

2017-2018 *Spreckels Sugar* RESEARCH REPORT



Spreckels Sugar Brawley, CA

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The Effect of Plant Spacing on New Round-up Ready Sugar Beet Varieties in the Imperial Valley

Final Report

2015 – 2016, 2016 – 2017, and 2017 - 2018 Growing Seasons

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Justification: Agricultural response to increased plant population, and thus seeding rate, is well documented. The generalized response is simple; increasing population increases competition for resources which decreases individual plant production. However, increasing population increases production per unit area (acres, hectares, etc.) until a population maximum is attained then production per unit area decreases. One of the facts seen in modern agriculture is the increase in recommended plant population over time. As agricultural production is a response to environmental management and genomics, it is thought variety competitiveness allows for a larger plant population.

Sugar beets are planted in rows. Increasing plant population occurs by either decreasing row spacing (distance between rows) or increasing the number of plants per linear foot of row (decreasing distance between plants). Changing row spacing affects most, if not all, mechanical manipulation of the crop as well as modifying all the equipment used to manage and harvest the crop. Altering the plant in-row spacing is much simpler as the planter is adjusted to modify spacing.

Currently, in southern California, the recommended plant spacing on 30 inch rows is between 3.0" – 5.5" (Kaffka and Hills, 1999), or plant populations of 36,000 – 70,000 seed/acre with a number of the Imperial Valley growers using 2 ³/₈" - 3 ¹/₂" (Santiago, I., Personal communication, 2014) or plant spacings of 60,000 – 88,000 plants/acre. With the introduction of Round-Up Ready technology, producers are curious if an increased plant spacing will result in a change for either sugar beet yield and/or sugar concentration. The newer varieties may be even more responsive to decreased plant spacing. Thus as new technology (varieties) becomes made available to growers, the question of proper plant spacing needs to be addressed.

Objective: Determine the yield and quality response of five (3 new and 2 currently used) Round Up Ready varieties to varying plant spacing at early, mid or late planting/harvest dates.

Methods and Materials:

2015-2016: Treatments for each of the planting/harvest dates are listed in Table 1. The study was conducted with split plot randomized complete block experimental design for each planting/harvest date. The main plot were plant spacings of 2, 3.5, and 5 inches between plants (spacings of 105, 60 or 42 thousand plants per acre) in 30 inch row width. The split plot was the variety. In this study the following varieties were used: Beta 52RR45, Beta 5499, SES 2013, SES 2014, and SES 2016. The planting dates were September 18, 2015 for Trial 1, October 2, 2015 for Trial 2, and October 14, 2015 for Trial 3. The harvest dates were May 2, 2016 for Trial 1, June 1, 2016 for Trial 2 and July 5, 2016 for Trial 3. There were 6 replications in each trial. The study was located at the Imperial Valley Research Center near Brawley, California. The fertilizer applied for Trial 1 was 200 pounds 11-52-0 per acre and 20 gallons of 32-0-0 per acre at pre-plant. For Trial 2, 200 pounds of 11-52-0 per acre and 20 gallons of 32-0-0 per acre at were applied at pre-plant and 22 gallons of 32-0-0 per acre at layby. Finally for Trial 3, 200 pounds 11-52-0 per acre and 20 gallons 32-0-0 per acre were applied at preplant while 44 gallon of 32-0-0 was applied at layby. Root yield, sucrose, extractable sucrose percent, extractable sucrose per ton, extractable sucrose per acre, purity, sugar beet nitrate-N, and number of bolters were measured. The plots were machine harvested and the quality information was determined in the Spreckels Tare Laboratory.

Table 1. Treatments for Trials 1, 2, and 3 for the 2015-2016 growing season in the Imperial Valley.

Treatment number	Plant spacing (inches)	Variety
1	2	Beta 52RR45
2	3.5	Beta 52RR45
3	5	Beta 52RR45
4	2	Beta 5499
5	3.5	Beta 5499
6	5	Beta 5499
7	2	SES 2013
8	3.5	SES 2013
9	5	SES 2013
10	2	SES 2014
11	3.5	SES 2014
12	5	SES 2014
13	2	SES 2016
14	3.5	SES 2016
15	5	SES 2016

2016-2017: Because of changed experimental design the treatments are listed in Table 2. The study was conducted at two locations. The experimental design was a completely randomized experimental design. There were two factors in this study, plant spacing (2, 3.5, and 5 inches between plants which is 105,000, 60,000, or 42,000 plants per acre in 30 inch row width) and variety (Beta 52RR45, Beta 5499, SES 2013, SES 2014, and SES 604). At the trial 1 site, the planting date was October 5, 2016 and harvest date was June 16, 2017. The other site, at Trial 2, the planting data was October 12, 2016 and harvest was on June 28, 2017. There were four replications in each trial. Root yield, sucrose, extractable sucrose percent, extractable sucrose per ton, extractable sucrose per acre, purity, sugar beet nitrate-N, and number of bolters were measured. Mildew occurrence was also rated at Trial 2 location. The plots were machine harvested and the quality information was determined in the Spreckels Tare Laboratory.

Table 2. Treatments for the 2016-2017 growing season in the Imperial Valley.

Treatment number	Plant spacing (inches)	Variety
1	2	Beta 52RR45
2	3.5	Beta 52RR45
3	5	Beta 52RR45
4	2	Beta 5499
5	3.5	Beta 5499
6	5	Beta 5499
7	2	SES 2013
8	3.5	SES 2013
9	5	SES 2013
10	2	SES 2014
11	3.5	SES 2014
12	5	SES 2014
13	2	SES 604
14	3.5	SES 604
15	5	SES 604

2017-2018: In the third year of this study the number of varieties was reduced because of poor stands of SV 2013. The experimental design was a randomized complete block with four replications. The treatments are listed in Table 3. The study was conducted at two locations. There were two factors in this study, Plant spacing (2, 3.5, and 5 inches between plants which is 105,000, 60,000, or 42,000 plants per acre in 30 inch row width) and variety (Beta 52RR45, Beta 5499, SES 2014, and SES 604). At the Trial 1 site, the planting date was September 21, 2017 and harvest date was April 18, 2018. The other site, Trial 2, the planting date was October 18, 2017 and harvest on June 13, 2018. Root yield, sucrose, extractable sucrose percent, extractable sucrose per ton, extractable sucrose per acre,

purity, and sugar beet nitrate-N were measured. The plots were machine harvested and the quality information was determined in the Spreckels Tare Laboratory.

Table 3. Treatments for the 2017-2018 growing season in the Imperial Valley.

Treatment number	Plant spacing (inches)	Variety
1	2	Beta 52RR45
2	3.5	Beta 52RR45
3	5	Beta 52RR45
4	2	Beta 5499
5	3.5	Beta 5499
6	5	Beta 5499
7	2	SES 2014
8	3.5	SES 2014
9	5	SES 2014
10	2	SES 604
11	3.5	SES 604
12	5	SES 604

Results and Discussion:

2015-2016 Trial 1

Trial 1 as the earliest planted and harvested study of the three. The statistical analysis for root yield, sucrose concentration, extractable sucrose in %, lb/ton, and lb/acre, purity, and beet nitrate-N concentration are presented in Table 4. The only factor that significantly affected all of these parameters was variety. There was no effect from plant spacing or interaction of plant spacing and variety. The means for root yield, sucrose concentration, extractable sucrose, purity, and beet nitrate-N concentration as affected by variety are reported in Table 5. Beta 5499 had the greatest root yield while SES 2014 was the least. The difference between the greatest root yield and least root yield was 4.3 tons per acre. The variety with the greatest concentration of sucrose and extractable sucrose per ton was SES 2013 while the varieties with the least sucrose concentration and extractable sucrose per ton were Beta 52RR45 and SES 2016. The variety with the greatest extractable sucrose per acre and purity was SES 2013 while SES 2014 had the least extractable sucrose per acre and purity. The beet nitrate-N concentrations were elevated compared to what the goal of high quality sugar beet production. All the treatment means for root yield, sucrose concentration, extractable sucrose, purity, and beet nitrate-N are listed for the readers information in Table 6.

Table 4. Statistical analysis for root yield, sucrose, extractable sucrose, purity, and beet nitrate-N for Trial 1 2015-2016.

Source of Variation	Root yield	Sucrose	Extractable sucrose			Purity	Beet nitrate-N
	ton/A	%	%	lb/ton	lb/A	%	ppm
Plant spacing	0.82	0.93	0.97	0.97	0.94	0.95	0.84
Variety	0.0002	0.0001	0.0001	0.0001	0.0002	0.0004	0.0002
Plant spacing X variety	0.94	0.98	0.97	0.97	0.90	0.83	0.65
C.V. (%)	6.0	2.6	3.8	3.8	7.0	1.1	37.3
Grand mean	45.4	16.3	13.1	261	11871	87.4	118

Table 5. The effect of variety on root yield, sucrose, extractable sucrose, purity, and beet nitrate-N for Trial 1 2015-2016.

Variety	Root yield	Sucrose	Extractable sucrose			Purity	Beet nitrate-N
	ton/A	%	%	lb/ton	lb/A	%	ppm
Beta 52RR45	46.2	16.0	12.7	254	11744	86.9	159
Beta 5499	47.0	16.2	13.1	262	12338	87.7	99
SES 2013	45.5	16.8	13.6	272	12360	88.0	127
SES 2014	42.7	16.4	13.1	261	11172	86.8	94
SES 2016	45.6	16.0	12.9	257	11743	87.6	110

Table 6. The means for root yield, sucrose, extractable sucrose, purity, and beet nitrate-N for all treatments in Trial 1 2015-2016.

Plant spacing Inch	Variety	Root yield	Sucrose	Extractable sucrose			Purity	Beet nitrate-N
		ton/A	%	%	lb/ton	lb/A	%	ppm
2	Beta 52RR45	46.7	16.1	12.9	258	12068	87.8	139
2	Beta 5499	47.4	16.2	13.0	261	12383	87.6	99
2	SES 2013	45.7	16.8	13.6	272	12473	88.1	126
2	SES 2014	42.2	16.3	13.0	259	10945	86.9	96
2	SES 2016	46.3	16.0	12.9	257	11930	87.5	100
3.5	Beta 52RR45	46.5	15.9	12.6	251	11682	86.4	180
3.5	Beta 5499	47.3	16.3	13.1	262	12444	87.6	111
3.5	SES 2013	45.1	16.7	13.6	271	12217	88.0	151
3.5	SES 2014	43.3	16.4	13.0	160	11280	86.7	81
3.5	SES 2016	46.3	15.9	12.8	257	11919	87.8	132
5	Beta 52RR45	45.4	16.0	12.7	253	11481	86.7	158
5	Beta 5499	46.4	16.3	13.2	263	12186	87.9	86
5	SES 2013	45.7	16.8	13.6	272	12391	87.8	103
5	SES 2014	42.7	16.6	13.2	264	11290	86.8	104
5	SES 2016	44.1	16.0	12.9	258	11381	87.6	98

Also measured as part of trial 1 was the rating for curly top and occurrence of bolters. The means and statistical analysis are reported in Table 7. Curly top and bolter occurrence was affected by variety and plant spacing. At the 2 inch plant spacing, SES 2016 and Beta 52RR45 had the greatest number of plants affected by curly top. At the 3.5 inch plant spacing, SES 2016 had the most occurrence of curly top, while SES 2014 and Beta 52RR45 were in the middle and Beta 5499 and SES 2013 had the least curly top. At the 5 inch plant spacing, SES 2016 had a large amount of curly top, while the rest were much less.

The number of bolters was interesting. Beta 5499 consistently had a significantly greater numbers of bolters. Only Beta 52RR45 grown in a 3.5 inch plant spacing had bolters besides Beta 5499. The data also indicates that with a closer plant spacing, more bolters occurred with Beta 5499.

Table 7. Means and statistical analysis for number of plants in the harvest area with curly top and bolters, Trial 1 2015-2016.

Plant spacing inch	Variety	Curly top	Bolters
		Number in harvest area	
2	Beta 52RR45	4.33	0
2	Beta 5499	0.83	7.83
2	SES 2013	2.50	0
2	SES 2014	2.33	0
2	SES 2016	7.33	0
3.5	Beta 52RR45	4.33	0.83
3.5	Beta 5499	3.00	4.83
3.5	SES 2013	2.00	0
3.5	SES 2014	4.83	0
3.5	SES 2016	6.83	0
5	Beta 52RR45	2.67	0
5	Beta 5499	3.67	3.00
5	SES 2013	2.83	0
5	SES 2014	2.00	0
5	SES 2016	21.17	0
Statistical analysis		P > F	
Plant spacing		0.05	0.05
Variety		0.0001	0.0001
Plant spacing X Variety		0.0001	0.009
C.V. (%)		79.2	147.0
Grand mean		4.7	1.1

2015-2016 Trial 2

Trial 2 was planted October 2, 2015 and harvested June 1, 2016. The only factor that significantly affected root yield, sucrose, extractable sucrose (% , lb/ton, and lb/acre), beet nitrate-N was variety, Table 8. The plant spacing had no effect on any of the parameters reported in Table 8. The means by variety for root yield, sucrose, extractable sucrose (% , lb/ton, and lb/acre), and beet nitrate-N are reported in Table 9. Beta 52RR45 had the greatest root yield, followed by Beta 5499, SES 2016, SES 2013, and the least with SES 2014. Sucrose concentration was the greatest with SES 2013. SES 2014 had a similar sucrose concentration as SES 2013. Beta 5499 had a medium sucrose concentration while SES 2016 and Beta 52RR45 had the least. The variety effects on extractable sucrose concentration and extractable sucrose lb/ton results were similar to the sucrose concentration. The extractable sucrose per acre was greatest with SES 2013 while SES 2014 and SES 2016 had the least. The extractable sucrose per acre for Beta 52RR45 and Beta 5499 were intermediate. The purities while being significantly affected by variety, the difference was not large. The greatest purity was found in SES 2013. The purity decreased from 85.4 % for SES 2014 and SES 2016 to 85.0 and 84.9 for Beta 5499 and Beta 52RR45, respectively. The beet nitrate-N values in general were elevated compared to what the goal should be for sugar beet production in the Imperial Valley. The greatest beet nitrate-N concentration was 213 ppm for Beta 52RR45 while the lowest concentration was for SES 2014 and SES 2013. The important information for Trial 2 is that plant spacing did not affect root yield, sucrose concentration, extractable sucrose (% , lb/ton, or lb acre), purity or sugar beet nitrate-N concentration. The means for all the treatments are reported in Table 10.

Table 8. Statistical analysis for root yield, sucrose, and extractable sucrose for Trial 2 2015-2016.

