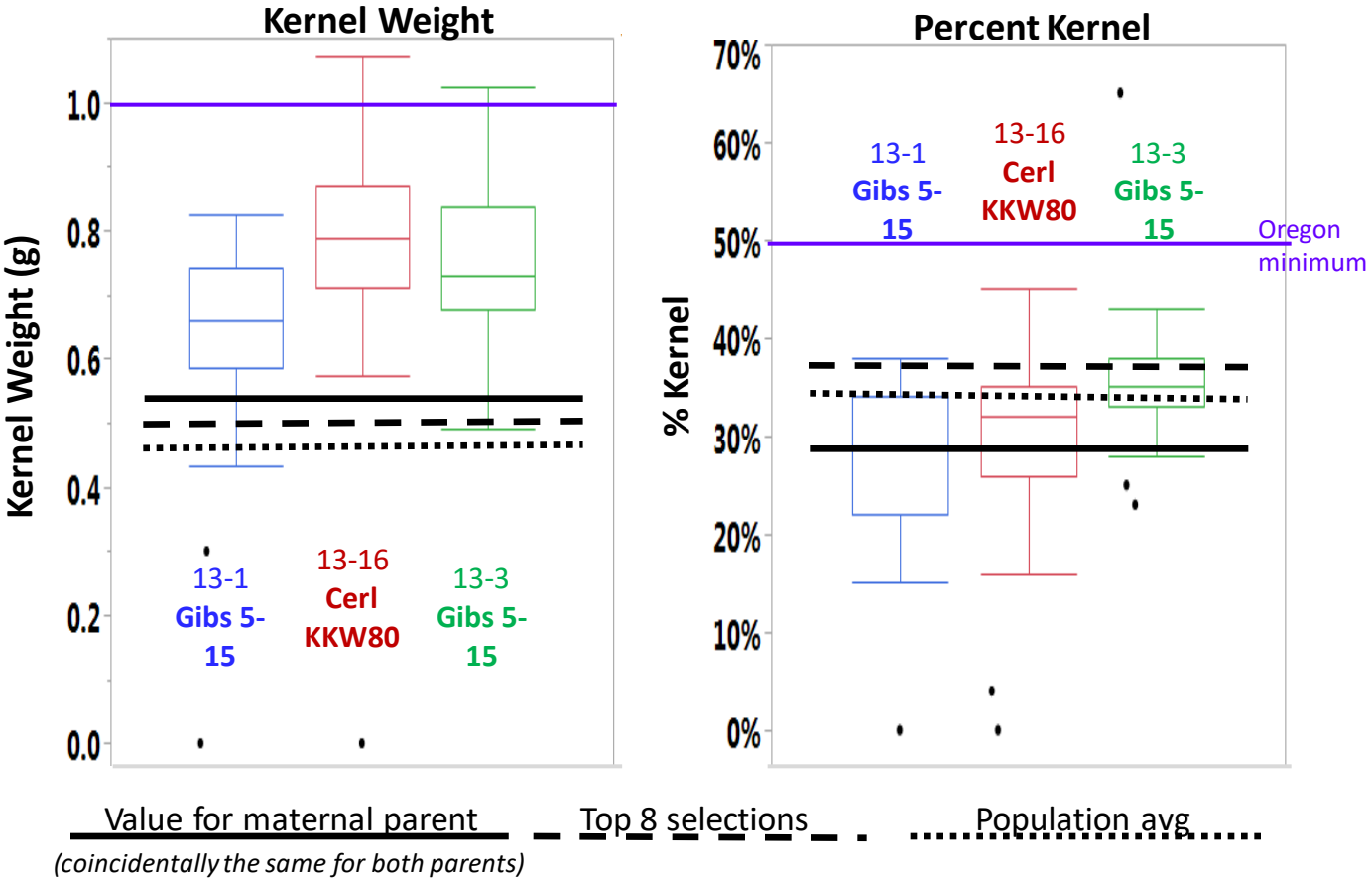


Percent Kernel



Purple line = minimum by Oregon standards

Kernel Weight and Percent Kernel of Three Full-Sib Families



(coincidentally the same for both parents)

