A Decade of Applied Processing Crop Research At the University of Delaware

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Effects of Nitrogen Rates and Sources on Yield and Quality of Pickling Cucumbers; Magnesium and Sulfur in Pickling Cucumbers; Gynoecious and Parthenocarpic Pickle Variety Trials; Pickle Downy Mildew Studies; Parthenocarpic Pickle Yield Stability Studies

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Light skin color was a problem

Pickle Length, Length:Diameter Issues

- Environment
  - Cooler = longer
  - Hotter = shorter
- Cell elongation
  - Hormones
- Rapid growth
  - Too much N?

Fertility and Pickle Quality - N

N rate (lbs/a)	CM Expedition	CM Vlaspik
80	36 b	33 c
120	31 b	36 b
160	40 a	40 a

N rate (lbs/a)	Visual rating (1-5, 5 full green)
80	4.1 b
120	4.1 b
160	4.6 a

Effects of Nitrogen Rates and Sources on Pickle Color, Trial1, 2012							
VAR	SIZE	NITROGEN TREATMENTS (lbs/a N)					
		80	120	160	200	80+40 AS	80+80 AS
		Chlorophyll Meter Values					
EXP	3A	27.9 c	31.0 b	31.0 b	33.8 ab	38.1 a	34.3 ab
	3B	31.6	33.2	32.1	30.8	34.3	29.9
	Total	29.8 b	32.1 ab	31.6 ab	32.3 ab	36.2 a	32.1 ab
VLAS	3A	31.5	30.6	27.5	29.9	26.6	28.7
	3B	24.7	27.1	22.8	26.9	26.9	28.7
	Total	28.3	28.8	25.3	28.4	26.7	28.7
Total		29.1	30.5	28.5	30.4	31.4	30.4

Variety	Nitrogen Treatment (Trial 1)					
	80	**120**	**160**	**200**	**80+40**	**80+80**
	L:D					
Expedition	2.94	2.96	3.12	2.93	3.16	2.97
Vlaspik	3.25 ab	2.99 b	2.89 b	3.01 b	3.60 a	3.00 b
Total	3.11	2.98	3.01	2.97	3.38	2.99

Sulfur and Magnesium Experiments

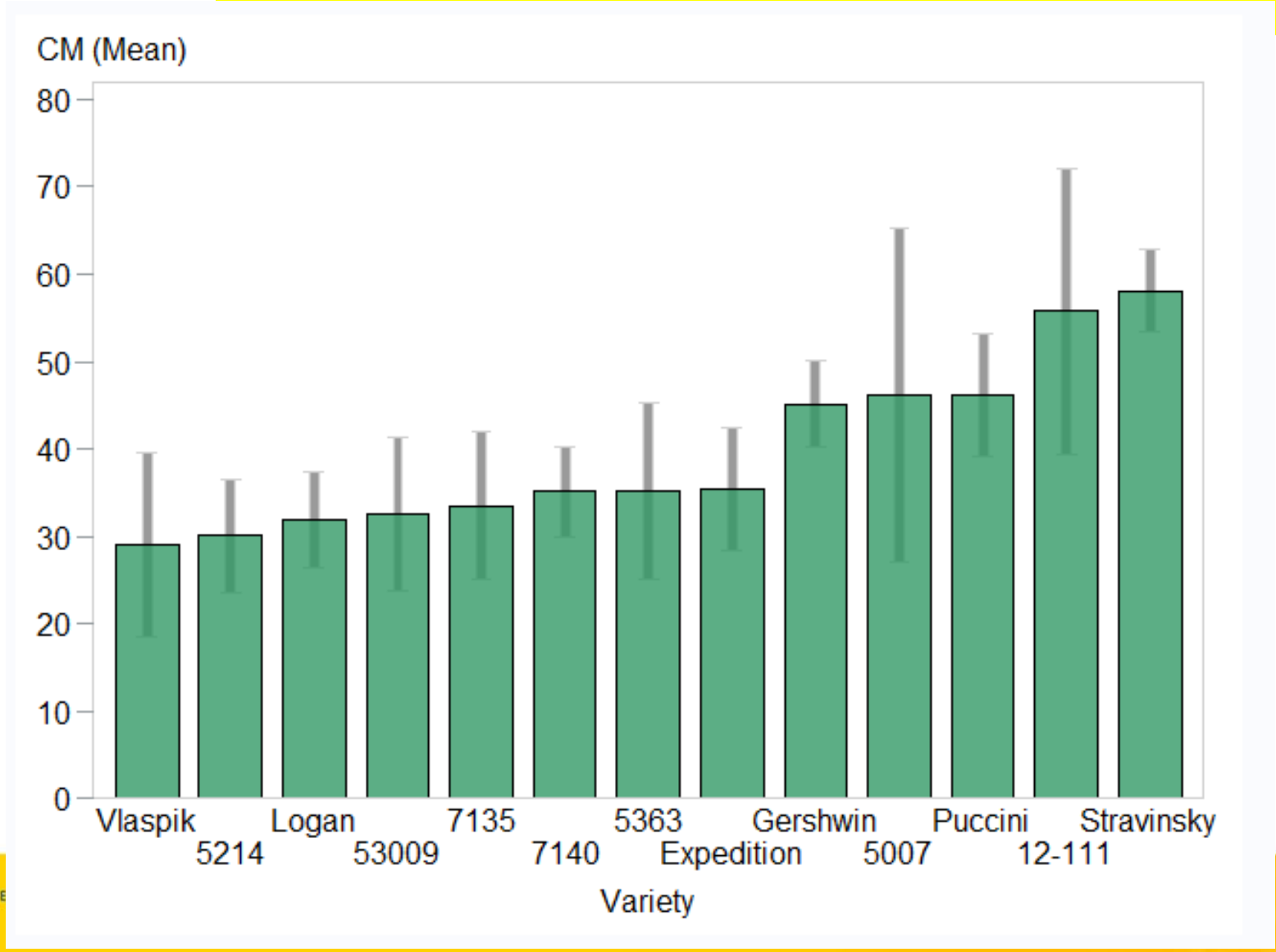
- 10 Treatments
  - Control – no added S or Mg
  - S provided by gypsum 500 lbs/A preplant
  - S provided by ammonium sulfate 200 lbs/A preplant
  - Sidedressed S as ammonium sulfate 200 lbs/A
  - Foliar S, 2 lbs S per acre equivalent
  - Mg provided by 1000 lbs/A dolomitic limestone preplant
  - Mg and S provided by K-mag 500 lbs/A preplant
  - Mg provided by MgSO4 sidedress
  - Mg provided by MgSO4 foliar
  - Mg and S provided by K-mag foliar

- 2 Varieties
  - Expedition
  - Vlaspik
- RCBD, 4 reps, 10 m x 2 row .76 m plots, harvest fruits from single row

Conclusions

- Increasing N provided more green areas on pickle fruits, more chlorophyll in most trials.
- High N rate to achieve color not desired, did not increase yields
- Length was not affected by N rate but was by N source
- Ammonium sulfate treatments had significantly longer pickle fruits
- There was an indication that ammonium sulfate produced more highly colored pickles.
- The nitrogen:sulfur balance appears to be important for pickle color and may be an issue on our light textured (sandy) soils.
- The nitrogen:sulfur ratio in the fruit may be a critical factor in producing well colored pickle fruits on coastal plain soils in the eastern US.