Source of Variation	Root yield	Sucrose	Extractable sucrose			Purity	Beet nitrate-N
	ton/A	%	%	lb/ton	lb/A	%	ppm
Plant spacing	0.49	0.95	0.84	0.84	0.68	0.88	0.90
Variety	0.0001	0.0001	0.0001	0.0001	0.02	0.007	0.006
Plant spacing X variety	0.14	0.47	0.50	0.50	0.51	0.77	0.21
C.V. (%)	5.3	3.9	5.4	5.4	9.1	1.5	30.4
Grand mean	44.3	16.2	12.5	251	11118	85.4	175

Table 9. The effect of variety on root yield, sucrose, extractable sucrose, purity, and beet nitrate-N for Trial 2 2015-2016.

Variety	Root yield	Sucrose	Extractable sucrose			Purity	Beet nitrate-N
	ton/A	%	%	lb/ton	lb/A	%	ppm
Beta 52RR45	46.2	15.7	12.0	240	11095	84.9	213
Beta 5499	45.6	16.0	12.3	246	11257	85.0	175
SES 2013	43.6	17.0	13.5	270	11779	86.4	155
SES 2014	40.7	16.7	13.0	259	10593	85.4	149
SES 2016	45.2	15.5	12.0	240	10864	85.4	185

Table 10. The means for root yield, sucrose, extractable sucrose, purity, and beet nitrate-N for all treatments in Trial 2 2015-2016.

Plant spacing inch	Variety	Root yield	Sucrose	Extractable sucrose			Purity	Beet nitrate-N
		ton/A	%	%	lb/ton	lb/A	%	ppm
2	Beta 52RR45	44.9	15.8	12.2	243	10934	85.2	211
2	Beta 5499	43.0	16.0	12.3	246	10579	84.9	165
2	SES 2013	43.3	17.3	13.8	275	11926	86.9	126
2	SES 2014	38.3	16.6	13.0	259	9973	85.7	112
2	SES 2016	43.4	15.4	11.9	238	10278	85.4	199
3.5	Beta 52RR45	47.0	15.3	11.7	234	11029	84.7	219
3.5	Beta 5499	46.1	16.2	12.6	253	11698	85.7	159
3.5	SES 2013	42.8	17.2	13.5	271	11615	86.3	180
3.5	SES 2014	42.9	16.9	13.2	264	11380	85.9	143
3.5	SES 2016	46.9	15.5	11.9	239	11256	85.4	194
5	Beta 52RR45	46.7	15.8	12.1	242	11322	84.8	208
5	Beta 5499	47.8	15.8	12.0	240	11495	84.4	200
5	SES 2013	44.8	16.7	13.1	263	11795	86.2	158
5	SES 2014	40.9	16.7	12.7	255	10425	84.5	193
5	SES 2016	45.2	15.7	12.2	244	11057	85.5	163

In Trial 2, additional observations were made, canopy score and bolters, Table 11. The greater the number for canopy score, the less top growth there was. The plant spacing did not affect the canopy score. There was an observation that one variety had a poorer canopy than the rest, SES 2013, Table 12. The number of bolters in the harvest area was affected by variety. Beta 5499 had a significant amount of bolters, Table 11. The plant spacing was not a factor.

Table 11. Means and statistical analysis for canopy score (top growth 1 = best, 5 = poor) and number of bolter plants in the harvest area, Trial 2 2015-2016.

Plant spacing inch	Variety	Canopy score	Bolters
		Score 1 – 5	Number in harvest area
2	Beta 52RR45	2.42	0
2	Beta 5499	2.50	6.33
2	SES 2013	3.17	0
2	SES 2014	2.75	0
2	SES 2016	2.75	0
3.5	Beta 52RR45	2.50	0
3.5	Beta 5499	2.67	5.83
3.5	SES 2013	3.50	0
3.5	SES 2014	2.92	0
3.5	SES 2016	2.67	0
5	Beta 52RR45	2.58	0
5	Beta 5499	2.50	5.83
5	SES 2013	3.50	0
5	SES 2014	2.83	0.17
5	SES 2016	3.25	0
Statistical analysis		P > F	
Plant spacing		0.80	0.98
Variety		0.0001	0.0001
Plant spacing X Variety		0.88	0.99
C.V. (%)		20	132.2
Grand mean		2.83	1.2

Table 12. The effect of variety on canopy score and number bolters for Trial 2 2015-2016.

Variety	Canopy score	Bolters
	Score 1 – 5	Number in harvest area
Beta 52RR45	2.50	0
Beta 5499	2.56	6.0
SES 2013	3.38	0
SES 2014	2.83	0.06
SES 2016	2.89	0

2015-2016 Trial 3

Trail 3 was planted October 14, 2015 and harvested July 5, 2016. The statistical analysis for sugar beet root yield, sucrose concentration, extractable sucrose (% , lb/ton, and lb/acre), purity and beet nitrate-N is reported in Table 13. The only treatment factor that affected these measured parameters was variety. Plant spacing had no effect on root yield, sucrose concentration, extractable sucrose (% , lb/ton, and lb/acre), purity, or beet nitrate-N. Beta 5499 had the lowest root yield, sucrose concentration, extractable sucrose (% , lb/ton, and lb/acre), and purity, Table 14. The greatest root yield occurred with Beta 52RR45. SES 2013 had the greatest sucrose concentration and extractable sucrose (% , lb/ton, and lb/acre), and purity. The sugar beet nitrate-N concentrations were very high. The means for all the factors are reported in Table 15.

Table 13. Statistical analysis for root yield, sucrose, and extractable sucrose for Trial 3 2015-2016.

Source of Variation	Root yield	Sucrose	Extractable sucrose			Purity	Beet nitrate-N
	ton/A	%	%	lb/ton	lb/A	%	ppm
Plant spacing	0.44	0.59	0.64	0.64	0.80	0.75	0.80
Variety	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Plant spacing X variety	0.56	0.16	0.41	0.41	0.53	0.65	0.21
C.V. (%)	8.2	3.9	6.7	6.7	12.0	1.8	20
Grand mean	41.5	13.4	9.4	189	7903	80.8	337

Table 14. The effect of variety on root yield, sucrose, extractable sucrose, purity, and beet nitrate-N for Trial 3 2015-2016.

Variety	Root yield	Sucrose	Extractable sucrose			Purity	Beet nitrate-N
	ton/A	%	%	lb/ton	lb/A	%	ppm
Beta 52RR45	46.2	12.7	8.9	178	8214	80.7	416
Beta 5499	39.4	12.6	8.3	167	6718	78.4	333
SES 2013	39.9	14.6	10.7	213	8765	82.6	305
SES 2014	40.1	14.3	10.2	205	8279	81.6	276
SES 2016	41.4	12.9	9.0	180	7475	80.6	353

Table 15. The means for root yield, sucrose, extractable sucrose, purity, and beet nitrate-N for all treatments in Trial 3 2015-2016.

Plant spacing inch	Variety	Root yield	Sucrose	Extractable sucrose			Purity	Beet nitrate-N
		ton/A	%	%	lb/ton	lb/A	%	ppm
2	Beta 52RR45	44.5	13.1	9.3	187	8342	81.6	373
2	Beta 5499	37.7	12.7	8.6	171	6516	79.0	343
2	SES 2013	38.0	14.7	10.9	218	8352	83.3	289
2	SES 2014	39.0	14.1	10.1	203	7949	81.8	223
2	SES 2016	38.6	13.0	9.0	180	6954	80.3	357
3.5	Beta 52RR45	46.7	12.9	9.0	179	8388	80.7	427
3.5	Beta 5499	42.5	12.6	8.3	165	7087	78.1	357
3.5	SES 2013	41.2	14.3	10.4	207	8605	82.2	316
3.5	SES 2014	40.6	14.4	10.4	209	8566	82.4	284
3.5	SES 2016	41.7	13.0	9.1	182	7603	81.1	314
5	Beta 52RR45	47.4	12.2	8.3	166	7911	79.9	447
5	Beta 5499	38.5	12.3	8.2	163	6592	78.1	302
5	SES 2013	40.5	14.8	10.7	214	9452	82.3	310
5	SES 2014	41.0	14.3	10.1	201	8331	80.8	322
5	SES 2016	44.1	12.8	8.9	178	7867	80.4	389

In Trial 3, canopy score and bolter number were measured. Because of the late harvest, root rot was also evaluated, Table 16. The canopy score was affected by plant spacing and variety, Table 16. In general SES 2014 had a better canopy than the other varieties, Table 17. As the plant spacing increased, the canopy score increased meaning that the amount of canopy was less, Table 18. The number of bolters was only significantly affected by variety. Beta 5499 had bolters in the plot while the rest of the varieties did not, Table 16 and 17. Root rot was not significantly affected by plant spacing while variety did affect the occurrence. Beta 5499 had the most root rot while Beta 52RR45 had the least, Table 17.

Table 16. Means and statistical analysis for canopy score (top growth 1 = best, 5 = poor), number of bolter plants, and number of beets with root rot in the harvest area, Trial 3 2015-2016.

Plant spacing inch	Variety	Canopy score	Bolters	Root rot
		Score 1 – 5	Number in harvest area	
2	Beta 52RR45	3.00	0	3.50
2	Beta 5499	3.00	3.67	7.33
2	SES 2013	3.50	0	7.00
2	SES 2014	1.83	0	1.50
2	SES 2016	3.50	0	7.50
3.5	Beta 52RR45	3.92	0	6.33
3.5	Beta 5499	3.58	3.00	11.33
3.5	SES 2013	3.75	0	8.50
3.5	SES 2014	2.33	0	2.83
3.5	SES 2016	3.42	0	7.67
5	Beta 52RR45	4.00	0	7.67
5	Beta 5499	3.75	2.17	13.00
5	SES 2013	4.00	0	10.17
5	SES 2014	2.75	0	7.67
5	SES 2016	4.08	0	5.83
Statistical analysis		P > F		
Plant spacing		0.002	0.35	0.37
Variety		0.0001	0.0001	0.03
Plant spacing X Variety		0.59	0.34	0.87
C.V. (%)		16.1	130	84
Grand mean		3.36	0.59	7.19

Table 17. The effect of variety on canopy score, number bolters, and root rot for Trial 3 2015-2016.

Variety	Canopy score	Bolters	Root rot
	Score 1 – 5	Number in harvest area	
Beta 52RR45	3.64	0	5.83
Beta 5499	3.44	2.94	10.56
SES 2013	3.75	0	8.56
SES 2014	2.31	0	4.00
SES 2016	3.67	0	7.00

Table 18. The effect of seed spacing on canopy score, number bolters, and root rot for Trial 3 2015-2016.

Plant spacing Inches	Canopy score	Bolters	Root rot
	Score 1 – 5	Number in harvest area	
2	3.00	0.73	5.37
3.5	3.40	0.60	7.33
5	3.72	0.43	8.87

2016-2017 Trial 1

Root yield in Trial 1 was very good in the 2016-2017 growing season, 70.0 ton/acre. Plant spacing significantly affected only the root yield at Trial 1, Table 19. As the plant spacing increased, the root yield also increased, Table 20. The plant spacing did not affect another measured parameter at Trial 1. Variety did affect root yield, sucrose concentration, extractable sucrose concentration, extractable sucrose per ton, extractable sucrose per acre, beet nitrate-N, and number of bolters in the harvest area, Table 19.

Table 19. Statistical analysis for root yield, sucrose, extractable sucrose, purity, beet nitrate-N, and bolters for Trial 1 2016-2017.

Source of Variation	Root yield	Sucrose	Extractable sucrose			Purity	Beet nitrate-N	Bolters
	ton/A	%	%	lb/ton	lb/A	%	ppm	Number in harvest area
Plant spacing	0.0001	0.67	0.31	0.28	0.006	0.13	0.54	0.14
Variety	0.0001	0.0002	0.009	0.01	0.10	0.47	0.002	0.0001
Plant spacing X variety	0.72	0.07	0.46	0.47	0.39	0.83	0.86	0.52
C.V. (%)	5.8	3.3	5.9	5.9	7.5	2.1	41.2	46.0
Grand mean	70.0	15.2	11.6	232	16244	84.7	215	4.4

Table 20. The effect of seed spacing on root yield, sucrose, extractable sucrose, purity, beet nitrate-N, and bolters for Trial 1 2016-2017.

Plant spacing	Root yield	Sucrose	Extractable sucrose			Purity	Beet nitrate-N	Bolters
Inches	ton/A	%	%	lb/ton	lb/A	%	ppm	Number in harvest area
2.0	66.9	15.2	11.7	235	15707	85.3	210	2.75
3.5	68.9	15.4	11.7	234	16048	84.6	203	3.25
5.0	74.2	15.1	11.5	229	16976	84.3	232	4.10

Beta 5499 had the greatest root yield of 73.6 ton per acre, Table 21. The least root yield occurred with SES 2014 at 65.2 ton per acre. The greatest sucrose concentration, extractable sucrose concentration and extractable sucrose per ton was from SES 2014. Beta 5499 and Beta 52RR45 had the least sucrose concentration, extractable sucrose concentration, and extractable sucrose per ton. When the root yield, sucrose, and impurity information is combined, Beta 5499 and SES 604 have the greatest extractable sucrose per acre. The downfall of Beta 5499 is the significantly larger number of bolters compared to the other varieties in the study. This is similar to observations at other locations.

Table 21. The effect of variety on root yield, sucrose, extractable sucrose, purity, beet nitrate-N, and bolters for Trial 1 2016-2017.

	Root yield	Sucrose	Extractable sucrose			Purity	Beet nitrate-N	Bolters
Variety	ton/A	%	%	lb/ton	lb/A	%	ppm	Number in harvest area
Beta 52RR45	70.6	14.8	11.1	223	15720	84.0	307	0.08
Beta 5499	73.6	14.9	11.4	228	16738	84.8	220	17.0
SES 2013	69.3	15.2	11.6	231	15993	84.5	227	0.08
SES 2014	65.2	15.9	12.3	246	15988	85.3	152	0
SES 604	71.6	15.3	11.8	235	16779	85.0	168	4.67

There was an interaction between variety and plant spacing for sucrose at this site, Figure 1. The interaction indicates that the sucrose concentration for each variety was different at each plant spacing. Beta 52RR45 and Beta 5499 had similar sucrose concentrations at all plant spacings while the SES varieties changed sucrose concentrations at different plant spacings. There is no particular reason why these differences occurred and since the extractable sucrose per acre was not affected, there was no economic impact from this interaction.