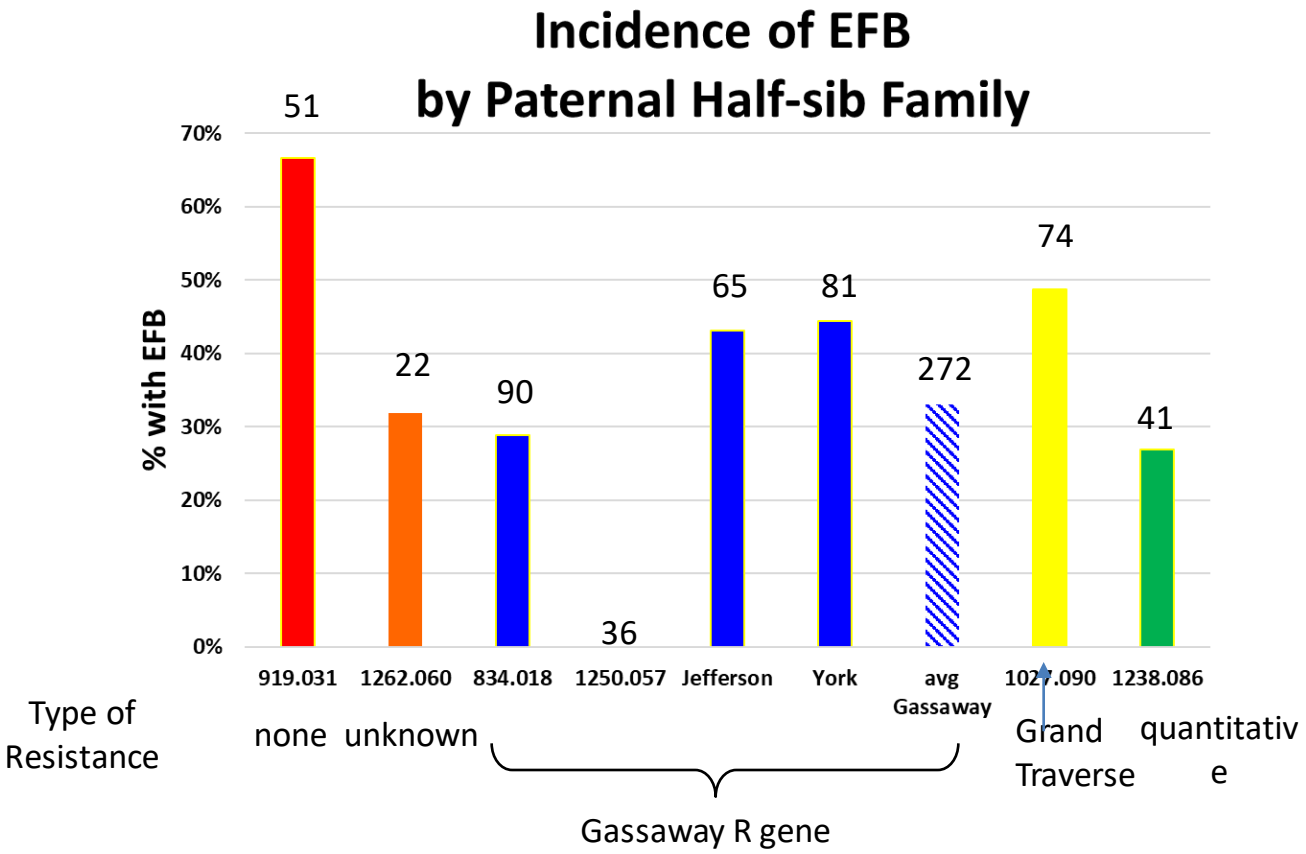
Previous Finding on Heritability of EFB Resistance

Thomas J. Molnar and John M. Capik
Eastern Filbert Blight Susceptibility of American x European Hazelnut Progenies
HortScience 47(10):1412–1418. 2012.