Variety Effects on Color



Pickle Industry Standard - Expedition

Variety Trials

Current Delmarva Gynoecious Varieties

Cucumber Recommendations

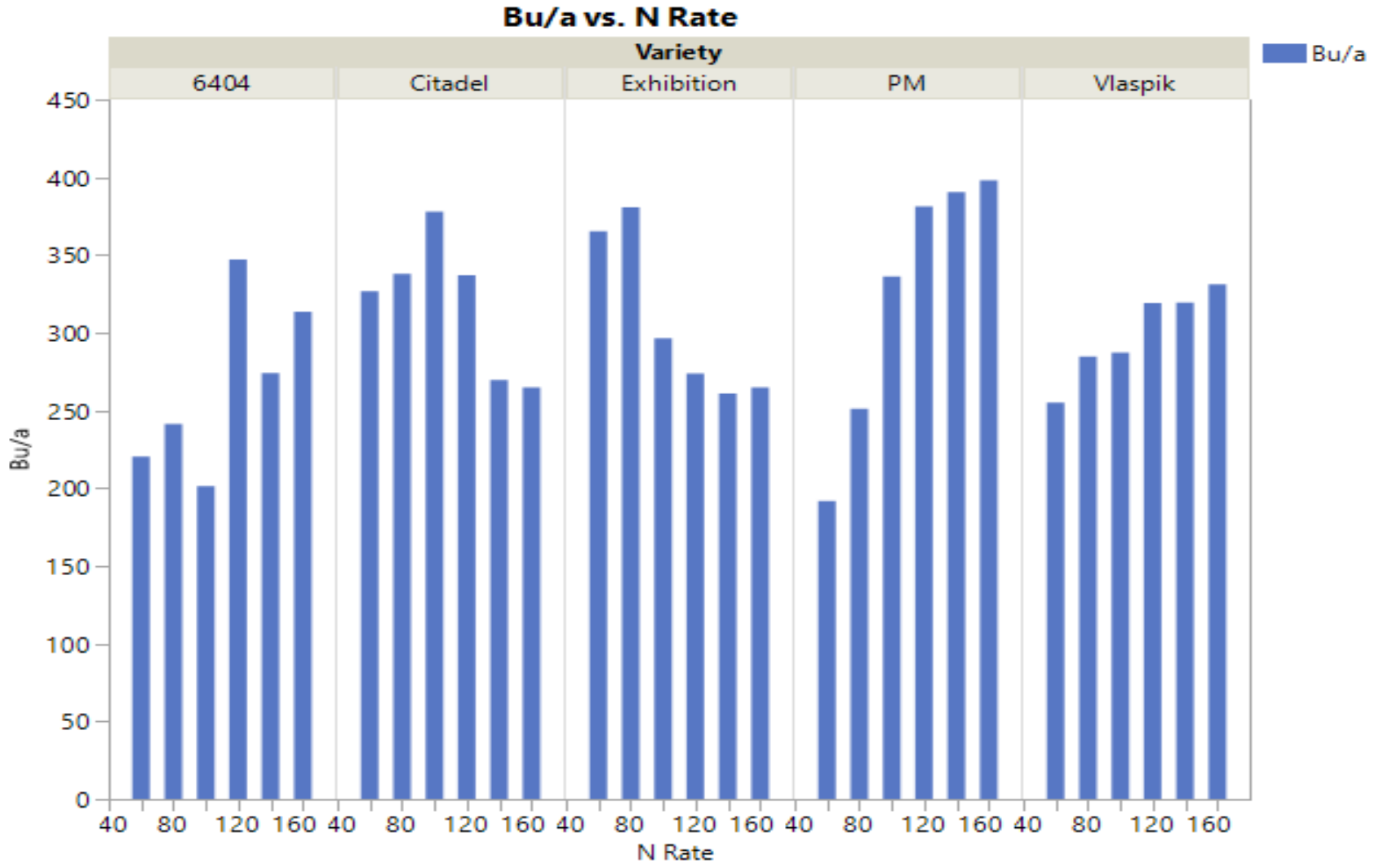
Cucumbers	Pounds N per Acre	Soil Phosphorus Level				Soil Potassium Level				Nutrient Timing and Method
		Low	Med	High (Opt.)	Very High	Low	Med	High (Opt.)	Very High	
		Pounds P_2O_5 per Acre				Pounds K_2O per Acre				
	80-150	150	100	50	0[1]	200	150	100	0[1]	Total nutrient recommended.
	25-50	125	75	25	0[1]	175	125	75	0[1]	Broadcast and disk-in.
	25	25	25	25	0	25	25	25	0	Band place with planter.
	25-75	0	0	0	0	0	0	0	0	Sidedress when vines begin to run.

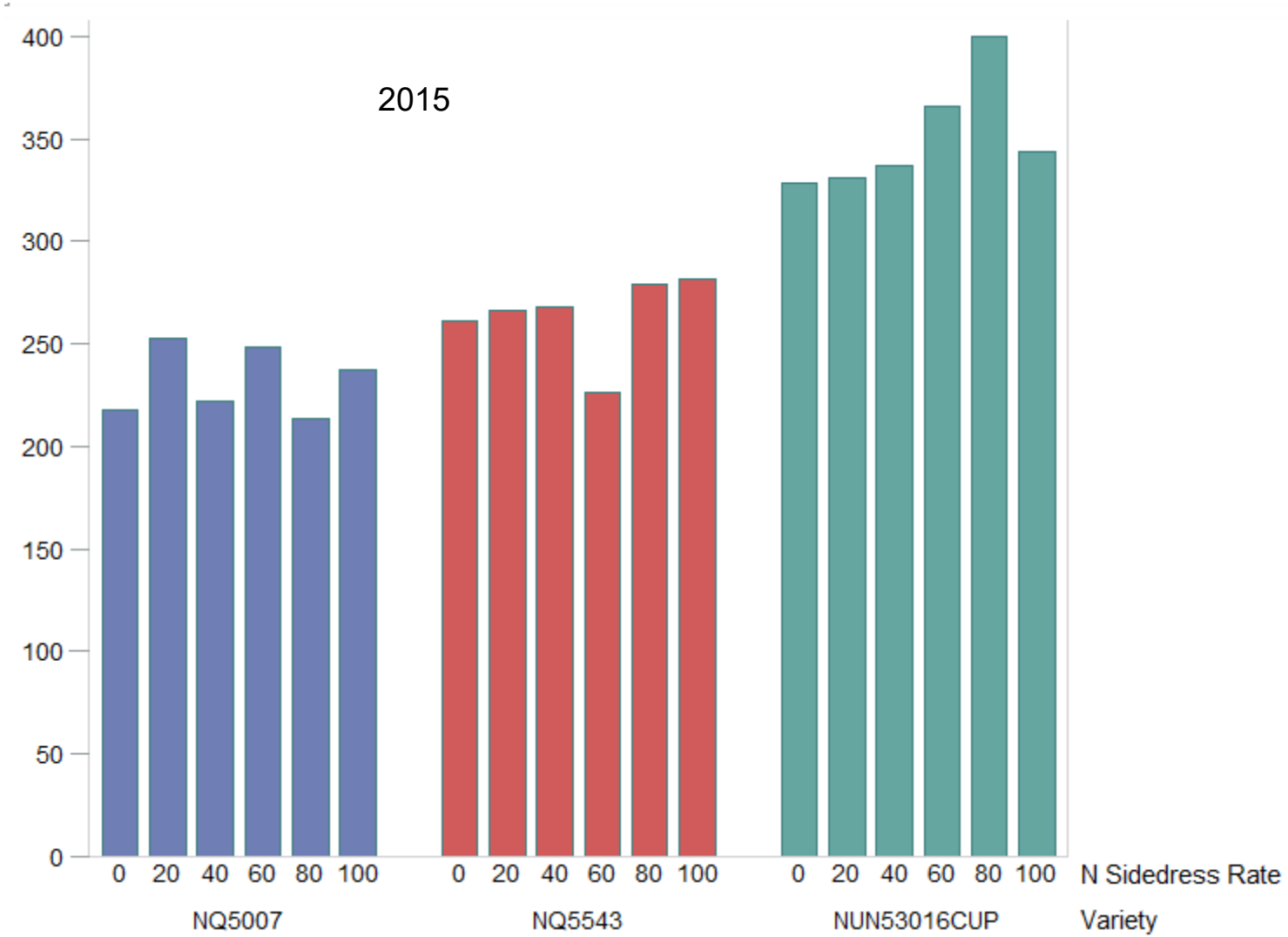
For plasticulture production, fertilization rates are based on a standard row spacing of 6-feet.

[1]In Virginia, crop replacement values of 25 lbs. P_2O_5 and 50 lbs. K_2O per acre are recommended on soils testing Very High.

Nitrogen Study

Overall yield of five gynoecious cucumbers by N rate.
Georgetown, DE 2018




2015
400
350
300
250
200
150
100
50
0
0 20 40 60 80 100
0 20 40 60 80 100
0 20 40 60 80 100
N Sidedress Rate
NQ5007
NQ5543
NUN53016CUP
Variety

Downy Mildew Resistant Pickle Varieties and Fungicide Programs

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Downy Mildew Tolerant Varieties 2018

Table 4. Yield by fungicide treatment in downy mildew resistant variety and fungicide timing studies, Trial 3, September 7, 2018 harvest date, Georgetown, Delaware, under heavy downy mildew pressure.