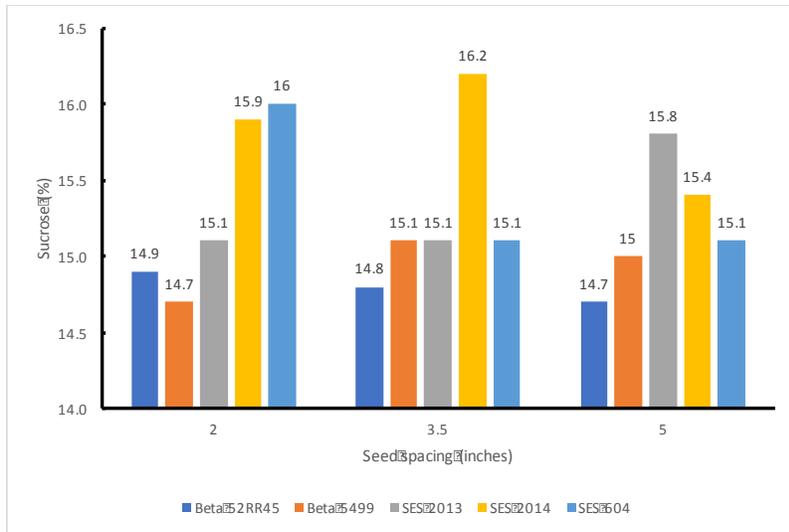


Figure 1. The interaction between variety and plant spacing for sucrose concentration at Trial 1 in the 2016-2017 growing season.

There were no interactions between variety and plant spacing for the rest of the parameters at this site. The means for all treatments are listed in Table 22.

Table 22. The means for root yield, sucrose, extractable sucrose, purity, and beet nitrate-N for all treatments in Trial 1 2016-2017.

Plant spacing inch	Variety	Root yield ton/A	Sucrose %	Extractable sucrose		Purity %	Beet nitrate-N ppm	Bolters Number in harvest area	
				%	lb/ton				lb/A
2	Beta 52RR45	68.6	14.9	11.5	230	15764	85.0	266	0.33
2	Beta 5499	70.0	14.7	11.5	229	16059	85.9	221	19.0
2	SES 2013	66.4	15.1	11.6	231	15354	84.8	231	0.14
2	SES 2014	58.2	15.9	12.2	243	14154	84.7	191	0
2	SES 604	57.1	16.0	12.6	252	16922	86.6	100	6
3.5	Beta 52RR45	68.0	14.8	11.1	222	15050	83.8	301	0
3.5	Beta 5499	73.5	15.1	11.2	225	16506	83.5	225	17.0
3.5	SES 2013	71.6	15.1	11.4	228	16364	84.3	225	0
3.5	SES 2014	64.2	16.2	12.6	252	16163	85.6	126	0
3.5	SES 604	72.4	15.1	11.6	231	16710	85.0	148	4.7
5	Beta 52RR45	75.2	14.7	11.0	219	16524	83.6	346	0
5	Beta 5499	78.3	15.0	11.4	227	17762	84.4	215	14.5
5	SES 2013	74.7	15.8	11.9	236	17675	83.7	218	0
5	SES 2014	70.2	15.4	11.9	237	16642	85.2	171	0
5	SES 604	73.4	15.1	11.4	228	16742	84.2	212	4.0

2016-2017 Trial 2

This statistical analysis for Trial 2 is reported in Table 23. There was a significant interaction between variety and plant spacing for sucrose concentration, extractable sucrose concentration, and extractable sucrose concentration per ton. This indicates that the interaction occurred because of differences in response to the treatments on the sucrose concentration and not the impurities that are accounted for in the extractable sucrose values. Figure 2 and Table 24 shows the interactions. There is no particular reason why these differences occurred and since the extractable sucrose per acre was not affected, there was no economic impact from this interaction.

Table 23. Statistical analysis for root yield, sucrose, extractable sucrose, purity, beet nitrate-N, and bolters for Trial 2 2016-2017.

Source of Variation	Root yield	Sucrose	Extractable sucrose		Purity	Beet nitrate-N	Bolters	Mildew	
	ton/A	%	%	lb/ton	lb/A	%	ppm	Number in harvest area	Rated on 1 to 9 scale
Plant spacing	0.0001	0.57	0.92	0.92	0.0001	0.69	0.51	0.26	0.06
Variety	0.0001	0.0001	0.0001	0.0001	0.0001	0.14	0.06	0.0001	0.0001
Plant spacing X variety	0.69	0.03	0.04	0.04	0.76	0.41	0.56	0.59	0.49
C.V. (%)	5.2	4.1	5.8	5.8	7.6	1.6	46.1	68.4	11.6
Grand mean	72.4	14.0	11.2	225	16251	87.8	79	2.3	4.5

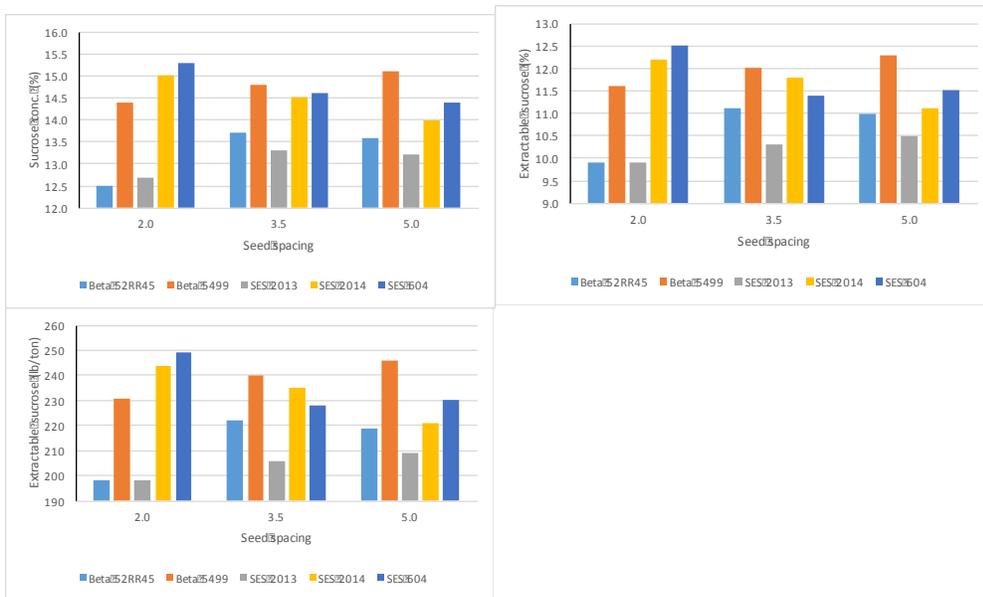


Figure 2. The interaction between variety and plant spacing for sucrose concentration, extractable sucrose concentration, and extractable sucrose per ton at Trial 2 in the 2016-2017 growing season.

Table 24. The means for root yield, sucrose, extractable sucrose, purity, and beet nitrate-N for all treatments in Trial 2 2016-2017.

Plant spacing	Variety	Root yield	Sucrose	Extractable sucrose		Purity	Beet nitrate-N	Bolters	Mildew	
		ton/A	%	%	lb/ton	lb/A	%	ppm	Number in harvest area	Rated on 1 to 9 scale
2	Beta 52RR45	67.5	12.5	9.9	198	13414	87.9	99	0	4.5
2	Beta 5499	67.0	14.4	11.6	231	15488	88.0	72	11.8	5.4
2	SES 2013	65.9	12.7	9.9	198	13069	86.8	105	0	6.1
2	SES 2014	60.8	15.0	12.2	244	14857	89.0	40	0	4.5
2	SES 604	66.0	15.3	12.5	249	16472	88.6	43	1.7	3.0
3.5	Beta 52RR45	72.4	13.7	11.1	222	16085	88.6	81	0	4.0
3.5	Beta 5499	76.2	14.8	12.0	240	18469	88.6	64	10	5.7
3.5	SES 2013	73.6	13.3	10.3	206	15163	86.1	89	0	5.7
3.5	SES 2014	69.5	14.5	11.8	235	16308	88.4	54	0	4.5
3.5	SES 604	79.2	14.6	11.4	228	18059	86.4	105	1.7	3.0
5	Beta 52RR45	76.3	13.6	11.0	219	16720	88.3	111	0	4.3
5	Beta 5499	78.1	15.1	12.3	246	19171	88.5	68	8.8	5.3
5	SES 2013	76.4	13.2	10.5	209	16004	87.8	107	0	5.0
5	SES 2014	71.8	14.0	11.1	221	15911	87.1	77	0	4.0
5	SES 604	82.5	14.4	11.5	230	18927	87.3	71	0.2	2.8

Plant spacing significantly affected root yield, extractable sucrose per acre, and the occurrence of mildew at Trial 2. As the plant spacing increased, root yield and extractable sucrose per acre increased, Table 25. In Trial 2, the root yields averaged 72.4 ton per acre. The amount of mildew observed decreased as plant spacing increased. This could be caused by better air movement in the canopy with the greater plant spacing during the growing season.

Table 25. The effect of plant spacing on root yield, sucrose, extractable sucrose, purity, beet nitrate-N, and bolters for Trial 2 2016-2017.

Plant spacing	Root yield	Sucrose	Extractable sucrose		Purity	Beet nitrate-N	Bolters	Mildew	
			%	lb/ton					lb/A
Inches	ton/A	%	%	lb/ton	lb/A	%	ppm	Number in harvest area	Rated on 1 to 9 scale
2.0	65.8	13.8	11.0	220	14467	87.8	79	3.4	5.1
3.5	73.3	14.2	11.3	226	16572	87.8	75	1.8	4.5
5.0	77.6	14.2	11.4	227	17639	87.7	83	1.8	4.1

Root yield, extractable sucrose per acre, number of bolter per plot, and mildew occurrence were affected by variety, Table 26. SES 604 had the greatest root yield and extractable sucrose yield at this site. SES 2013 and SES 2014 had the least root yield and Beta 52RR45 and Beta 5499 were intermediate. Beta 5499 and SES 604 had the greatest extractable sucrose per acre, SES 2013 had the least extractable sucrose per acre and SES 2014 and Beta 52RR45 were intermediate. SES 604 had the least mildew while the rest of the varieties were significantly greater. As in the other Trials reported, Beta 5499 had a significant number of bolters compared to the other varieties.

Table 26. The effect of variety on root yield, sucrose, extractable sucrose, purity, beet nitrate-N, and bolters for Trial 2 2016-2017.

Variety	Root yield	Sucrose	Extractable sucrose			Purity	Beet nitrate-N	Bolters	Mildew
	ton/A	%	%	lb/ton	lb/A	%	ppm	Number in harvest area	Rated on 1 to 9 scale
Beta 52RR45	72.9	13.5	10.8	217	15830	88.3	95	0	4.2
Beta 5499	73.0	14.7	11.9	238	17369	88.3	69	10.3	5.4
SES 2013	69.6	12.9	10.1	202	14081	86.8	101	0	5.8
SES 2014	68.8	14.4	11.6	232	15934	88.1	59	0	4.3
SES 604	77.6	14.7	11.7	234	18096	87.1	73	0.9	2.9

2017-2018 Trial 1

Trial 1 in 2017-2018 was considered an early harvest site. It was harvested April 18, 2018. The statistical analysis is presented in Table 27. There were no significant interactions between variety and plant spacing. Variety and plant spacing affected stand. The differences in plant stand reflected the spacing treatments that were part of the study, Table 28. We made the spacing differences as part of the treatments.

The differences in stand caused by variety were small, Table 29. The Beta varieties had better stand than the SV varieties. SV 2013 was eliminated for analysis because of poor emergence.

Root yield was affected by plant spacing and variety, Table 27. As plant spacing increased, root yield increased, Table 28. Varieties from least yield to greatest were, SV 2014, B5499, B52RR45, and SV604, Table 29.

Sugar, extractable sucrose %, and extractable sucrose per ton were not affected by plant spacing or variety. Extractable sucrose per acre was affected by plant spacing and variety. As plant spacing increased the extractable sucrose per acre increased, Table 28. These results are similar to the results for root yield.

Purity was not affected by plant spacing, Table 27. Variety did have significant differences in purity between them, Table 29. These differences in purity were not large, 88.17 to 88.89 %.

Table 27. Statistical analysis of plant spacing study – Early Harvest Trial 1 2017-2018.

Source of variation	Stand	Root yield	Sugar	Extractable Sucrose			Purity
	Plants/plot	ton/A	%	%	lb/ton	lb/A	%
Rep	0.59	0.32	0.39	0.14	0.14	0.83	0.04
Variety	0.05	0.0001	0.61	0.63	0.63	0.0001	0.04
Spacing	0.0001	0.04	0.45	0.66	0.66	0.04	0.90
Variety X Spacing	0.20	0.26	0.54	0.63	0.63	0.17	0.47
C.V (%)	7.4	3.7	2.0	2.7	2.7	3.7	0.8
Mean	134	35.5	16.7	13.7	274	9728	88.67

Table 28. The effect of plant spacing on stand, root yield, sugar, extractable sucrose, and purity at Trial 1 in 2017-2018 growing season.

Plant spacing	Stand	Root yield	Sugar	Extractable Sucrose			Purity
	Plants/plot	ton/A	%	%	lb/ton	lb/A	%
2.0	170	34.9	16.7	13.7	274	9544	88.61
3.5	127	35.5	16.8	13.8	275	9765	88.67
5.0	104	36.1	16.7	13.7	273	9876	88.72

Table 29. The effect of variety on stand, root yield, sugar, extractable sucrose, and purity at Trial 1 in 2017-2018 growing season.

Variety	Stand	Root yield ton/A	Sugar %	Extractable Sucrose			Purity %
	Plants/plot			%	lb/ton	lb/A	
B52RR45	137	35.2	16.6	13.7	273	9606	88.87
B5499	137	34.7	16.8	13.8	276	9574	88.89
SV2014	133	34.2	16.7	13.6	272	9313	88.17
SV604	127	38.0	16.7	13.7	275	10421	88.76

2017-2018 Trial 2

The Trial 2 locations was considered the late harvest site in 2017-2018. This site was harvested June 13, 2018, much earlier than planned. This makes it a mid-harvest site. This location had phenomenal sucrose concentrations, good root yields, and good purities. There were no statistical interactions between ariety and plant spacing at this site, Table 30.

Variety and plant spacing affected stand, Table 30, 31 and 32. We made the spacing differences as part of the treatments. The variety differences were small, Table 32. Stands from greatest to least were SV2014, B5499 and SV 604, and then B52RR45. Similar to Trial 1, SV 2013 was eliminated for analysis because of poor emergence.