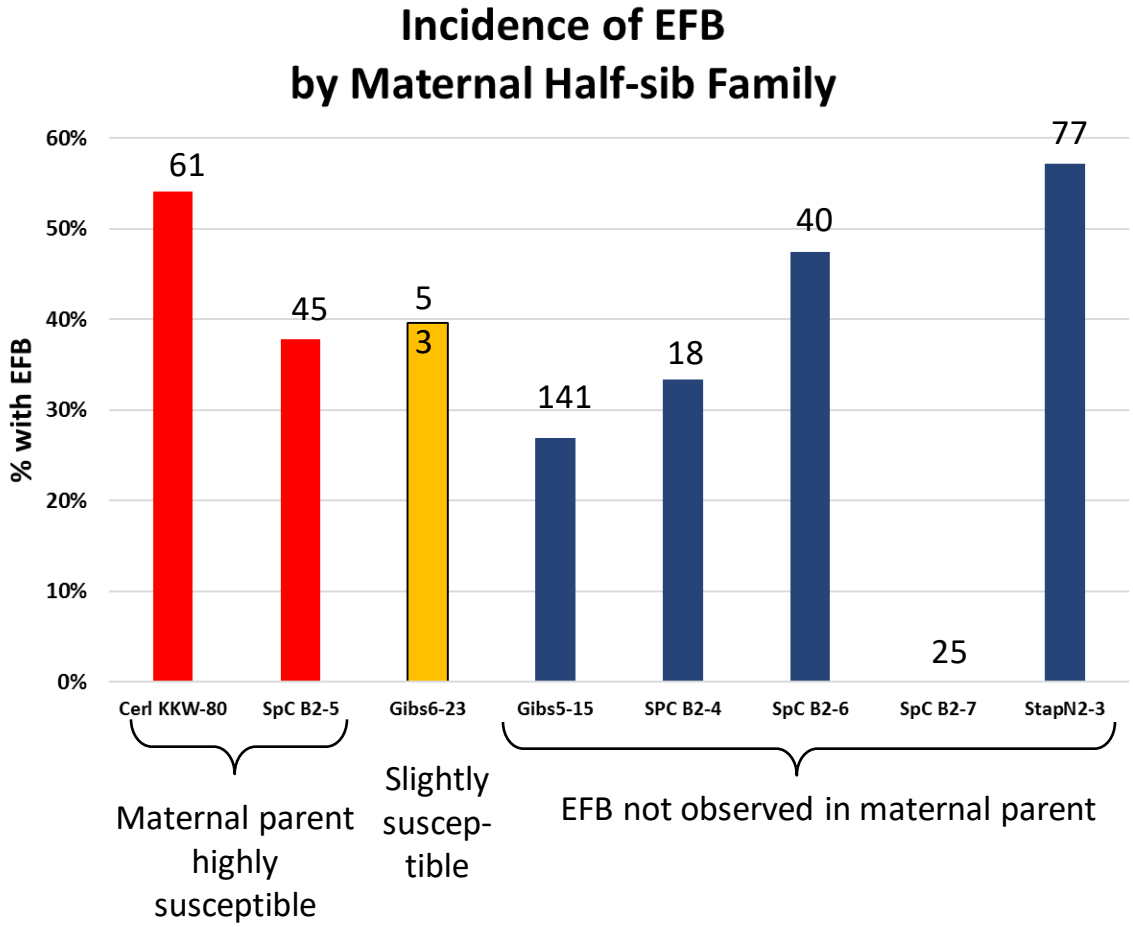
8 Badgersett *C. americana x C. avellana* hybrids,
found to be EFB resistant in New Jersey,
were crossed with a mix of known EFB-susceptible *C. avellana*.