Fungicide Treatment	**Yield (bu/a)**	*
Orondis Opti 1.75 oz/a + BWS 1 pint per acre at 2-4 leaf August 17 followed by Ranman 2.75 oz/a + BWS 2 pint per acre August 28	288	a
Orondis Opti 1.75 oz/a + BWS 1 pint per acre at flop August 28	275	a
Orondis Opti 1.75 oz/a + BWS 1 pint per acre at 2-4 leaf August 17	274	a
Ranman 2.75 oz/a + BWS 2 pint per acre 2-4 leaf August 17	259	a
Bravo Weather Stik (BWS) 2 pt./a 1x at 2-4 leaf August 17	213	b
Control	164	c
**Means followed by the same letter are not significantly different at the 0.05 level*	p <0.0001	

Downy Mildew Tolerant Varieties 2018

Table 3. Yield by variety in downy mildew resistant variety and fungicide timing studies, Trial 3, September 7, 2018 harvest date, Georgetown, Delaware, under heavy downy mildew pressure.

Variety[y]	**Yield[x] (bu/a)**	
6404 + SV2789CL	288	a
Citadel + SV2789CL	259	ab
Peacemaker + SV2789CL	248	bc
Expedition + Sire	219	c
Vlaspik + Sire	215	c
[x]*Means followed by the same letter are not significantly different at the 0.05 level*	p <0.0012	
[y]gynoecious variety + pollenizer		

Downy Mildew Tolerant Varieties 2018

Table 2. Yield by variety in downy mildew resistant variety and fungicide timing studies, Trial 2, August 6, 2018 harvest date, Georgetown, Delaware, under moderate downy mildew pressure.

Variety[y]	**Yield[x] (bu/a)**	
Peacemaker + SV2789CL	344	a
Citadel + SV2789CL	325	a
6404 + SV2789CL	287	ab
Vlaspik + Sire	249	bc
Expedition + Sire	203	c
[x]*Means followed by the same letter are not significantly different at the 0.05 level*	p <0.0002	
[Y]gynoecious variety + pollenizer		

Parthenocarpic Pickles

- Several breeding programs
  - Quality much improved
- Gaining acreage worldwide
- Seedless
- Requires isolation
- Does not need bees
- Lower populations
  - 50-60% lower
- No pollenizers
- Higher potential yield
- Better size specific
  - Parth varieties sets its fruit in flushes
- Better color often
- Fewer culls, straighter

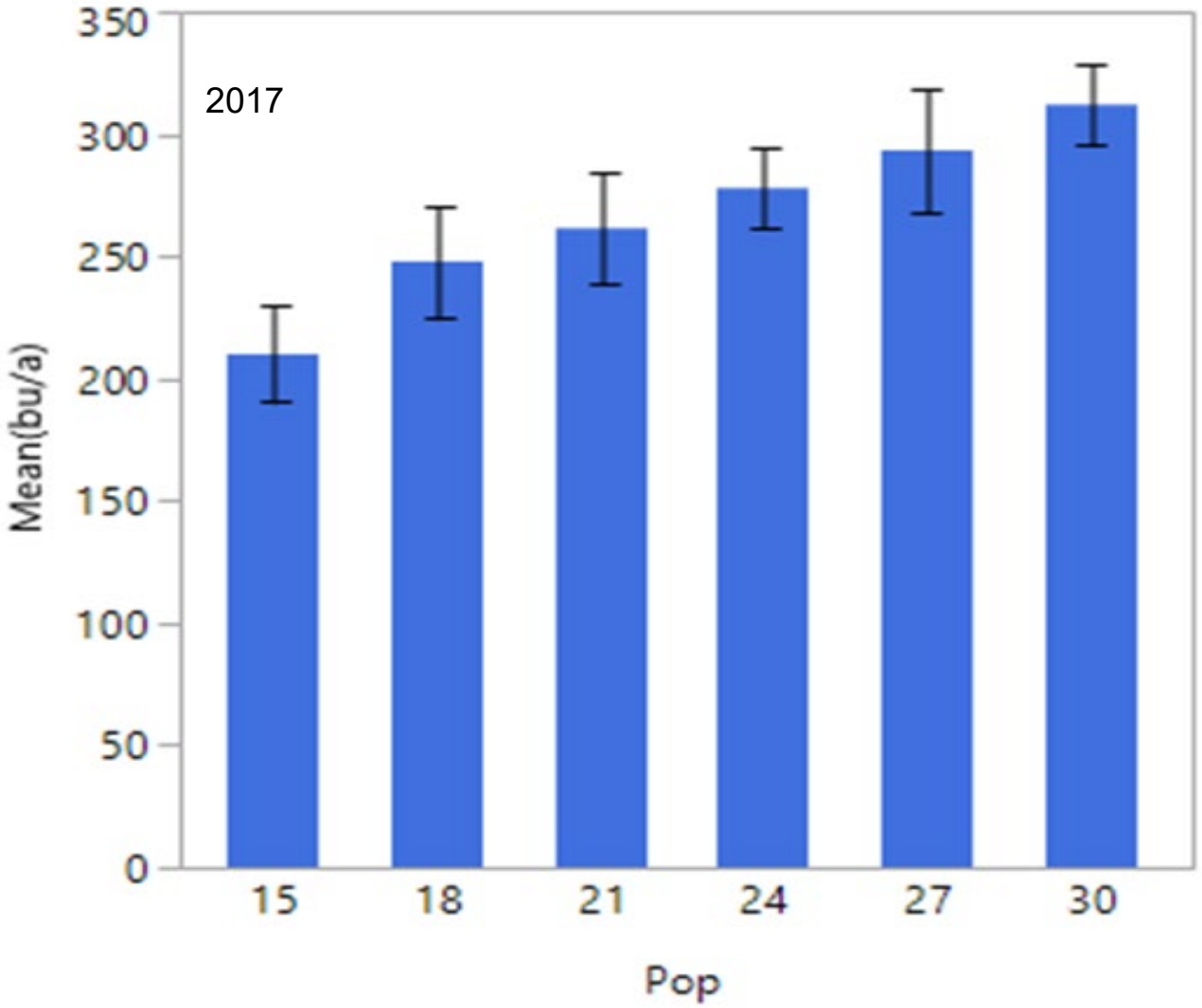
Variable Performance in Delaware So Far – However, the Potential is there

Promising Parthenocarpic Varieties


Bowie


Gershwin

Plant populations for Parthenocarpic Pickles



Parthenocarpic pickle small plot trials – May/June and July planted

Variety	3B%	3A%	2B%	2A%	C&N%	No/a 1-4	L:D	Bu/a 2-3
12-115	33.8	33.8	9.9	4.1	1.8	67518	2.8	370
Amarok	3.9	16.7	32.8	25.4	6.8	66429	2.76	211
Ansor	4.8	16.9	23.3	33.2	1.4	50312	2.71	151
Aristan	18.7	35.0	21.9	9.5	4.8	75359	2.69	334
Bowie	11.0	10.6	22.5	28.8	9.9	60984	2.89	225
Gershwin	16.7	19.2	22.0	15.9	16.8	69260	2.75	311
Liszt	21.2	20.8	20.3	7.1	4.4	37244	3.12	155
Nun103	12.5	40.8	23.0	8.1	11.0	74923	2.85	392
Nun110	19.1	47.3	18.4	6.2	0.9	75504	2.76	421
Nun111	34.0	21.0	12.8	9.4	6.5	53361	3.03	292
Nun118	18.8	43.4	25.5	3.7	3.3	58370	2.98	337
Nun53016	23.5	48.8	19.2	1.7	1.0	63380	3.07	381
Nun53025	26.4	46.8	17.7	3.1	3.2	75141	3.27	469
Nun53028	26.3	23.7	15.6	5.5	15.7	54014	3.15	300
Rubenstein	9.7	19.8	28.6	17.6	4.0	62073	2.78	231
RZ72	10.1	16.6	28.7	24.5	4.9	77537	2.91	260
RZ76	6.9	11.6	27.2	23.5	7.7	64251	2.82	197
RZ78	15.2	19.1	19.4	12.4	1.1	35937	2.85	128
RZ79	11.9	35.9	26.2	6.4	16.2	60113	3.09	312
RZ80	7.8	9.8	27.4	23.7	15.9	53579	2.73	182

Nun53025	469	A
Nun110	421	AB
Nun103	392	ABC
Nun53016	381	ABC
12-115	370	ABC
Nun118	337	BCD
Aristan	334	BCDE
RZ79	312	BCDEF
Gershwin	311	BCDEF
Nun53028	300	CDEFG