Root yield was affected by plant spacing, Table 31. As plant spacing increased, root yield increased. Varieties from least yield to greatest were, SV2014, B52RR45, B5499, and SV604, Table 32.

Sugar, extractable sucrose %, and extractable sucrose per ton were affected similarly by variety, Table 30 and 32. B5299 had the greatest sucrose, while SV2014 was intermediate, and B52RR45 and SV 604 had the least.

Extractable sucrose per acre was affected by plant spacing and variety, Table 30. As plant spacing increased the extractable sucrose per acre was increased, Table 31. The greatest extractable sucrose per acre occurred with B5499, with SV2014 intermediate, and B52RR45 and SV 604 with the least, Table 32.

Purity was not affected by plant spacing. Variety did have significant differences in purity between them, Table 32. These differences were not big, 89.65 to 90.65 %.

Table 30. Statistical analysis of plant spacing study – Late Harvest Trial 2 2017-2018.

Source of variation	Stand	Root yield ton/A	Sugar %	Extractable Sucrose			Purity %
	Plants/plot			%	lb/ton	lb/A	
Rep	0.23	0.53	0.63	0.41	0.41	0.69	0.07
Variety	0.04	0.12	0.004	0.002	0.002	0.06	0.006
Spacing	0.0001	0.004	0.58	0.63	0.63	0.003	0.97
Variety X Spacing	0.86	0.90	0.42	0.66	0.63	0.87	0.52
C.V (%)	3.1	8.8	2.1	2.7	2.7	8.7	0.74
Mean	149	50.6	19.2	16.2	323	16353	90.00

Table 31. The effect of plant spacing on stand, root yield, sugar, extractable sucrose, and purity at the Trial 2 in 2017-2018 growing season.

Plant spacing Inches	Stand	Root yield ton/A	Sugar %	Extractable Sucrose			Purity %
	Plants/plot			%	lb/ton	lb/A	
2.0	199	47.4	19.2	16.1	323	15289	89.99
3.5	143	51.2	19.3	16.2	325	16635	90.02
5.0	104	53.3	19.1	16.1	323	17206	90.00

Table 32. The effect of variety on stand, root yield, sugar, extractable sucrose, and purity at the Trial 2 in 2017-2018 growing season.

Variety	Stand	Root yield ton/A	Sugar %	Extractable Sucrose			Purity %
	Plants/plot			%	lb/ton	lb/A	
B52RR45	146	49.0	19.1	16.0	321	15705	89.87
B5499	149	51.8	19.6	16.7	333	17229	90.69
SV2014	152	48.7	19.3	16.1	323	15777	89.65
SV604	149	52.7	18.9	15.9	317	16727	89.86

Summary

Root Yield

1. There was no significant interaction between variety and plant spacing for root yield.
2. Variety significantly affected root yield in 5 of 7 site years. No consistent variety was best for the 5 site years that were affected
3. Plant spacing affected root yield in 4 of the 7 site years. When plant spacing did affect root yield, the increased plant spacing had greater yields.
4. Having a plant spacing at 41,818 plants per acre was the best in this study.

Extractable sucrose per ton

1. Variety affected extractable sucrose per ton at 6 of the 7 site years. At 4 of the 6 responsive sites SV2014 had the greatest extractable sucrose of the varieties.
2. There was no effect of plant spacing at 6 of the 7 sites. One site, 16171, had an interaction between variety and plant spacing for extractable sucrose per ton, Figure 1. The interaction was caused by the B52RR45 and B5499 varieties increasing extractable sucrose with increasing plant spacing while SV2014, the extractable sucrose per ton decreased with increasing plant spacing population.

Extractable sucrose per acre

1. Variety affected extractable sucrose per acre at 6 of the 7 site years. The non-significant site, variety significantly affected root yield and extractable sucrose per ton in opposite ways and thus caused the lack of response for extractable sucrose per acre. At 4 of the 6 responsive sites, B5499 had the best extractable sucrose per acre. At the other two responsive sites B5499 had the least (15163) or intermediate (16172) extractable sucrose.
2. Plant spacing did not affect extractable sucrose per acre at 3 of the 7 site years. At 4 of the 7 site years, plant spacing significantly affected extractable sucrose per acre. At those sites, as the plant spacing increased, the extractable sucrose per acre increased. These extractable sucrose per acre increases were more pronounced at sites with extractable sucrose per acre values above 15,000 lb per acre.
3. There were no variety by plant spacing interactions for extractable sucrose per acre.

Nitrogen rate and timing study in Imperial Valley 2017-2018 growing season

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Objective:

1. Determine the effect of nitrogen rate and timing on sugar beet root yield and quality.

Materials and Methods: 2017-2018 A study was located at the Imperial Valley Research Center near Brawley, California. The treatments were a factorial combination of eight nitrogen application rates (0, 40, 80, 120, 160, 200, 240, and 280 lb N/A) and two application times (pre-plant and layby. All plots received 20 lb N/A from the pre-plant application of phosphate fertilizer as 11-52-0. The nitrogen source will be liquid UAN (32-0-0). The soil nitrate-N in the surface 4 feet of soil was 71 lb/A on October 16, 2017. Of that 60 lb N/A was in the surface 2 feet and 11 lb N/A was in the 2 to 4 ft depth. The soil nitrate-N in the 0 to 5 foot depth was 93 lb N/A. Pre-plant N application occurred on October 19, 2017 and planted October 20, 2017. The study had to be replanted because of poor emergence on November 20, 2017. Because of the replanting, the layby N application occurred on January 22, 2018. This is much later than originally planned. The variety was SES 2014. At layby, all plots were cultivated to insure irrigation water flow. Table 1. lists the treatments for this study. The study had four replications. March 21, 2018, petioles from the most recently matured leaves were sampled to determine the effect of the treatments on the nitrogen status of the sugar beet plants. The roots were harvested June 26, 2018. Root yield and quality were determined by the Spreckels Sugar tare laboratory.

Table 1. Treatments for the Nitrogen rate and application time study.

Treatment number	N rate	N application timing
1	0	Pre-plant
2	40	Pre-plant
3	80	Pre-plant
4	120	Pre-plant
5	160	Pre-plant
6	200	Pre-plant
7	240	Pre-plant
8	280	Pre-plant
9	0	Layby
10	40	Layby
11	80	Layby
12	120	Layby
13	160	Layby
14	200	Layby
15	240	Layby
16	280	Layby

Results from 2017-2018:

This study had several production issues early in the growing season. The plant emergence from the initial planting was very poor. It was decided to replant. This late planting delayed growth and thus the layby treatment was not applied until January 22, 2018. The statistical analysis for the N timing by N rate study is presented in Table 2. The means for the effect of N timing are presented in Table 3 while the results for the application rate of N are reported in Table 4.

Table 2. The statistical analysis of the N timing by N rate study at the Imperial Valley Research Center, 2017-2018.

Source of variation	Root yield	Sucrose concentration	Extractable sucrose			Purity	Petiole nitrate-N
	ton/A	%	%	lb/ton	lb/A	%	ppm
Rep	0.08	0.12	0.20	0.20	0.04	0.23	0.02
N timing	0.65	0.93	.074	0.74	0.83	0.51	0.0001
N rate	0.0001	0.03	0.005	0.005	0.0003	0.0009	0.0001
N timing X N rate	0.88	0.31	0.52	0.52	0.85	0.90	0.0001
C.V. (%)	6.8	3.1	4.6	4.6	8.9	1.3	30.0
Grand mean	46.6	15.8	12.7	255	11802	87.42	1410

The timing of N application did not affect root yield, sucrose concentration, extractable sucrose percentage, extractable sucrose per ton, extractable sucrose per acre, or purity, Table 3.

Table 3. The effect of N timing on root yield, sucrose concentration, extractable sucrose percentage, extractable sucrose per ton, extractable sucrose per acre, and purity at the Imperial Valley Research Center, 2017-2018.

Application time	Root yield	Sucrose concentration	Extractable sucrose			Purity
	ton/A	%	%	lb/ton	lb/A	%
Pre-plant	46.8	15.8	12.7	253	11818	87.34
Layby	46.4	15.8	12.7	254	11784	87.50

There as a significant response to N fertilizer application for root yield, sucrose concentration, extractable sucrose percentage, extractable sucrose per ton, extractable sucrose per acre, and purity, Table 2 and 4. The agronomic optimum N rate (AONR) for root yield was 71 lb N/A, Figure 1. When you account for the 20 lb N/A in the pre-plant phosphorus fertilizer (11-52-0) and the amount of soil N as nitrate the AONR would be 142 lb N/A. Sucrose concentration was maximized at a N application of 70 lb N/A, Figure 2. Above 70 lb N/A the extractable sucrose per ton decreased very quickly. The agronomic optimum N rate (AONR) for extractable sucrose per acre was 64 lb N/A, Figure 2. Combine this with the initial soil nitrate of 71 lb N/A to a depth of 4 feet the total N and the 20 lb N/A in the phosphorus fertilizer, the AONR would be 135 lb N/A. These AONR values are less than the 250 lb N/A that is recommended for sugar beet production in the Imperial Valley of California. One possible reason could be the shortened growing season for this study caused by the late replant November 20, 2017.

There was an interaction between the N application time and the N rate for petiole nitrate-N taken on March 21, 2018, Table 5. In general, petiole-nitrate-N increased with increasing N rate. It also was greater for the sugar beet treated at layby as opposed to pre-plant application. The interaction is caused by the greatest petiole nitrate-N increased at different rate for lay-by versus pre-plant applications, Figure 4.

Table 4. The effect of N application rate on root yield, sucrose concentration, extractable sucrose percentage, extractable sucrose per ton, extractable sucrose per acre, and purity at the Imperial Valley Research Center, 2017-2018.

N rate	Root yield	Sucrose concentration	Extractable sucrose			Purity
lb/A	ton/A	%	%	lb/ton	lb/A	%
0	36.9	15.8	12.7	253	9414	87.68
40	46.0	15.9	12.8	256	11783	87.85
80	44.6	16.2	13.1	261	11867	87.85
120	48.1	16.0	13.0	259	12421	88.00
160	47.9	15.8	12.8	256	12280	88.14
200	47.6	16.1	13.0	260	12257	87.62
240	49.6	15.6	12.4	247	12267	86.75
280	49.9	15.4	11.9	238	11882	85.61

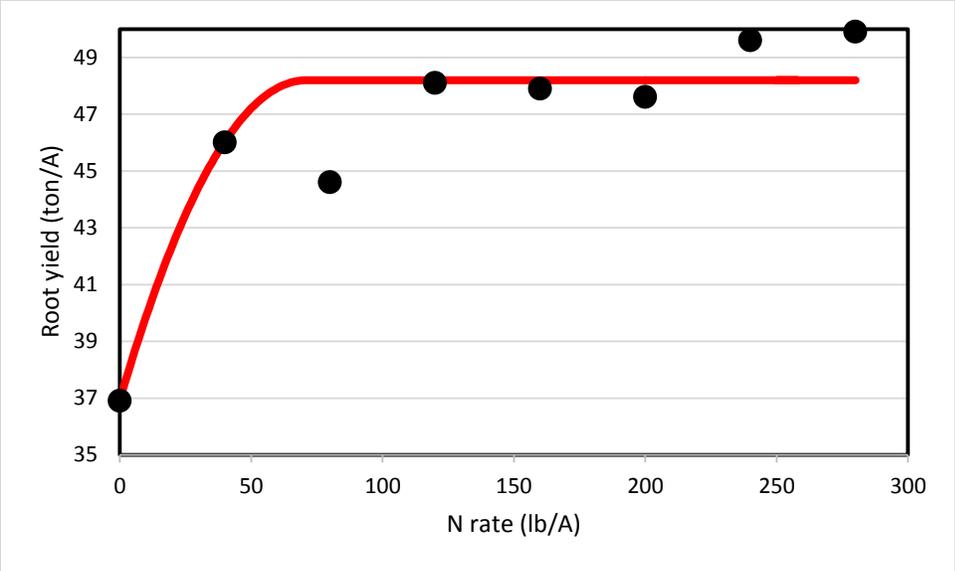


Figure 1. The effect of N application on root yield in the 2017-2018 growing season.

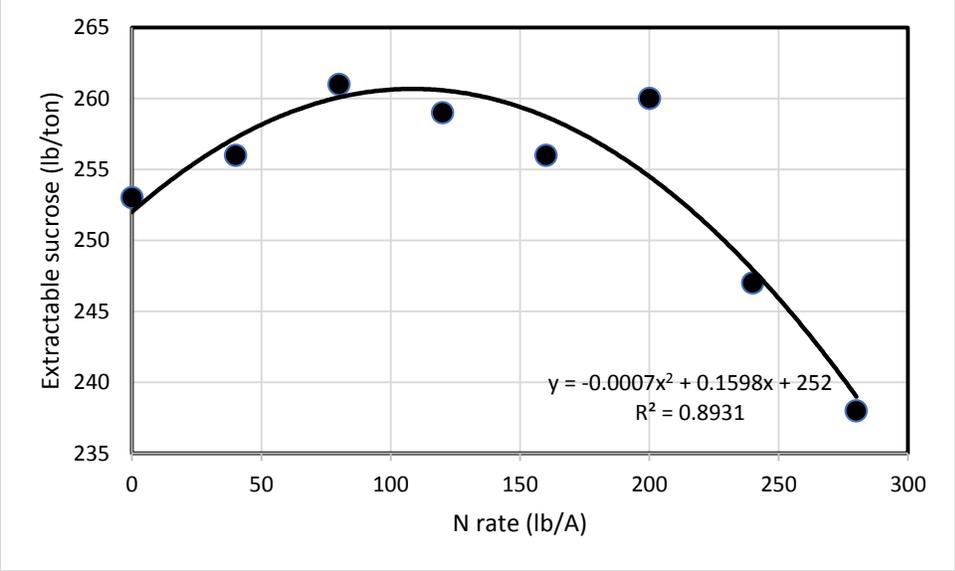


Figure 2. The effect of N rate on extractable sucrose per ton in the 2017-2018 growing season.