Of the 491 progeny

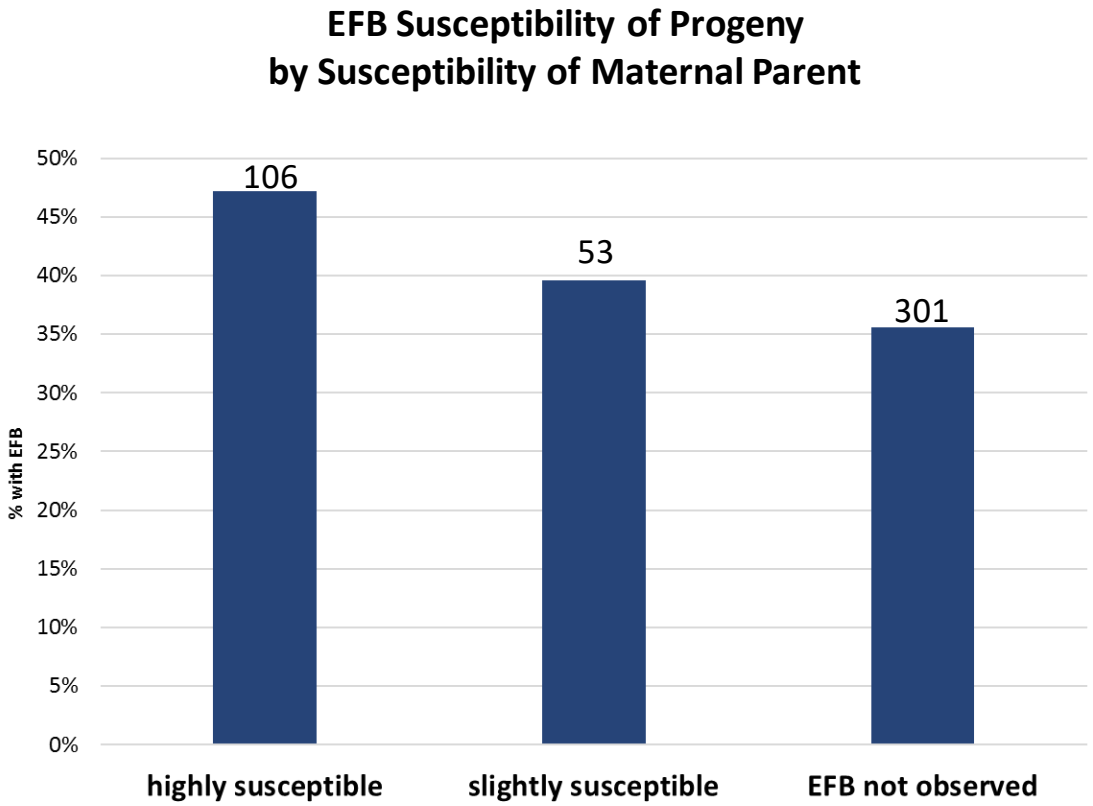
- Only 19 were disease free after five years (96% disease incidence)
- Only 25 had disease scored in the “tolerant” range; all the others were highly susceptible.



Numbers over bars indicate the number of individuals in the families.



Numbers over bars indicate the number of individuals in the families.



Numbers over bars indicate the number of individuals in the groups.

EFB lesions on McDonald, a recent “EFB-Resistant” release

Top 20 Controlled Cross Seedlings Based on 2018 Data

Row	No in row	Cross ID	Pistillate parent	Staminate parent	Kern Wt 18	% kernel 18	Kern Yld 18	Adj Kern Yld 18
7	6	13-3	Gibs5-15	834.018	1.025	43%	132	132
3	19	12-10	SPC B2-7	1250.057	0.990	42%	162	162
2	18	12-5	SPC B2-4	834.018	0.920	46%	199	199
1	19	12-2	SpC B2-5	1250.057	1.000	43%	66	66
~~1~~	~~17~~	~~12-3~~	~~SpC B2-5~~	~~1027.090~~	~~0.900~~	~~40%~~	~~146~~	~~146~~
6	10	13-3	Gibs5-15	834.018	0.930	65%	46	46
2	9	12-7	SPC B2-7	Jeff	0.913	45%	88	70
16	10	13-27	SpC B2-5	Jeff	0.889	40%	109	87
1	12	12-3	SpC B2-5	1027.090	1.320	43%	25	25
2	15	12-6	SPC B2-4	1027.090	0.838	39%	73	59
13	8	13-16	CerlKKW-80	834.018	0.850	45%	33	33
13	7	13-16	CerlKKW-80	834.018	0.817	41%	65	59
2	19	12-5	SPC B2-4	834.018	0.730	45%	90	90
2	20	12-5	SPC B2-4	834.018	0.689	41%	214	171
6	25	13-3	Gibs5-15	834.018	0.710	39%	100	100
~~1~~	~~4~~	~~12-4~~	~~SPC B2-4~~	~~Jeff~~	~~0.760~~	~~50%~~	~~17~~	~~17~~
2	14	12-6	SPC B2-4	1027.090	0.700	39%	40	40
~~16~~	~~15~~	~~13-27~~	~~SpC B2-5~~	~~Jeff~~	~~1.000~~	~~39%~~	~~6~~	~~2~~
1	5	12-4	SPC B2-4	Jeff	0.738	46%	14	14
1	3	12-4	SPC B2-4	Jeff	0.760	40%	8	8