Variety	3B%	3A%	2B%	2A%	C&N%	No/a 1-4	L:D	bu/a 2-3
12-115	12.1	24.7	28.4	14.6	7.2	67300	3.01	282
Amarok	3.6	18.8	18.0	18.3	2.0	73762	2.54	190
Ansor	9.7	14.5	43.8	15.6	1.0	44431	2.75	174
Aristan	3.2	19.1	20.6	20.3	4.3	71729	2.55	198
Bowie	4.6	9.5	6.6	17.4	23.5	60694	3.16	140
Gershwin	14.8	21.1	16.6	10.2	21.9	64469	2.86	280
Liszt	27.4	16.1	16.3	13.9	4.4	69914	2.52	324
Nun103	5.1	20.7	35.1	21.0	4.3	81893	2.79	321
Nun110	5.6	22.4	26.3	19.8	6.7	76230	2.89	268
Nun111	15.1	25.0	24.8	12.2	4.8	55975	2.61	248
Nun118	12.7	22.7	22.8	16.5	6.2	73181	2.9	274
Nun53016	5.3	20.3	38.7	15.3	8.4	69696	2.75	236
Nun53025	8.9	16.6	31.0	19.1	5.1	88209	2.83	288
Nun53028	5.4	21.9	32.0	12.3	11.4	63307	3	244
Rubinstein	4.9	13.3	20.8	13.4	11.8	84506	2.96	226
RZ72	12.0	16.6	28.9	17.8	3.9	69478	2.76	255
RZ76	8.2	17.1	18.6	15.2	8.3	79715	2.77	245
RZ78	9.5	9.7	23.7	21.6	8.4	66211	2.77	177
RZ79	22.6	30.2	21.4	11.3	4.4	77537	2.95	409
RZ80	7.8	23.6	25.7	13.7	6.5	67518	2.95	248

RZ79	409	A
Liszt	324	AB
Nun103	321	AB
Nun53025	288	ABC
12-115	282	ABC
Gershwin	279	ABC
Nun118	274	ABC
Nun110	267	ABC

Factors affecting yield stability in parthenocarpic cucumbers on Delmarva

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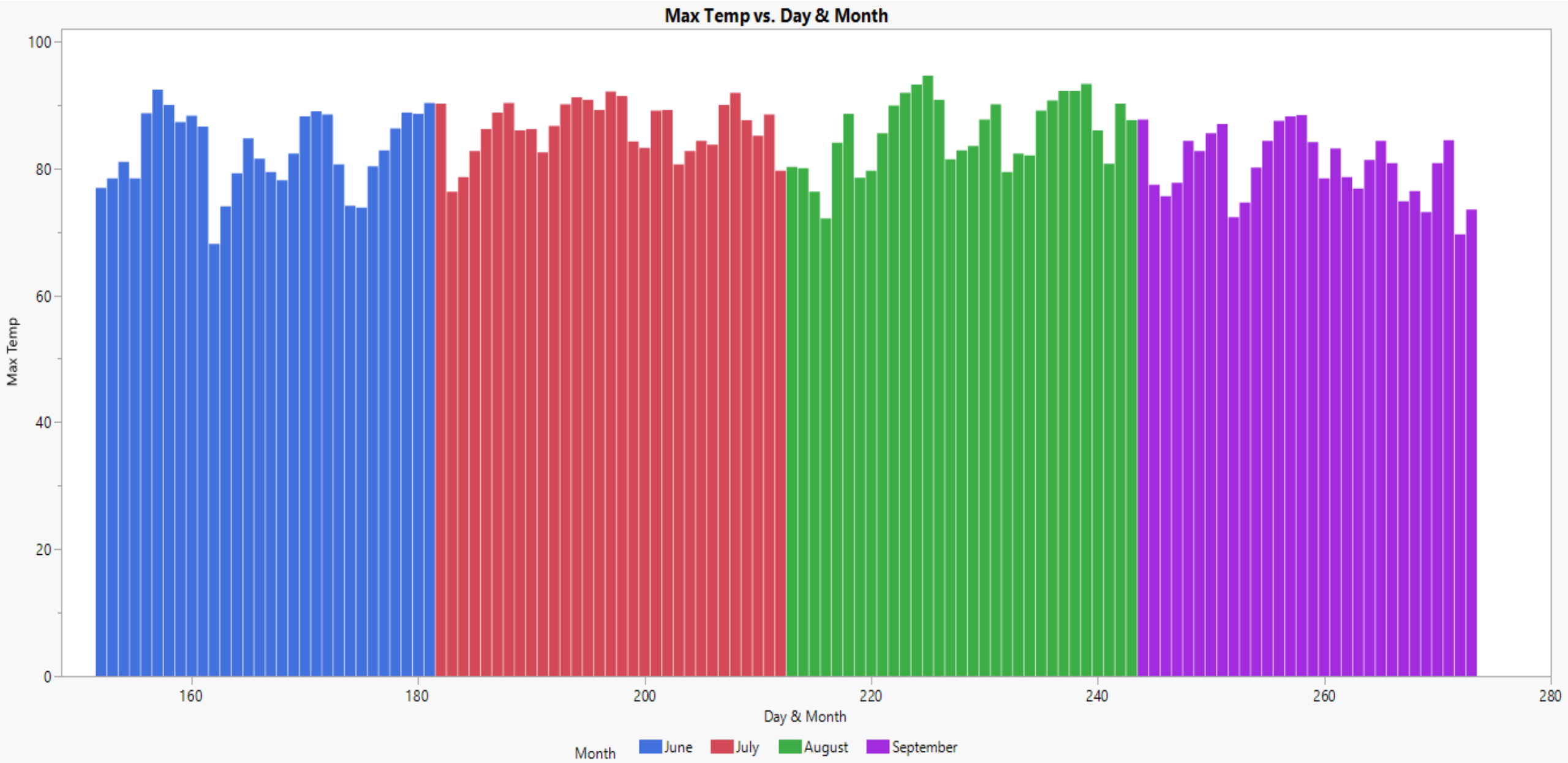
Issues

- Parthocarpic pickles have been trialed on Delmarva with mixed results.
- One issue is the variability of yield responses in parthenocarpic pickle cultivars.
- Cultivars with more stable yields over multiple environments are most desirable.
- There is a lack of information on those factors that affect parthenocarpic cucumber yield stability: temperature, water (rainfall and irrigation), fertility, and planting date (daylength and heat units) as examples.


Max Temp vs. Day & Month
100
80
60
40
20
0
Max Temp
160
180
200
220
240
260
280
Day & Month
Month
June
July
August
September

Parthenocarpic varieties for 3 seed companies were tested Two locations: Georgetown DE, Salisbury MD, 2019 – 2 N rates, 2 irrigation rates

- Nun 53025
- RZ4 = Bowie
- RZ7 = Liszt
- RZ 11 = RZ-76
- Amarok
- Aristan

Factors affecting yield stability in parthenocarpic cucumbers on Delmarva 2021

H=120 lbs N
L= 80 lbs N

Multiple hand harvests

Variety	N rate	May	June	July	August	Total	Mean	SD	bu/a
		#	#	#	#	#			total
Absolut	H	390	285	241	167	1083	271	93	524
Absolut	L	398	405	263	291	1357	339	73	557
Amarok	H	474	423	348	303	1548	387	76	662
Amarok	L	422	494	362	350	1628	407	66	628
Aristan	H	435	432	295	233	1395	349	101	646
Aristan	L	314	333	250	235	1132	283	48	446
Bowie	H	534	478	340	318	1670	418	105	713
Bowie	L	520	447	417	375	1759	440	61	656
Liszt	H	402	364	262	253	1281	320	74	589
Liszt	L	418	316	246	317	1297	324	71	551
RZ-76	H	464	482	292	416	1654	414	86	694
RZ-76	L	469	311	352	251	1383	346	92	556
V5016	H	405	268	238	211	1122	281	86	529
V5016	L	355	378	309	216	1258	315	72	579
V5025	H	516	466	375	372	1729	432	71	687
V5025	L	462	366	327	327	1482	371	64	618
V5031	H	379	346	318	352	1395	349	25	577
V5031	L	446	417	367	340	1570	393	48	630

The most stable varieties in this set of trials were Amarok, V5025, and V5031. Bowie had high yield potential but with less stability at higher N rate.