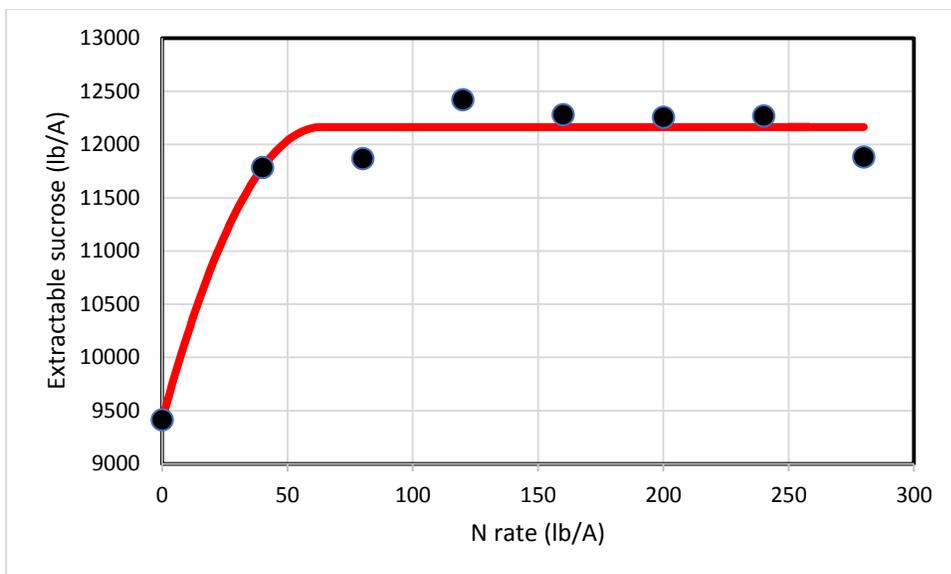


Figure 3. The effect of N application to extractable sucrose per acre in 2017-2018. The AONR was 64 lb N/A.

Table 5. The effect of N application rate and time of application on sugar beet petiole nitrate-N at the Imperial Valley Research Center, 2017-2018.

N rate lb/A	Pre-plant	Layby	Mean
	----- ppm-N -----		
0	367	236	301
40	476	356	416
80	390	588	489
120	1139	1334	1222
160	1120	2100	1610
200	606	1256	931
240	1901	3648	2775
280	2804	4221	3512
Mean	1100	1730	1410

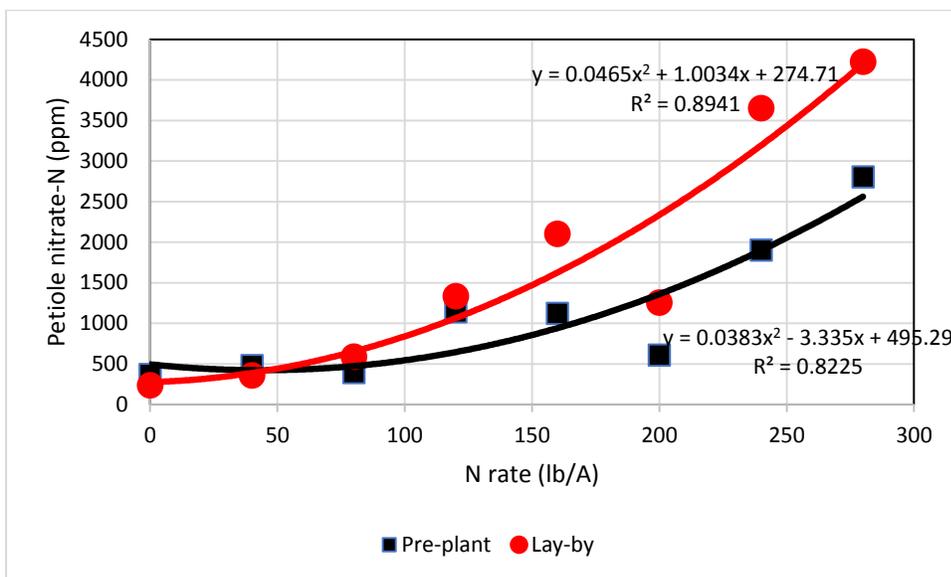


Figure 4. Petiole nitrate-N for pre-plant and lay-by treatments.

At What Plant Stand is Replanting Needed?

A report for the 2017-2018 growing season

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Justification: Establishing an optimum sugar beet plant stand is important to maximizing extractable sucrose yield in the Imperial Valley of California. If conditions are right at planting, then an optimum stand is the result. If there are problems such as seed quality, hot weather, or crusting soil, the stand will be reduced. Currently, the growers in the Imperial Valley aim for a plant stand of 30 sugar beet plants per ten feet of row for optimum production. At what plant stand should a grower decide to replant when the emergence is sub-optimal? The current answer to the question is 15 to 16 sugar beet plants per 10 feet of row. Since the advent of glyphosate resistant sugar beet varieties, there has been no research information from the Imperial Valley about replanting thresholds. This proposed study would generate that information for both early and late harvested sugar beet production.

Objective: Determine the threshold plant stand that requires replanting in early and late harvested sugar beet production.

Methods and Materials: The treatments are listed in Table 1. The study was a randomized complete block design with 4 replications. There were seven plant stand treatments to represent different plant population thresholds. Stands were thinned after emergence. Treatments 1, 2, 3, and 4 were thinned to an even stand while treatments 5, 6, and 7 were thinned unequally simulating an uneven stand that would occur when poor emergence would occur (gappy). Treatment 8 was similar to a replant decision was made. During the 2017-2018 growing season, two sites were established. Site 1 was an early harvest site while Site 2 was a late harvest site. The planting, thinning, and harvest dates are listed in Table 2. Both locations were planted to Beta 5460. Root yield was determined on the dates reported in Table 2. Root quality determined by the Spreckels Sugar Tare Laboratory.

Table 1. Treatments for the proposed reduced stand study.

Treatment	Sugar beet per 10 feet of row
1.	34
2.	30
3.	26
4.	22
5.	18 gaps
6.	14 gaps
7.	10 gaps
8.	30 replant – planted at 3 weeks after original planting.

Table 2. Planting, thinning, and harvest dates for the replanting study.

Site	Planting date	Thinning date	Replant	Harvest date	Variety
Site 1 2017-2018	Oct. 2, 2017	Oct. 30, 2017	Nov. 15, 2017*	June 5, 2018	Beta 5460
Site 2 2017-2018	Oct. 6, 2017	Nov. 9, 2017	Nov. 13, 2017	July 17 and 18, 2018	Beta 5460

* birds ate seed from the previous planting in early November.

Results:

Early harvest 2017-2018 Site 1:

The root yields and quality were good for an early harvest location. The population treatments significantly affected root yield, extractable sucrose per acre, brei nitrate, and stand, Table 3. Extractable sucrose per ton and purity were not affected by the treatments. The root yields for all of the population treatments, 1 through 7 were not significantly different, Table 4. The root yield for the replant treatment, 8, was significantly less than the root yields

for the other treatments. Extractable sucrose per acre was the greatest for treatment 3. The stand was significantly affected by the treatments. This shows that the treatment did get established as intended. Brei nitrate was significantly increased by the replant treatment (8). The late planting of treatment 8 caused most of the significant differences that occurred at this site.

Table 3. Statistical analysis for the Early Harvest Replanting Trial – Site 1 2017-2018.

Statistics	Root yield	Extractable sucrose per ton	Extractable sucrose per acre	Purity	Brei nitrate	Stand
Rep	0.77	0.14	0.29	0.29	0.13	0.36
Treatment	0.0001	0.32	0.0001	0.61	0.04	0.0001
C.V. (%)	5.7	3.7	5.7	1.0	44.7	5.0
Grand mean	59.7	281	16766	90.14	18	89
LSD _{0.05}	5.0	NS	1407	NS	12	6.5

Table 4. Means for root yield, extractable sucrose per ton, extractable sucrose per acre, purity, brei nitrate, and stand for early harvest replant study, Site 1, 2017-2018.

Treatment	Root yield	Extractable sucrose		Purity	Brei nitrate	Stand
plants per 10 ft of row	ton/A	lb/ton	lb/A	%	ppm	plants/plot
1 (34)	61.4	281	17238	90.3	13	133
2 (30)	63.6	273	17335	89.8	18	116
3 (26)	65.2	292	19031	90.9	13	101
4 (22)	64.5	286	18388	90.1	15	85
5 (18 gappy)	63.3	278	17568	90.1	17	68
6 (14 gappy)	63.9	280	17893	90.4	16	55
7 (10 gappy)	61.2	279	17044	89.7	20	39
8 (30 replant)	34.5	279	9631	89.9	34	112

Late harvest 2017-2018 Site 2:

The root yield and quality for this sites was very good for a late harvested sugar beet crop. The plant stand treatments did not significantly affect the extractable sucrose per ton, purity or brei nitrate-N, Table 5 and 6. Root yield was only affected by the replant treatment, 8. Treatment 6 was superior in root yield while treatment 5 was superior in extractable sucrose per acre. The stand was significantly affected by the treatments. This shows that the treatments did get established as intended. The late planting of treatment 8 caused most of the significant difference that occurred in this study.

Table 5. Statistical analysis for the Late Harvest Replanting Trial – Site 2 2017-2018.

Statistics	Root yield	Extractable sucrose per ton	Extractable sucrose per acre	Purity	Brei nitrate	Stand
Rep	0.38	0.47	0.20	0.52	0.95	0.66
Treatment	0.0001	0.20	0.0001	0.88	0.56	0.0001
C.V. (%)	4.9	4.4	4.8	1.2	28.9	2.1
Grand mean	89.7	245	21989	87.0	162	92.9
LSD _{0.05}	6.5	NS	1561	NS	NS	2.8

Table 6. Means for root yield, extractable sucrose per ton, extractable sucrose per acre, purity, brei nitrate, and stand for early harvest replant study, Site 2, 2017-2018.

Treatment	Root yield	Extractable sucrose		Purity	Brei nitrate	Stand
plants per 10 ft of row	ton/A	lb/ton	lb/A	%	ppm	plants/plot
1 (34)	86.9	244	21169	87.0	155	131
2 (30)	90.7	238	21531	86.6	183	122
3 (26)	92.4	249	22975	87.3	153	113
4 (22)	95.1	245	23247	86.8	162	89
5 (18 gappy)	92.3	259	23918	87.6	119	69
6 (14 gappy)	96.3	240	23065	86.8	170	56
7 (10 gappy)	94.4	240	22682	86.7	162	40
8 (30 replant)	71.6	247	17595	87.2	190	124

Summary:

In the growing season of 2017-2018, the replanting of a reduced stand of sugar beet would not have been advisable. This is not what was expected, as the population was reduced to 1 sugar beet per foot of row and gappy in distribution yielded very well. The late harvest site sugar beets from the gappy reduced populations (5 to 7) were very difficult to harvest and would be a large problem for commercial harvesting equipment. The large beets caused issues with plugging the harvester. The replant treatment, 8, was not as successful as originally thought. At the early harvest site, the replanting was delayed by irrigation water scheduling and the fact that it was replanted again because of bird feeding damage. At the late harvest site, the replant may not have yielded well because of the later than originally planned replanting. **Caution: Reported are the results of one year!!** This study is planned to continue for two years and thus the results could be different.

2017 – 2018
Imperial Valley
Official Variety
Trial Results

**Imperial Valley Early Harvest Official Variety Trials
3 Year Data (2016-2018)**

Variety	Marketing Approval	Extractable Sugar/ Acre	Extractable Sugar/ Ton	Gross Sugar/ Acre	Tons/ Acre	% Sugar	Final Stand ^{1/}	% Bolt	Purity	Percent Emergence		Curly Top	% of Mkt.	Erwinia Root Rot+	% of Mkt. Avg.	Powdery Mildew	% of Mkt. Avg.	Rhizomania Root Rating
BTS 5678	Full Approval											--- M = 150 ---		--M = 300		-- M = 100		
2018 Trial		11,230	295.0	13,466	38.2	17.7	207	0.0	89.6	43.9		--	--	--	--	5.2	97.7	--
2017 Trial		12,543	258.4	15,017	48.3	15.5	233	0.0	90.0	72.0		6.6	99.8	--	--	--	--	2.1
2016 Trial		10,874	304.0	12,603	35.8	17.6	231	0.0	92.0	--		--	--	--	--	--	--	--
Average		11,549	285.8	13,695	40.8	16.9	224	0.0	90.5	--		--	--	--	--	--	--	--
BTS 5460	Full Approval																	
2018 Trial		11,246	285.2	13,616	39.4	17.3	204	0.0	89.0	46.4		--	--	--	--	4.8	90.1	--
2017 Trial		11,760	242.3	14,434	48.4	14.9	235	0.0	88.6	64.7		6.4	96.8	--	--	--	--	1.8
2016 Trial		10,712	299.2	12,546	35.8	17.5	234	0.0	91.3	--		4.9	105.8	64.6	176.7	4.8	132.4	1.9
Average		11,239	275.6	13,532	41.2	16.6	224	0.0	89.6	--								
SV501TT	Full Approval																	
2018 Trial		11,438	279.3	13,896	40.7	17.0	192	0.0	88.9	35.9		--	--	--	--	5.1	95.8	--
2017 Trial		12,357	250.7	14,915	49.3	15.1	241	0.0	89.7	76.9		6.7	101.3	--	--	--	--	1.9
2016 Trial		11,526	293.5	13,527	39.3	17.2	236	0.0	91.2	--		3.8	82.0	24.0	65.8	2.7	74.5	2.1
Average		11,774	274.5	14,113	43.1	16.4	223	0.0	89.9	--		--	--	--	--	--	--	--
BTS 5499	Full Approval																	
2018 Trial		10,318	284.0	12,495	36.5	17.2	212	0.0	89.1	59.5		--	--	--	--	4.1	77.0	--
2017 Trial		11,337	244.0	13,784	46.4	14.9	240	0.0	89.2	84.3		6.3	95.3	--	--	--	--	2.2
2016 Trial		10,081	291.5	11,937	34.6	17.3	234	0.0	90.6	--		3.9	84.2	31.9	87.2	3.5	96.6	2.1
Average		10,579	273.2	12,738	39.2	16.5	229	0.0	89.6	--								
BTS 5600	Full Approval																	
2018 Trial		10,959	264.4	13,511	41.6	16.3	211	0.0	88.1	54.1		--	--	--	--	5.4	101.4	--
2017 Trial		12,576	244.5	15,210	51.4	14.8	240	0.0	89.5	80.1		6.8	102.8	--	--	--	--	1.4
2016 Trial		11,403	289.3	13,457	39.4	17.1	230	0.0	90.9	--		--	--	--	--	--	--	--
Average		11,646	266.1	14,059	44.1	16.1	227	0.0	89.5	--		--	--	--	--	--	--	--
SV 602TT	Full Approval																	
2018 Trial		12,201	275.6	14,692	44.1	16.6	198	0.0	89.4	37.1		--	--	--	--	5.7	107.0	--
2017 Trial		13,215	240.4	15,957	54.9	14.6	237	0.0	89.9	70.7		7.0	105.9	--	--	--	--	2.0
2016 Trial		12,106	282.3	14,254	42.9	16.6	227	0.0	91.1	--		--	--	--	--	--	--	--
Average		12,507	266.1	14,968	47.3	15.9	221	0.0	90.1	--		--	--	--	--	--	--	--

**Imperial Valley Early Harvest Official Variety Trials
3 Year Data (2016-2018)**

Variety	Marketing Approval	Extractable Sugar/ Acre	Extractable Sugar/ Ton	Gross Sugar/ Acre	Tons/ Acre	% Sugar	Final Stand ^{1/}	% Bolt	Purity	Percent Emergence	Curly Top	% of Mkt.	Erwinia Root Rot+	% of Mkt. Avg.	Powdery Mildew	% of Mkt. Avg.	Rhizomania Root Rating
BTS 566N	Full Approval																
2018 Trial		9,972	273.1	12,286	36.7	16.8	208	0.0	88.0	46.7	--	--	--	--	4.9	92.0	--
2017 Trial		10,315	240.4	12,711	43.0	14.8	239	0.0	88.6	76.2	6.2	93.8	--	--	--	--	2.1
2016 Trial		9,500	281.6	11,414	33.8	16.9	238	0.0	89.7	--	--	--	--	--	--	--	--
Average		9,929	265.0	12,137	37.8	16.2	228	0.0	88.8	--	--	--	--	--	--	--	--
SV401	Full Approval																
2018 Trial		11,545	273.8	13,956	42.3	16.6	206	0.0	89.4	57.4	--	--	--	--	7.4	139.0	--
2017 Trial		11,889	239.3	14,488	50.2	14.5	239	0.0	89.6	86.8	6.9	104.3	--	--	--	--	2.1
2016 Trial		11,536	276.8	13,705	41.7	16.4	232	0.0	90.5	--	6.2	133.8	25.7	70.2	3.5	96.6	2.0
Average		11,656	263.3	14,050	44.7	15.8	226	0.0	89.8	--	--	--	--	--	--	--	--

GRAND MEAN		11,360	271.2	13,661	42.3	16.3			89.7
97%		11,019	263.1	13,252	41.0	15.8			87.1

2018 Mean	--	--	--	--	5.3	100	--
2017 Mean	6.6	100	--	--	--	--	2.0
2016 Mean	4.6	100	36.5	100	3.6	100	2.0

Pr>F

2018 Trial	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	n/a	<0.0001	<0.0001	n/a	n/a	<0.0001
2017 Trial	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	n/a	n/a	<0.0001	0.0001	<0.0001	n/a	<0.0001
2016 Trial	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	n/a	n/a	<0.0001	0.0001	<0.0001	<0.0001	<0.0001

CV

2018 Trial	6.1	2.6	5.9	5.8	1.8	5.4	0.8	16.7	n/a	n/a	12.5	n/a
2017 Trial	6.2	4.1	5.6	4.9	3.1		1.0		6.0	62.7	n/a	n/a
2016 Trial	5.6	2.5	5.5	5.9	1.9		0.8		7.0	25.4	33.5	n/a

LSD (0.05)

2018 Trial	633.5	7.1	743.3	2.1	0.3	10.6	0.7	7.6	n/a	n/a	0.6	n/a
2017 Trial	689.3	9.9	765.8	2.3	0.5		0.8		0.6	n/a	n/a	0.3
2016 Trial	584.2	7.2	672.1	2.1	0.3		0.7		0.5	n/a	n/a	0.2

Cooperator

	<u>Planted</u>	<u>Harvested</u>	<u>Plot Size</u>
Paul Cameron	9/21/17	4/17/18	Plot Size: 2 rows. 30" rows.
Von Medearis	9/24/16	4/07/17	Plot Size: 2 rows. 30" rows.
Von Medearis	9/25/15	4/12/16	Plot Size: 2 rows. 30" rows.

Notes:

Experimental Trial Design : 5X5 lattice
 Experimental Trial Design : 5X5 lattice
 Experimental Trial Design : RCBD

* Emergence counts taken prior to thinning and converted to a percent.

** Final Stand counts converted to beets per 100 foot of row. Final stand counts taken after thinning.

*** 2018 Powdery Mildew Ratings taken from 2017-2018 Mamer Warva Early Harvest Official Trial Location. Ratings are on 1-10 scale. 1=clean, 10= completely covered in disease. Ratings taken by Israel Santiago and Mark Bloomquist.

+ 2017 Erwinia Nursery Data was not used for approval due to high variability in the trial.

**Imperial Valley Early Harvest Official Variety Trials
2 Year Data (2017-2018)**

Variety	Marketing Approval	Extractable Sugar/ Acre	Extractable Sugar/ Ton	Gross Sugar/ Acre	Tons/ Acre	% Sugar	Final Stand ^{1/}	% Bolt	Purity	Percent Emergence		Curly Top	% of Mkt.	Erwinia Root Rot+	% of Mkt. Avg.	Powdery Mildew***	% of Entry Avg.	Rhizomania Root Rating
												--- M = 150 ---		--M = 300		-- M = 100		
BTS 5678	Full Approval																	
2018 Trial		11,230	295.0	13,466	38.2	17.7	207	0.0	89.6	43.9		--	--	--	--	5.2	99.5	--
2017 Trial		12,543	258.4	15,017	48.3	15.5	233	0.0	90.0	72.0		6.6	99.8	--	--	--	--	2.1
Average		11,887	276.7	14,241	43.3	16.6	220	0.0	89.8	58.0		--	--	--	--	--	--	--
BTS 5780																		
2018 Trial		9,740	284.2	11,997	34.0	17.5	209	0.0	87.9	60.5		--	--	--	--	3.2	61.2	--
2017 Trial		11,263	251.6	13,785	45.3	15.4	241	0.0	88.8	86.1		--	--	--	--	--	--	--
Average		10,502	267.9	12,891	39.7	16.5	225	0.0	88.4	73.3		--	--	--	--	--	--	--
SV501TT	Full Approval																	
2018 Trial		11,438	279.3	13,896	40.7	17.0	192	0.0	88.9	35.9		--	--	--	--	5.1	97.6	--
2017 Trial		12,357	250.7	14,915	49.3	15.1	241	0.0	89.7	76.9		6.7	101.3	--	--	--	--	1.9
Average		11,898	265.0	14,405	45.0	16.1	216	0.0	89.3	56.4		--	--	--	--	--	--	--
SV 979	Limited Approval																	
2018 Trial		11,560	282.1	13,799	41.1	16.8	215	0.0	90.1	61.7		--	--	--	--	7.2	137.8	--
2017 Trial		12,021	245.8	14,466	49.4	14.8	240	0.0	90.2	83.5		--	--	--	--	--	--	--
Average		11,790	264.0	14,132	45.3	15.8	227	0.0	90.2	72.6		--	--	--	--	--	--	--
BTS 5499	Full Approval																	
2018 Trial		10,318	284.0	12,495	36.5	17.2	212	0.0	89.1	59.5		--	--	--	--	4.1	78.5	--
2017 Trial		11,337	244.0	13,784	46.4	14.9	240	0.0	89.2	84.3		6.3	95.3	--	--	--	--	2.2
Average		10,827	264.0	13,139	41.5	16.1	226	0.0	89.2	71.9		--	--	--	--	--	--	--
BTS 5460	Full Approval																	
2018 Trial		11,246	285.2	13,616	39.4	17.3	204	0.0	89.0	46.4		--	--	--	--	4.8	91.9	--
2017 Trial		11,760	242.3	14,434	48.4	14.9	235	0.0	88.6	64.7		6.4	96.8	--	--	--	--	1.8
Average		11,503	263.8	14,025	43.9	16.1	220	0.0	88.8	55.6		--	--	--	--	--	--	--
BTS 5775	Limited Approval																	
2018 Trial		10,491	277.2	12,877	37.6	17.0	202	0.0	88.2	52.2		--	--	--	--	3.6	68.9	--
2017 Trial		11,672	243.7	14,357	48.0	15.0	240	0.0	88.7	85.5		--	--	--	--	--	--	--
Average		11,081	260.5	13,617	42.8	16.0	221	0.0	88.5	68.9		--	--	--	--	--	--	--
SV 972	Limited Approval																	
2018 Trial		11,343	279.9	13,586	41.2	16.8	203	0.0	89.7	48.2		--	--	--	--	6.1	116.7	--
2017 Trial		12,638	236.0	15,261	53.7	14.3	233	0.0	90.1	68.4		--	--	--	--	--	--	--
Average		11,990	258.0	14,424	47.5	15.6	218	0.0	89.9	58.3		--	--	--	--	--	--	--
SV 602TT	Full Approval																	
2018 Trial		12,201	275.6	14,692	44.1	16.6	198	0.0	89.4	37.1		--	--	--	--	5.7	109.1	--
2017 Trial		13,215	240.4	15,957	54.9	14.6	237	0.0	89.9	70.7		7.0	105.9	--	--	--	--	2.0
Average		12,708	258.0	15,324	49.5	15.6	218	0.0	89.7	53.9		--	--	--	--	--	--	--

**Imperial Valley Early Harvest Official Variety Trials
2 Year Data (2017-2018)**

Variety	Marketing Approval	Extractable Sugar/ Acre	Extractable Sugar/ Ton	Gross Sugar/ Acre	Tons/ Acre	% Sugar	Final Stand ^{1/}	% Bolt	Purity	Percent Emergence		Curly Top	% of Mkt.	Erwinia Root Rot ⁺	% of Mkt. Avg.	Powdery Mildew ^{***}	% of Entry Avg.	Rhizomania Root Rating
BTS 566N	Full Approval																	
2018 Trial		9,972	273.1	12,286	36.7	16.8	208	0.0	88.0	46.7		--	--	--	--	4.9	93.8	--
2017 Trial		10,315	240.4	12,711	43.0	14.8	239	0.0	88.6	76.2		6.2	93.8	--	--	--	--	2.1
Average		10,143	256.8	12,498	39.9	15.8	223	0.0	88.3	61.5		--	--	--	--	--	--	--
SV401RR	Full Approval																	
2018 Trial		11,545	273.8	13,956	42.3	16.6	206	0.0	89.4	57.4		--	--	--	--	7.4	141.6	--
2017 Trial		11,889	239.3	14,488	50.2	14.5	239	0.0	89.6	86.8		6.9	104.3	--	--	--	--	2.1
Average		11,717	256.6	14,222	46.3	15.6	223	0.0	89.5	72.1		--	--	--	--	--	--	--
BTS 5600	Full Approval																	
2018 Trial		10,959	264.4	13,511	41.6	16.3	211	0.0	88.1	54.1		--	--	--	--	5.4	103.3	--
2017 Trial		12,576	244.5	15,210	51.4	14.8	240	0.0	89.5	80.1		6.8	102.8	--	--	--	--	1.4
Average		11,768	254.5	14,361	46.5	15.6	226	0.0	88.8	67.1		--	--	--	--	--	--	--

GRAND MEAN		11,485	262.1	13,940	44.2	15.9			89.2	64.1	2018 Mean	n/a	n/a	n/a	n/a	5.2	100	n/a
97%		11,140	254.3	13,522	42.9	15.4			86.5	62.2	2017 Mean	6.6	100			n/a	n/a	2.0

F VALUE

2018 Trial	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	n/a	<0.0001	<0.0001								
2017 Trial	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	n/a	n/a	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001			--		<0.0001

CV

2018 Trial	6.1	2.6	5.9	5.8	1.8	5.4	n/a	0.8	16.7									
2017 Trial	6.2	4.1	5.6	4.9	3.1		n/a	1.0	6.4	6.0	62.69					--		n/a

LSD (0.05)

2018 Trial	633.5	7.1	743.3	2.1	0.3	10.6	n/a	0.7	7.6									
2017 Trial	689.30	9.91	765.77	2.25	0.46		n/a	0.85	5.0	0.6	n/a					--		0.3

Cooperator

Planted	Harvested	Plot Size
Paul Cameron	9/21/17 4/17/18	2 rows. 30" rows.
Von Medearis	9/24/16 4/07/17	2 rows. 30" rows.

Notes:

Experimental Trial Design : 5X5 lattice
Experimental Trial Design : 5X5 lattice

* Emergence counts taken prior to thinning and converted to a percent.

** Final Stand counts converted to beets per 100 foot of row. Final stand counts taken after thinning.

*** Powdery Mildew Ratings taken from 2017-2018 Mamer Warva Early Harvest Official Trial Location. Ratings are on 1-10 scale. 1=clean, 10= completely covered in disease. Ratings taken by Israel Santiago and Mark Bloomquist.

+ 2017 Erwinia Nursery Data was not used for approval due to high variability in the trial.