Acknowledgements

- Pickle Packers International
- Seed Companies – Seminis, Rijk Zwaan, Nunhems, Bejo
- Emily Zobel – University of Maryland
- Student and summer workers – Jennifer Jones, Joseph Jones, Khashad Gillespie, Jake Jones, Lori Ockels and many others
- UD and UMD farm staff

BAYER Vegetables
Products / Resources

BASF We create chemistry | nunhems

RIJK ZWAAN

bejo

Other Processing Crop Applied Research

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Lima Bean Culture

- No-till
- Inoculation
- Seed production
- Populations
- Fordhook production
- Specialty types
- Regrowth cropping

Lima Bean Disease

- Root Knot Nematode
  - Distribution/mapping
  - Chemical control
  - Biofumigation
  - Rotation
- Phytophthora capsica
  - Chemical control
  - Cultural control

Sweet Corn

- Nitrogen – Rates, precision
- No-till
- Cover crops
- Planting density

Heat Stress Mitigation

- Particle Film
- Growth regulators
- No-till
- Varieties
- Inoculation

Soil health

- Compost
- Cover Crops
- Biofumigants
- Rotations
- No-till, Strip till
- Inoculants
- Compaction mitigation

Variety Trials

- Greens
- Pickles
- Processing peppers
- Beets
- Broccoli, specialty brassicas
- Brussels sprouts

Fertility and Nutrition

- Nitrogen
- Sulfur
- Calcium
- Magnesium

Crop Management

- Irrigation rates
- No-Till - Lima, pea, corn, snap bean
- Populations
- Planting dates
- Overwintering
- Cutting management

Usage

- Specialty limas
  - Lima products
  - Consumer appeal
- Freezing
- Dry seed production

New Processing Crop Grant

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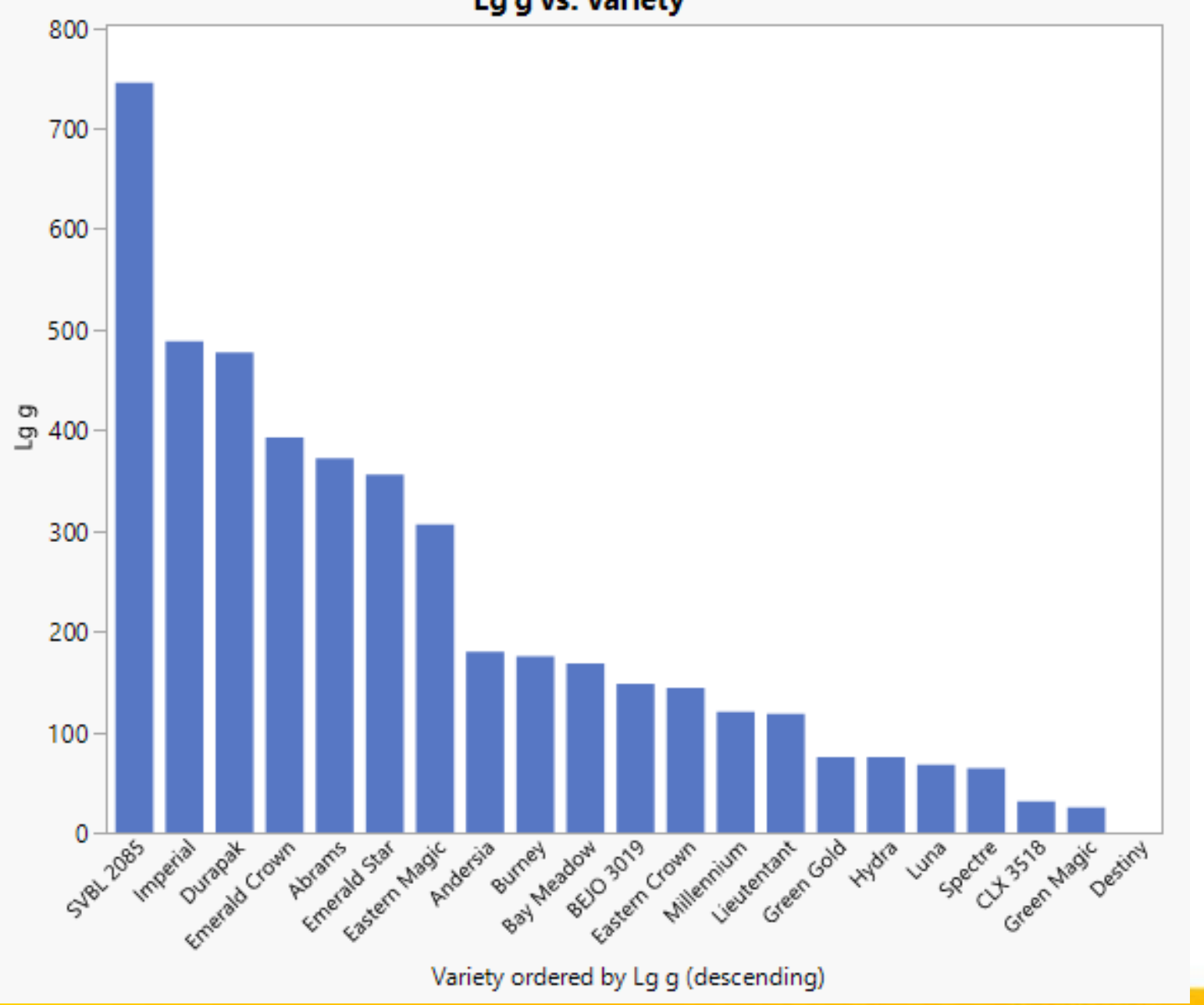
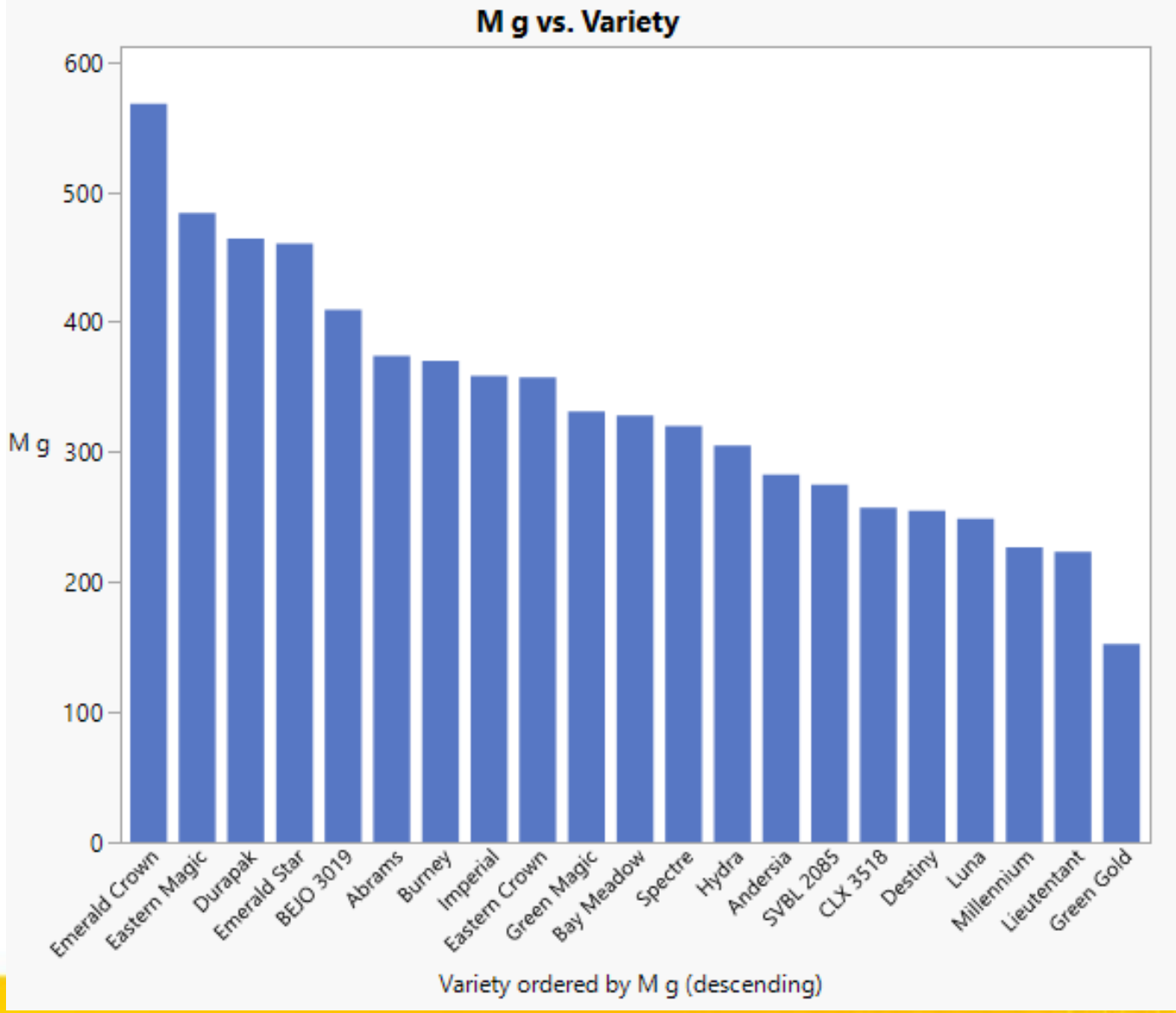
Processing Broccoli