**Imperial Valley Early Harvest Official Variety Trials
1- Year Data (2018)**

Variety	Marketing Approval	Extractable Sugar/ Acre	Extractable Sugar/ Ton	Gross Sugar/ Acre	Tons/ Acre	% Sugar	Final Stand**	% Bolt	Purity	Percent Emergence*	Curly Top	% of Mkt.	Erwinia Root Rot	% of Mkt. Avg.	Powdery Mildew***	% of Trial Avg.	Rhizomania Root Rating
											--- M = 150 ---		--M = 300		-- M = 100		
BTS 5678	Full Approval	11,230	295.0	13,466	38.2	17.7	207	0.0	89.6	43.9	--	--	--	--	5.2	104.0	--
MA722		9,300	295.0	11,208	31.5	17.8	190	0.0	89.2	28.7	--	--	--	--	6.7	134.0	--
SV 983TT	Limited Approval	11,762	293.9	14,101	40.3	17.6	201	0.0	89.6	38.0	--	--	--	--	3.7	74.0	--
BTS 5817		10,573	291.8	12,931	36.2	17.8	161	0.0	88.4	22.9	--	--	--	--	5.5	110.0	--
BTS 582N		10,417	290.8	12,812	34.9	17.9	207	0.0	87.9	53.3	--	--	--	--	4.9	98.0	--
BTS 5865		9,210	286.8	11,255	32.0	17.5	213	0.0	88.4	48.7	--	--	--	--	3.3	66.0	--
SV 984		10,379	286.0	12,711	36.1	17.5	204	0.0	88.2	38.8	--	--	--	--	2.6	52.0	--
BTS 5460	Full Approval	11,246	285.2	13,616	39.4	17.3	204	0.0	89.0	46.4	--	--	--	--	4.8	96.0	--
SV 982		11,178	284.9	13,464	39.3	17.2	206	0.0	89.4	64.0	--	--	--	--	6.2	124.0	--
BTS 5780		9,740	284.2	11,997	34.0	17.5	209	0.0	87.9	60.5	--	--	--	--	3.2	64.0	--
BTS 5499	Full Approval	10,318	284.0	12,495	36.5	17.2	212	0.0	89.1	59.5	--	--	--	--	4.1	82.0	--
BTS 5833		10,321	282.3	12,644	36.6	17.3	206	0.0	88.3	48.3	--	--	--	--	3.3	66.0	--
SV 979	Limited Approval	11,560	282.1	13,799	41.1	16.8	215	0.0	90.1	61.7	--	--	--	--	7.2	144.0	--
BTS 5809		9,898	280.8	12,158	35.7	17.2	211	0.0	88.2	60.0	--	--	--	--	3.7	74.0	--
SV 985		10,658	280.6	12,946	38.0	17.1	178	0.0	88.9	28.2	--	--	--	--	5.4	108.0	--
SV 972TT	Limited Approval	11,343	279.9	13,586	41.2	16.8	203	0.0	89.7	48.2	--	--	--	--	6.1	122.0	--
SV 501TT	Full Approval	11,438	279.3	13,896	40.7	17.0	192	0.0	88.9	35.9	--	--	--	--	5.1	102.0	--
BTS 5775	Limited Approval	10,491	277.2	12,877	37.6	17.0	202	0.0	88.2	52.2	--	--	--	--	3.6	72.0	--
SV 602TT	Full Approval	12,201	275.6	14,692	44.1	16.6	198	0.0	89.4	37.1	--	--	--	--	5.7	114.0	--
SV 981		12,260	275.6	14,801	44.9	16.6	207	0.0	89.6	46.1	--	--	--	--	5.5	110.0	--
SV 401	Full Approval	11,545	273.8	13,956	42.3	16.6	206	0.0	89.4	57.4	--	--	--	--	7.4	148.0	--
BTS 566N	Full Approval	9,972	273.1	12,286	36.7	16.8	208	0.0	88.0	46.7	--	--	--	--	4.9	98.0	--
MA721		8,392	272.6	10,423	31.2	16.9	212	0.0	87.5	57.1	--	--	--	--	4.8	96.0	--
BTS 5600	Full Approval	10,959	264.4	13,511	41.6	16.3	211	0.0	88.1	54.1	--	--	--	--	5.4	108.0	--
											--	--	--	--	--	--	--

Mean 10,683 282.3 12,985 37.9 17.2 203 88.8 5.0 100
 97% 10,362 273.8 12,595 36.8 16.65 197 86.13

Pr>F <0.0001 <0.0001 <0.0001 <0.0001 <0.0001 <0.0001 <0.0001 <0.0001 <0.0001 <0.0001 <0.0001
 CV 6.1 2.6 5.9 5.8 1.8 5.4 0.8 16.7 12.5
 LSD 0.05 633.5 7.1 743.3 2.1 0.3 10.6 0.7 7.6 0.62

Cooperator Planted Harvested Plot Size
 Paul Cameron 9/21/17 4/17/18 Plot Size: 2 rows. 30" rows.
 Experimental Trial Design : 5X5 lattice

* Emergence counts taken prior to thinning and converted to a percent.

** Final Stand counts converted to beets per 100 foot of row. Final stand counts taken after thinning.

*** Powdery Mildew Ratings taken from 2017-2018 Mamer Warva Early Harvest Official Trial Location. Ratings are on 1-10 scale. 1=clean, 10= completely covered in disease.

Ratings taken by Israel Santiago and Mark Bloomquist.

2017-2018 Imperial Valley Early Harvest Official Variety Trial Results

Cooperator: Paul Cameron

<u>Entry</u>	<u>Entry Code</u>	<u>Entry Name</u>	<u>Gross Sugar per Acre</u>	<u>Extractable Sugar per Acre</u>	<u>Extractable Sugar per Ton</u>	<u>Percent Sugar</u>	<u>Extractable Sugar Percent</u>	<u>Tons per Acre</u>	<u>Percent Purity</u>	<u>Nitrate</u>	<u>Tare Percent</u>	<u>Percent Emergence</u>	<u>Final Stand Beets/100' row</u>	<u>Percent Bolters</u>
13	2017/18 IVEH	BTS 5678	13466.2	11230.2	295.0	17.7	14.8	38.2	89.6	33.4	1.0	43.9	207	0.0
9	2017/18 IVEH	MA722	11207.6	9300.0	295.0	17.8	14.7	31.5	89.2	28.5	0.8	28.7	190	0.0
11	2017/18 IVEH	SV 983	14100.9	11761.5	293.9	17.6	14.7	40.3	89.6	20.4	0.6	38.0	201	0.0
4	2017/18 IVEH	BTS 5817	12930.7	10573.0	291.8	17.8	14.6	36.2	88.4	36.3	1.0	22.9	160	0.0
1	2017/18 IVEH	BTS 582N	12811.8	10416.6	290.8	17.9	14.5	34.9	87.9	29.0	1.8	53.3	207	0.0
24	2017/18 IVEH	BTS 5865	11255.4	9209.5	286.8	17.5	14.4	32.0	88.4	38.9	1.1	48.7	213	0.0
18	2017/18 IVEH	SV 984	12710.7	10379.4	286.0	17.5	14.3	36.1	88.2	29.8	1.4	38.8	204	0.0
20	2017/18 IVEH	Filler	11162.5	9124.6	285.4	17.5	14.3	31.6	88.3	38.5	1.0	15.2	116	0.0
16	2017/18 IVEH	BTS 5460	13616.0	11246.2	285.2	17.3	14.3	39.4	89.0	28.4	0.9	46.4	204	0.0
12	2017/18 IVEH	SV 982	13463.6	11177.8	284.9	17.2	14.3	39.3	89.4	22.2	0.8	64.0	206	0.0
2	2017/18 IVEH	BTS 5780	11996.6	9740.1	284.2	17.5	14.2	34.0	87.9	36.5	0.9	60.5	209	0.0
15	2017/18 IVEH	BTS 5499	12494.5	10317.7	284.0	17.2	14.2	36.5	89.1	22.6	1.1	59.5	212	0.0
22	2017/18 IVEH	BTS 5833	12644.2	10320.8	282.3	17.3	14.1	36.6	88.3	50.6	1.0	48.3	205	0.0
21	2017/18 IVEH	SV 979	13798.9	11559.9	282.1	16.8	14.1	41.1	90.1	34.5	0.9	61.7	215	0.0
7	2017/18 IVEH	BTS 5809	12158.2	9898.0	280.8	17.2	14.0	35.7	88.2	56.8	1.3	60.0	211	0.0
10	2017/18 IVEH	SV 985	12946.4	10658.1	280.6	17.1	14.0	38.0	88.9	31.3	0.8	28.2	178	0.0
6	2017/18 IVEH	SV 972	13586.4	11342.5	279.9	16.8	14.0	41.2	89.7	24.0	0.6	48.2	203	0.0
17	2017/18 IVEH	SV 501TT	13896.2	11437.7	279.3	17.0	14.0	40.7	88.9	27.2	0.8	35.9	192	0.0
5	2017/18 IVEH	BTS 5775	12877.4	10490.8	277.2	17.0	13.9	37.6	88.2	69.6	0.7	52.2	202	0.0
19	2017/18 IVEH	SV 981	14801.4	12259.6	275.6	16.6	13.8	44.9	89.6	27.2	0.8	46.1	207	0.0
14	2017/18 IVEH	SV 602TT	14691.7	12200.9	275.6	16.6	13.8	44.1	89.4	29.2	0.6	37.1	198	0.0
3	2017/18 IVEH	SV 401	13955.5	11544.5	273.8	16.6	13.7	42.3	89.4	36.6	0.3	57.4	206	0.0
25	2017/18 IVEH	BTS 566N	12285.8	9971.9	273.1	16.8	13.7	36.7	88.0	22.1	1.4	46.7	208	0.0
23	2017/18 IVEH	MA721	10423.4	8392.1	272.6	16.9	13.6	31.2	87.5	24.0	3.0	57.1	212	0.0
8	2017/18 IVEH	BTS 5600	13510.8	10959.1	264.4	16.3	13.2	41.6	88.1	39.9	1.3	54.1	211	0.0
		Mean	12911.7	10620.5	282.4	17.2	14.1	37.7	88.8	33.5	1.0	46.1	199.2	
		CV (%)	5.9	6.1	2.6	1.8	2.6	5.8	0.8	41.5	47.0	16.7	5.4	
		LSD (0.05)	743.30	633.53	7.08	0.31	0.35	2.12	0.66	13.62	0.47	7.56	10.59	
		Pr>F	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	
		Error MS	575274.5	417908.3	52.2	0.1	0.1	4.7	0.5	193.1	0.2	59.5	116.8	
		Reps	8	8	8	8	8	8	8	8	8	8	8	

*Emergence counts taken prior to thinning and converted to a percent.

** Final stand counts taken after thinning and converted to beets per 100 foot of row.

Plant Date: September 21, 2017

Harvest Date: April 17, 2018

Plot Size: 2 row. 30" rows.

Experimental Design: 5X5 lattice

Imperial Valley Late Harvest Official Variety Trials
3 Year Data (2016-2018)

Variety	Year	Gross Sugar/ Acre	Extractable Sugar/ Acre	Extractable Sugar/ Ton [†]	Tons/ Acre	% Sugar	Purity	Final Stand Beets/ 100'	% Bolt	% Rot	Emergence	Curly Top Rating	% of Fully Approved	Erwinia* Rating	% of Fully Approved	Powdery Mildew Rating*	% of Fully Approved	Rhizomania Root Rating*
												--- M = 150 ---		--M = 300		-- M = 100		
Beta 5678	2018	27,396	21,807	256.4	85.0	16.1	86.9	237	0.0	5.6	65.0	6.6	104	n/a		n/a		n/a
	2017	23,054	18,626	261.3	71.1	16.2	87.9	240	0.0	0.1	79.5	6.6	102	n/a		n/a		2.1
	2016	19,078	14,863	242.5	61.2	15.6	85.8	231	0.0	13.4	--	--	n/a	n/a		n/a		n/a
Average		23,176	18,432	253.4	72.4	16.0	86.9	236.1	0.0	6.4								
BTS 5460	2018	28,995	23,310	261.8	88.3	16.3	87.5	231	1.2	1.2	63.6	6.2	98	n/a		n/a		n/a
	2017	23,375	18,739	256.6	72.9	16.0	87.4	241	0.1	0.3	70.5	6.4	99	n/a		n/a		1.8
	2016	20,385	15,623	226.9	68.8	14.8	85.0	224	0.0	5.5	--	4.9	101	64.6	168	4.8	111	1.9
Average		24,252	19,224	248.4	76.7	15.7	86.6	232.0	0.4	2.3								
Beta 566N	2018	24,297	19,013	244.0	77.8	15.6	86.0	229	0.3	3.3	65.9	6.3	99	n/a		n/a		n/a
	2017	21,089	16,826	245.2	69.2	15.4	87.3	241	0.0	0.0	80.4	6.2	96	n/a		n/a		2.1
	2016	19,359	15,022	228.7	65.6	14.8	85.8	229	0.0	8.6	--	--	n/a			n/a		n/a
Average		21,581	16,954	239.3	70.9	15.3	86.4	233.0	0.1	4.0								
Beta 5600	2018	27,332	21,571	248.9	87.7	15.7	86.6	232	0.0	15.0	69.4	6.4	101	n/a		n/a		n/a
	2017	23,676	18,707	230.1	81.1	14.6	86.9	240	0.3	0.5	83.6	6.8	105	n/a		n/a		1.4
	2016	19,758	15,635	236.7	66.2	15.0	86.9	225	0.0	25.0	--	--	n/a	n/a		n/a		n/a
Average		23,589	18,638	238.6	78.3	15.1	86.8	232.4	0.1	13.5								
SV143NTT	2018	27,711	21,517	237.8	90.9	15.3	85.7	239	4.0	12.0	83.2	6.4	101	n/a		n/a		n/a
	2017	22,751	18,059	240.0	75.5	15.1	87.1	242	1.1	0.3	84.5	6.5	100	n/a		n/a		1.8
	2016	20,324	15,724	226.2	69.7	14.6	85.5	225	0.6	15.8	--	5.0	103	18.6	48	4.2	97	2.2
Average		23,595	18,433	234.7	78.7	15.0	86.1	235.1	1.9	9.4								
SV 604TT	2018	25,235	19,614	235.9	83.1	15.2	85.8	228	1.5	7.9	60.1	6.6	104	n/a		n/a		n/a
	2017	23,062	18,129	234.5	77.5	14.9	86.4	239	0.3	0.1	71.7	6.5	100	n/a		n/a		2.0
	2016	21,614	16,901	227.3	74.3	14.5	86.3	225	0.0	7.9	--	--	n/a	n/a		n/a		n/a
Average		23,304	18,215	232.6	78.3	14.9	86.2	230.8	0.6	5.3								
SV2014	2018	23,480	18,155	237.0	76.6	15.3	85.4	233	1.4	10.3	69.6	6.0	95	n/a		n/a		n/a
	2017	20,134	15,875	234.2	68.1	14.9	86.8	242	0.9	0.2	78.3	6.6	102	n/a		n/a		2.5
	2016	18,900	14,324	222.5	64.3	14.7	84.5	232	0.1	12.1	--	5.7	117	38.7	101	4.8	111	2.3
Average		20,838	16,118	231.2	69.7	15.0	85.5	235.6	0.8	7.5								
BTS 5499	2018	25,387	19,901	244.1	81.7	15.6	86.2	236	14.9	2.4	75.3	6.2	98	n/a		n/a		n/a
	2017	23,110	18,266	238.5	76.7	15.1	86.8	244	8.0	0.2	93.8	6.3	97	n/a		n/a		2.2
	2016	18,857	13,133	199.7	65.6	14.3	80.3	224	4.4	15.6	--	3.9	80	31.9	83	3.5	81	2.1
Average		22,451	17,100	227.4	74.7	15.0	84.4	234.5	9.1	6.1								

[†] varieties ranked by Extractable Sugar per Ton

Mean of Full Approved	22,848	17,889	238.2	75.0	15.2	86.1
97% of Full Approved	22,163	17,353	231.0	72.7	14.8	83.5

2018 Approved Mean	6.3	--	--	--
2017 Approved Mean	6.5	--	--	2.0
2016 Approved Mean	4.9	38.4	4.3	2.1

Variety		Gross Sugar/ Acre	Extractable Sugar/ Acre	Extractable Sugar/ Ton	Tons/ Acre	% Sugar	Purity	Stand	% Bolt*			Curly Top* % of Mkt.	Erwinia* % of Mkt.	Powdery Mildew % of Mkt. Avg.	% Rhiz. Resist.
												--- M = 150 ---	--M = 300	-- M = 100	
Pr>F	2018	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001		--	--	--
	2017	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.4	0.02	<0.0001	0.4	<0.0001	<0.0001	--	--	<0.0001
	2016	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.04	<0.0001	<0.0001	--	<0.0001		<0.0001	<0.0001
LSD	2018	1702.8	1439.5	9.9	4.9	0.4	1.0	7.4	1.3	4.2	7.0		--	--	
	2017	1280.1	1176.9	10.8	3.5	0.5	N/S	3.7	1.3	N/S	5.5		--	--	0.3
	2016	1515.1	1329.1	13.6	5.2	0.6	1.6	7.0	0.7	9.4	--	0.5			0.2
C.V.	2018	6.7	7.3	4.1	6.1	2.8	1.1	3.2	76.0	47.8	10.5		--	--	
	2017	5.9	6.9	4.6	4.8	3.2	1.3	1.6	118.5	191.6	6.80		--	--	
	2016	8.2	9.4	6.1	8.3	4.3	1.9	3.2	122.0	61.0	--	7.0		30.4	--

Cooperator

Planted

Harvested

Plot Size

Gary and Ryan Mamer 10/6/2017 7/16-17/2018 2 rows -- 30 in. 5 x 5 lattice

Paul Cameron 10/5/2016 6/15-16/2017 2 rows -- 30 in. 5 x 5 lattice

Jim Mamer/Vince Wavra 10/12/2016 6/27-28/2017 2 rows -- 30 in. 5 x 5 lattice

Peter Osterkamp 10/14/2015 7/25-26/2016 Trial Design was a RCBD with 8 replications. Plots were 2 row. Row Spacing was 30". Plots were 21' long.

*Data not yet available. * Disease nursery ratings: Lower numbers are more resistant, higher numbers are more susceptible.

Imperial Valley Late Harvest Official Variety Trials
2 Year Data (2017-2018)

Variety	Year	Gross Sugar/ Acre	Extractable Sugar/ Acre	Extractable Sugar/ Ton ⁺	Tons/ Acre	% Sugar	Purity	Final Stand Beets/100'	% Bolt	% Rot	Percent Emergence	Curly Top Rating	% of Fully Approved	Erwinia* Rating	% of Fully Approved	Powdery Mildew Rating*	% of Fully Approved	Rhizomania Root Rating*
Pr>F	2018	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001							
	2017	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.4	0.015	<0.0001	0.4	<0.0001	<0.0001						<0.0001
LSD	2018	1702.8	1439.5	9.9	4.9	0.4	1.0	7.4	1.3	4.2	7.0							
	2017	1280.1	1176.9	10.8	3.5	0.5	N/S	3.7	1.3	N/S	5.5	0.6						0.3
C.V.	2018	6.7	7.3	4.1	6.1	2.8	1.1	3.2	76.0	47.8	10.5							
	2017	5.9	6.9	4.6	4.8	3.2	1.3	1.6	118.5	191.6	6.8	6.0						--

Cooperator	Planted	Harvested	Plot Size
Gary and Ryan Mamer	10/6/2017	7/16-17/2018	2 rows -- 30 in. 5 x 5 lattice
Paul Cameron	10/5/2016	6/15-16/2017	2 rows -- 30 in. 5 x 5 lattice
Jim Mamer/Vince Wavra	10/12/2016	6/27-28/2017	2 rows -- 30 in. 5 x 5 lattice

* Disease nursery ratings: Lower numbers are more resistant, higher numbers are more susceptible.

*Data not yet available.

**Imperial Valley Late Harvest Official Variety Trials
1 Year Data Summary (2018)**

Variety	Gross Sugar/ Acre	Extractable Sugar/ Acre	Extractable Sugar/ Ton*	Tons/ Acre	% Sugar	Purity	Final Stand Beets/1 00'	% Bolt	% Rot	Percent Emergence	Curly Top Rating	% of Fully Approved	Erwinia Rating*	% of Fully Approved	Powdery Mildew Rating*	% of Fully Approved	Rhizomania Root Rating*
											--- M = 150 ---		--- M = 300 ---		-- M = 100		
BTS 5817	26,753	21,644	268.9	80.0	16.6	87.8	222	0.0	4.8	45.8	--	--	n/a		n/a		n/a
MA722	25,568	20,644	268.1	75.7	16.7	87.5	221	3.6	8.8	44.3	--	--	n/a		n/a		n/a
BTS 5460	28,995	23,310	261.8	88.3	16.3	87.5	231	1.2	1.2	63.6	6.2	97.8	n/a		n/a		n/a
BTS 582N	25,000	19,925	261.3	75.1	16.4	87.1	239	0.0	14.3	75.0	--	--	n/a		n/a		n/a
BTS 5780	26,329	20,778	256.8	81.2	16.3	86.4	239	0.0	5.9	70.6	7.0	110.5	n/a		n/a		n/a
BTS 5678	27,396	21,807	256.4	85.0	16.1	86.9	237	0.0	5.6	65.0	6.6	104.1	n/a		n/a		n/a
BTS 5775	26,362	20,793	252.3	82.9	16.0	86.5	231	0.4	6.2	70.1	6.8	107.3	n/a		n/a		n/a
BTS 5833	27,322	21,387	250.2	85.9	16.0	86.0	235	0.0	6.9	69.0	--	--	n/a		n/a		n/a
BTS 5865	25,877	20,271	250.0	81.2	15.9	86.1	237	0.0	4.6	68.3	--	--	n/a		n/a		n/a
BTS 5600	27,332	21,571	248.9	87.7	15.7	86.6	232	0.0	15.0	69.4	6.4	101.0	n/a		n/a		n/a
SV 2983	25,048	19,700	248.3	80.9	15.6	86.9	235	0.0	13.1	81.9	6.0	94.7	n/a		n/a		n/a
MA721	24,974	19,429	245.5	80.1	15.8	85.8	233	2.2	3.7	62.6	--	--	n/a		n/a		n/a
BTS 5499	25,387	19,901	244.1	81.7	15.6	86.2	236	14.9	2.4	75.3	6.2	97.8	n/a		n/a		n/a
BTS 566N	24,297	19,013	244.0	77.8	15.6	86.0	229	0.3	3.3	65.9	6.3	99.4	n/a		n/a		n/a
BTS 5809	23,377	17,991	243.2	74.3	15.8	85.2	237	0.1	7.8	78.8	--	--	n/a		n/a		n/a
SV 971	27,156	21,274	242.8	87.7	15.5	86.2	218	3.5	13.3	51.9	6.6	104.1	n/a		n/a		n/a
SV 978	25,024	19,629	238.9	82.4	15.2	86.4	227	1.4	10.1	54.5	6.3	99.4	n/a		n/a		n/a
SV 143	27,711	21,517	237.8	90.9	15.3	85.7	239	4.0	12.0	83.2	6.4	101.0	n/a		n/a		n/a
SV 2982	25,445	19,896	237.7	83.6	15.3	85.9	242	3.7	14.7	85.8	--	--	n/a		n/a		n/a
SV 2984	24,638	19,183	237.3	81.4	15.3	85.9	231	1.3	12.1	52.7	--	--	n/a		n/a		n/a
SV 2014RR	23,480	18,155	237.0	76.6	15.3	85.4	233	1.4	10.3	69.6	6.0	94.7	n/a		n/a		n/a
SV 604TT	25,235	19,614	235.9	83.1	15.2	85.8	228	1.5	7.9	60.1	6.6	104.1	n/a		n/a		n/a
SV 2981	23,938	18,313	228.6	80.1	15.0	85.0	241	0.0	15.5	80.1	6.4	101.0	n/a		n/a		n/a

* varieties ranked by Extractable Sugar per Ton

Mean of Fully Approved	26,229	20,611	245.7	83.9	15.6	86.3						6.3					
97% of Full Approved	25,442	19,993	238.3	81.4	15.2	83.7											
Pr>F	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001					
LSD	1702.8	1439.5	9.9	4.9	0.4	1.0	7.4	1.3	4.2	7.0	0.4						
C.V.	6.7	7.3	4.1	6.1	2.8	1.1	3.2	76.0	47.8	10.5	4.0						

<u>Cooperator</u>	<u>Planted</u>	<u>Harvested</u>	<u>Plot Size</u>
Gary and Ryan Mamer	10/6/2017	7/16-17/2018	2 rows -- 30 in. 5 x 5 lattice

* Disease nursery ratings: Lower numbers are more resistant, higher numbers are more susceptible.

*Data not yet available.

2017-2018 Imperial Valley Late Harvest Official Variety Trial Results - Location 1

Cooperators: Gary and Ryan Mamer

Entry	Entry Code	Entry Name	Gross Sugar per Acre	Extractable Sugar per Acre	Extractable Sugar per Ton	Percent Sugar	Extractable Sugar Percent	Tons per Acre	Percent Purity	Nitrate	Percent Tare	Percent Emergence*	Final Stand** Beets/100' row	Percent Bolters***	Percent Rot****
1	2017/18 IVLH	Filler 2	27,832.9	21,579.7	245.1	15.8	12.3	88.1	85.5	104.0	0.5	66.7	237	3.1	15.9
2	2017/18 IVLH	SV 978	25,024.1	19,629.3	238.9	15.2	11.9	82.4	86.4	111.7	0.8	54.5	227	1.4	10.1
3	2017/18 IVLH	SV 2983	25,048.0	19,699.6	248.3	15.6	12.4	80.9	86.9	118.2	0.9	81.9	235	0.0	13.1
4	2017/18 IVLH	SV 971	27,155.6	21,273.6	242.8	15.5	12.1	87.7	86.2	103.4	0.6	51.9	218	3.5	13.3
5	2017/18 IVLH	SV 2981	23,937.9	18,312.9	228.6	15.0	11.4	80.1	85.0	94.4	0.9	80.1	241	0.0	15.5
6	2017/18 IVLH	SV 2982	25,445.5	19,895.5	237.7	15.3	11.9	83.6	85.9	77.9	0.8	85.8	242	3.7	14.7
7	2017/18 IVLH	BTS 5678	27,396.4	21,807.2	256.4	16.1	12.8	85.0	86.9	119.0	1.2	65.0	237	0.0	5.6
8	2017/18 IVLH	BTS 5865	25,877.1	20,271.2	250.0	15.9	12.5	81.2	86.1	144.7	0.7	68.3	237	0.0	4.6
9	2017/18 IVLH	BTS 5600	27,331.8	21,570.9	248.9	15.7	12.5	87.7	86.6	165.5	0.9	69.4	232	0.0	15.0
10	2017/18 IVLH	MA721	24,973.9	19,428.8	245.5	15.8	12.3	80.1	85.8	68.0	1.1	62.6	233	2.2	3.7
11	2017/18 IVLH	BTS 5817	26,753.2	21,644.5	268.9	16.6	13.4	80.0	87.8	95.7	1.0	45.8	222	0.0	4.8
12	2017/18 IVLH	BTS 5460	28,995.3	23,310.0	261.8	16.3	13.1	88.3	87.5	105.7	0.7	63.6	231	1.2	1.2
13	2017/18 IVLH	SV 2014RR	23,480.2	18,154.7	237.0	15.3	11.8	76.6	85.4	94.4	1.0	69.6	233	1.4	10.3
14	2017/18 IVLH	BTS 5775	26,362.4	20,793.0	252.3	16.0	12.6	82.9	86.5	154.6	1.0	70.1	231	0.4	6.2
15	2017/18 IVLH	MA722	25,567.6	20,644.0	268.1	16.7	13.4	75.7	87.5	103.2	0.7	44.3	221	3.6	8.8
16	2017/18 IVLH	BTS 566N	24,296.6	19,013.1	244.0	15.6	12.2	77.8	86.0	96.0	0.9	65.9	229	0.3	3.3
17	2017/18 IVLH	SV 2984	24,638.1	19,183.4	237.3	15.3	11.9	81.4	85.9	105.9	0.8	52.7	231	1.3	12.1
18	2017/18 IVLH	BTS 5499	25,387.4	19,900.8	244.1	15.6	12.2	81.7	86.2	88.8	0.8	75.3	236	14.9	2.4
19	2017/18 IVLH	Filler 1	23,841.3	18,538.6	242.9	15.6	12.2	76.8	85.8	89.2	0.9	87.5	239	0.0	10.3
20	2017/18 IVLH	BTS 5809	23,376.9	17,990.7	243.2	15.8	12.1	74.3	85.2	148.5	0.7	78.8	237	0.1	7.8
21	2017/18 IVLH	SV 143	27,710.6	21,516.9	237.8	15.3	11.9	90.9	85.7	84.5	0.7	83.2	239	4.0	12.0
22	2017/18 IVLH	SV 604	25,235.4	19,613.5	235.9	15.2	11.8	83.1	85.8	97.7	0.6	60.1	228	1.5	7.9
23	2017/18 IVLH	BTS 5780	26,328.9	20,777.7	256.8	16.3	12.9	81.2	86.4	115.6	0.7	70.6	239	0.0	5.9
24	2017/18 IVLH	BTS 5833	27,322.3	21,386.7	250.2	16.0	12.5	85.9	86.0	157.8	0.6	69.0	235	0.0	6.9
25	2017/18 IVLH	BTS 582N	25,000.3	19,925.4	261.3	16.4	13.1	75.1	87.1	101.0	1.2	75.0	239	0.0	14.3
		Mean	25,772.8	20,234.5	247.3	15.7	12.4	81.9	86.2	109.8	0.8	67.9	233.1	1.7	9.0
		CV (%)	6.7	7.3	4.1	2.8	4.1	6.1	1.1	29.9	42.7	10.5	3.2	76.0	47.8
		LSD (0.05)	1,702.8	1,439.5	9.9	0.4	0.5	4.9	1.0	32.2	0.3	7.0	7.4	1.3	4.2
		Pr>F	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.02	<0.0001	<0.0001	<0.0001	<0.0001
		Error MS	3,019,125.0	2,157,656.0	101.9	0.2	0.3	24.7	0.9	1,080.1	0.1	50.5	56.5	1.6	18.6
		Reps	8	8	8	8	8	8	8	8	8	8	8	8	8

* Emergence counts taken prior to thinning and converted to a percent.

** Final stand counts taken after thinning and converted to beets per 100' of row.

*** Percent bolters calculated by counting the bolters per plot and dividing by total number of beets per plot multiplied by 100.

**** Percent rot calculated by counting beets with rot symptoms in the plot after defoliation and dividing by total number of beets per plot multiplied by 100.

Plant Date: October 6, 2017

Harvest Date: July 16-17, 2018

Plot Size: 2 row. 30" rows.

Experimental Design: 5X5 lattice