- July 21-22 Direct Seeded
- 21 Varieties, 12 varieties
- Harvested October to November
- Cut floret evaluation
  - Recovery
  - Sizes
  - Core
  - Blonding
- Freezing


IMPERIAL


Lg g vs. Variety
Lg g
800
700
600
500
400
300
200
100
0
SVBL 2085
Imperial
Durapak
Emerald Crown
Abrams
Emerald Star
Eastern Magic
Andersia
Burney
Bay Meadow
BEJO 3019
Eastern Crown
Millennium
Lieutentant
Green Gold
Hydra
Luna
Spectre
CLX 3518
Green Magic
Destiny
Variety ordered by Lg g (descending)



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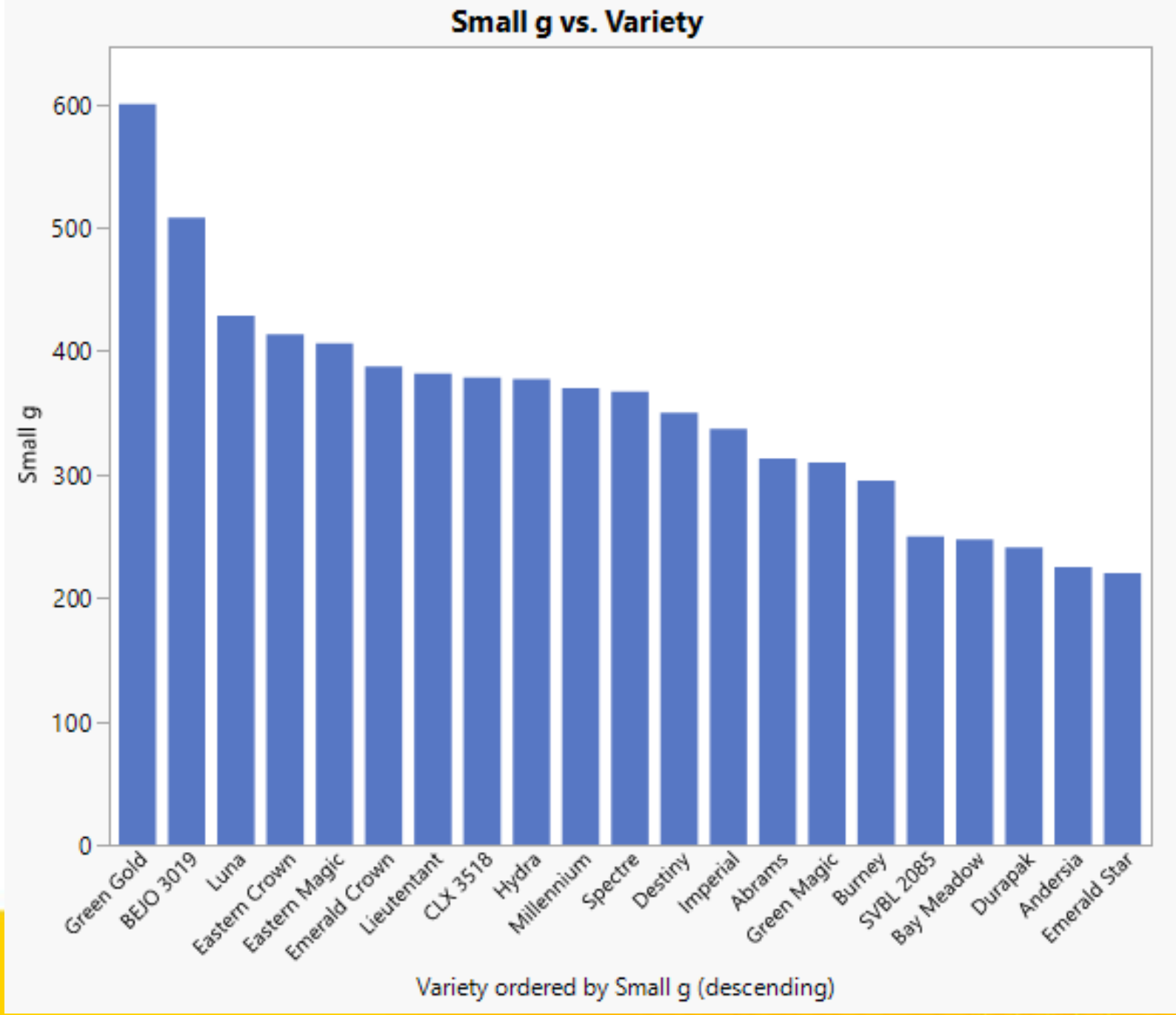

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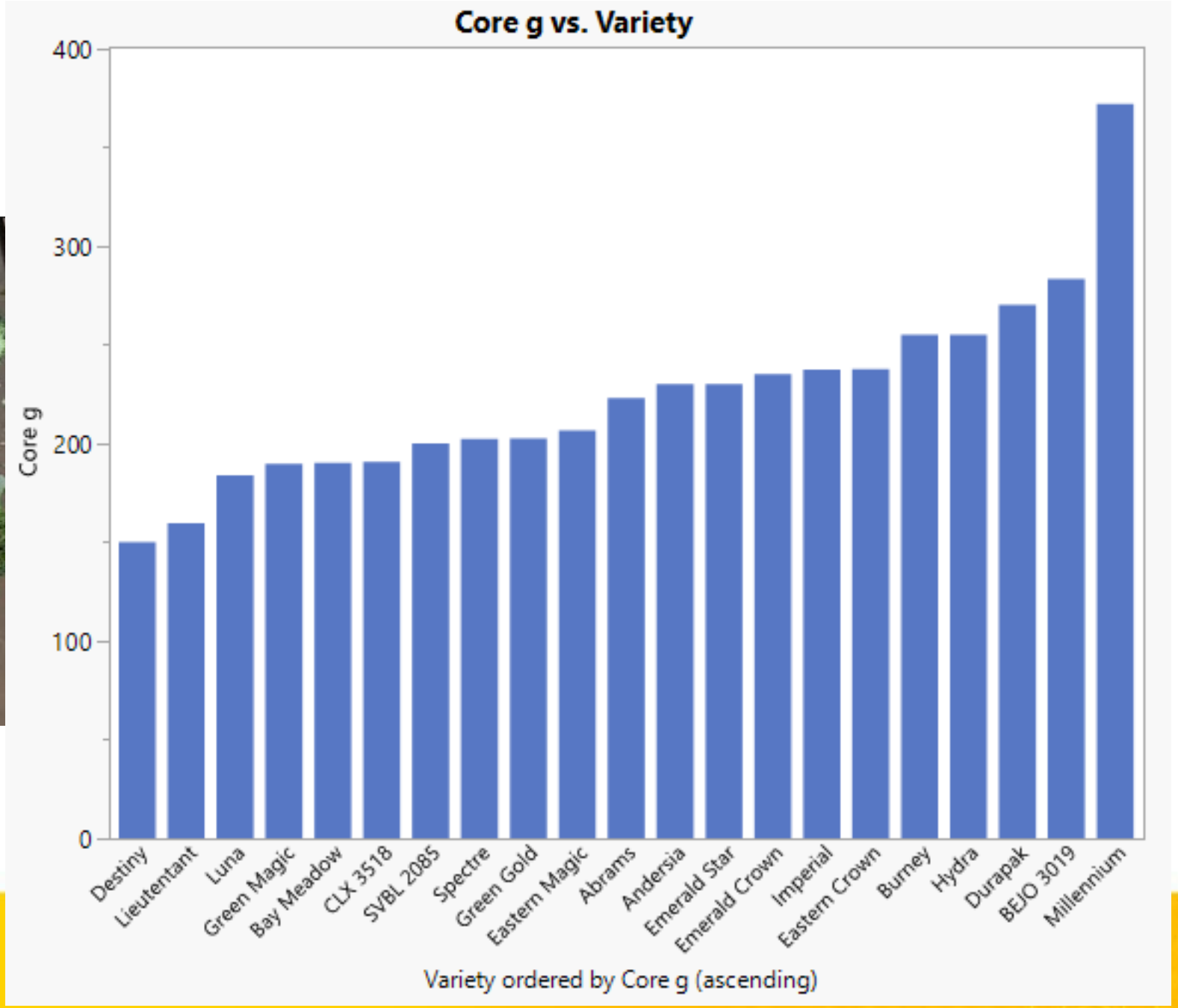
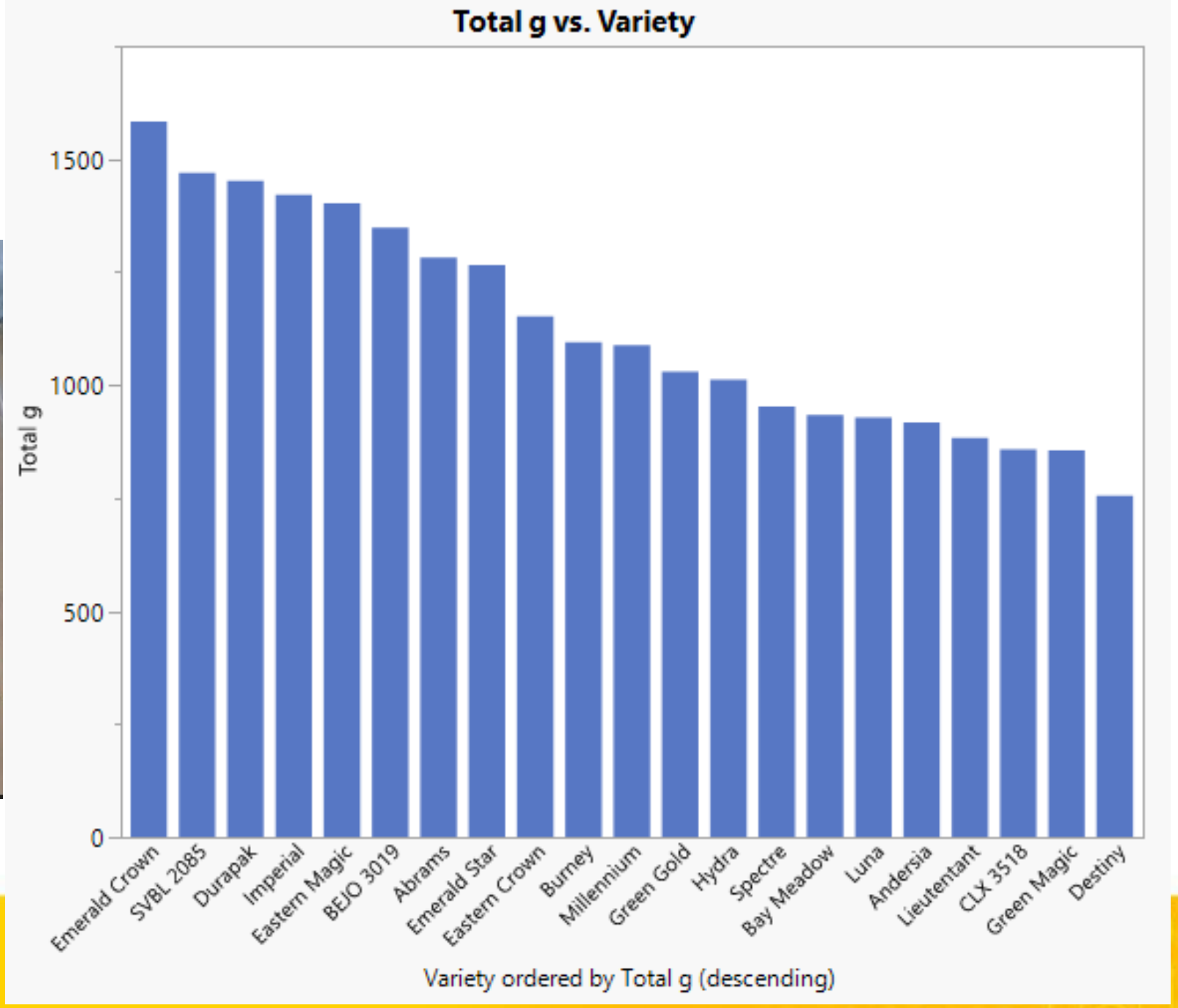
BAY
MEADOWS


Core g vs. Variety
Core g
400
300
200
100
0
Destiny
Lieutentant
Luna
Green Magic
Bay Meadow
CLX 3518
SVBL 2085
Spectre
Green Gold
Eastern Magic
Abrams
Andersia
Emerald Star
Emerald Crown
Imperial
Eastern Crown
Burney
Hydra
Durapak
BEJO 3019
Millennium
Variety ordered by Core g (ascending)



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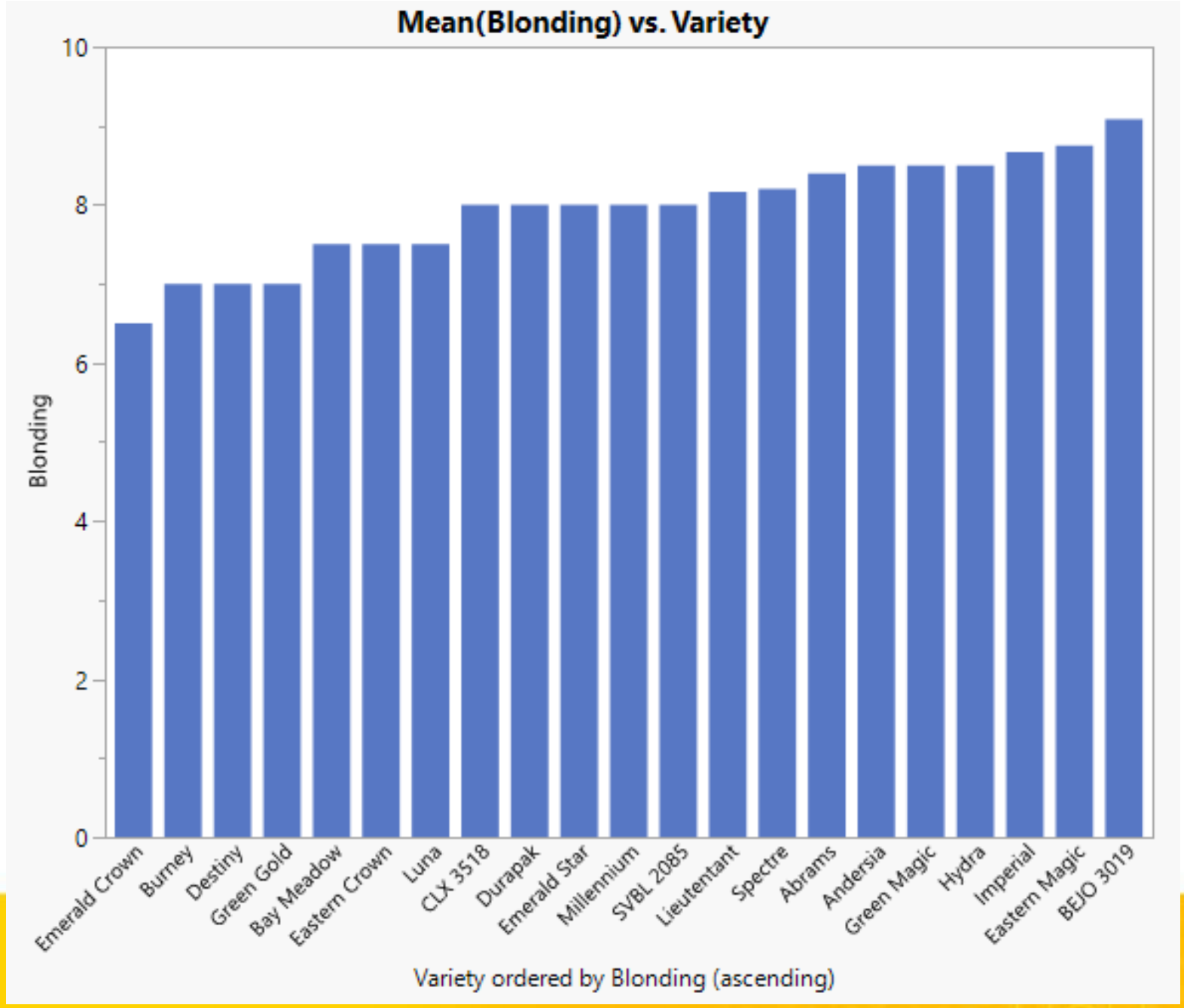

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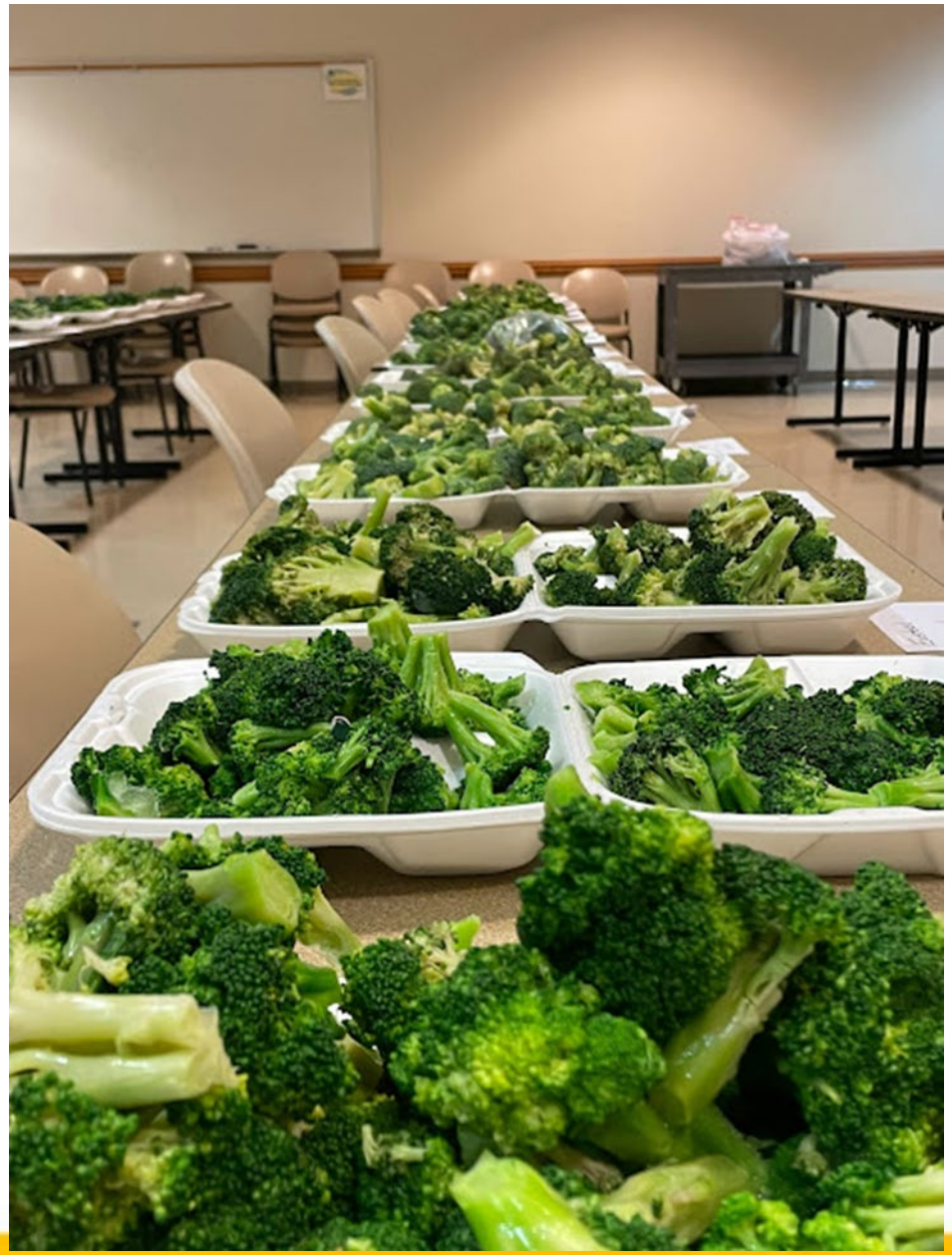
Frozen Sample Evaluations 2022



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Imperial


Imperial

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Specialty Cole Crops – Broccolini, Caulilini, Sprouting Broccoli, Gai Lan

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SPROUTING
BROCCOLI
MONTEBELLO


CB


MB
Happy
Rich
9/26


Hybrid Mini Broccoli: Melody F1


FIORELLO
11/10


FIORELLO

Brussels Sprouts 2023

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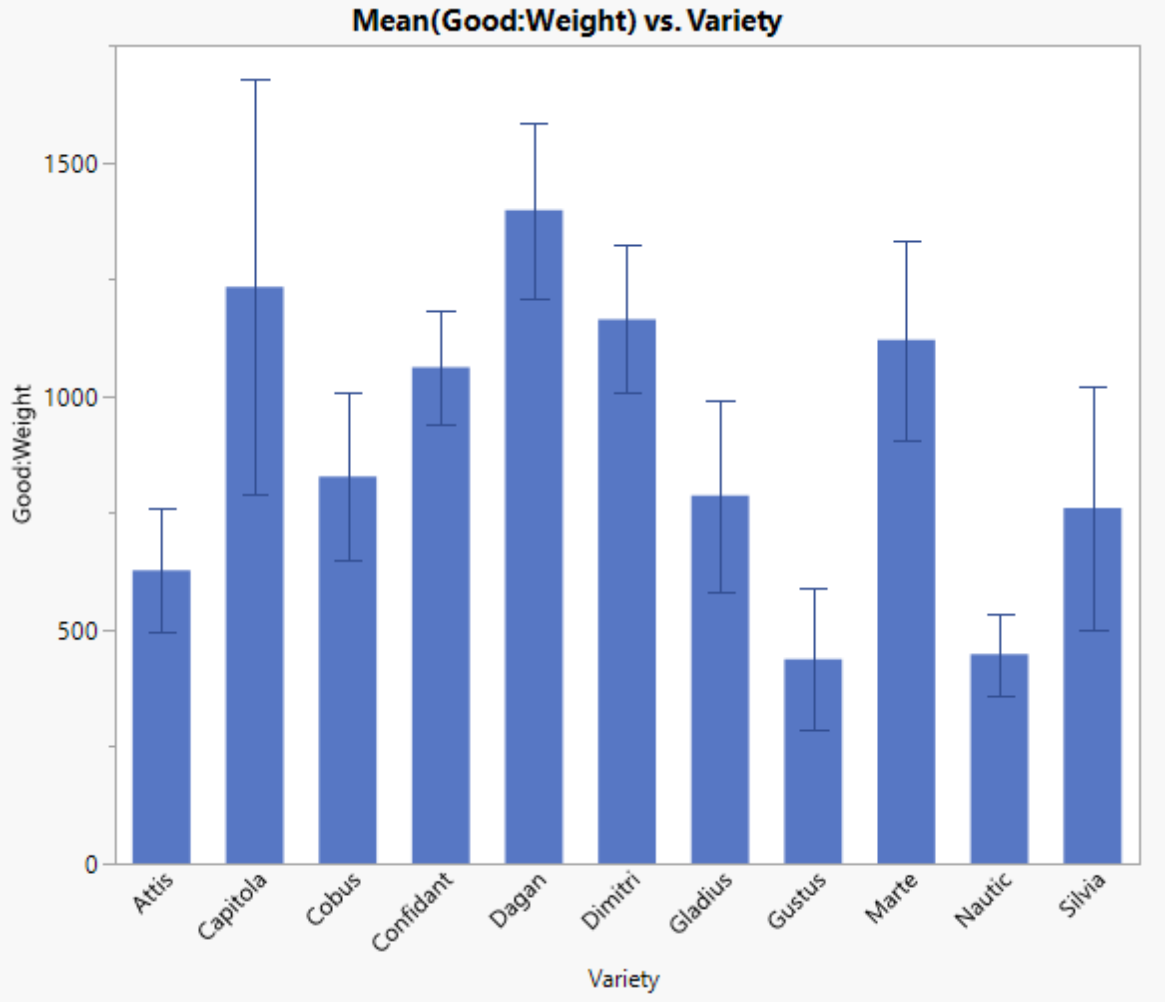
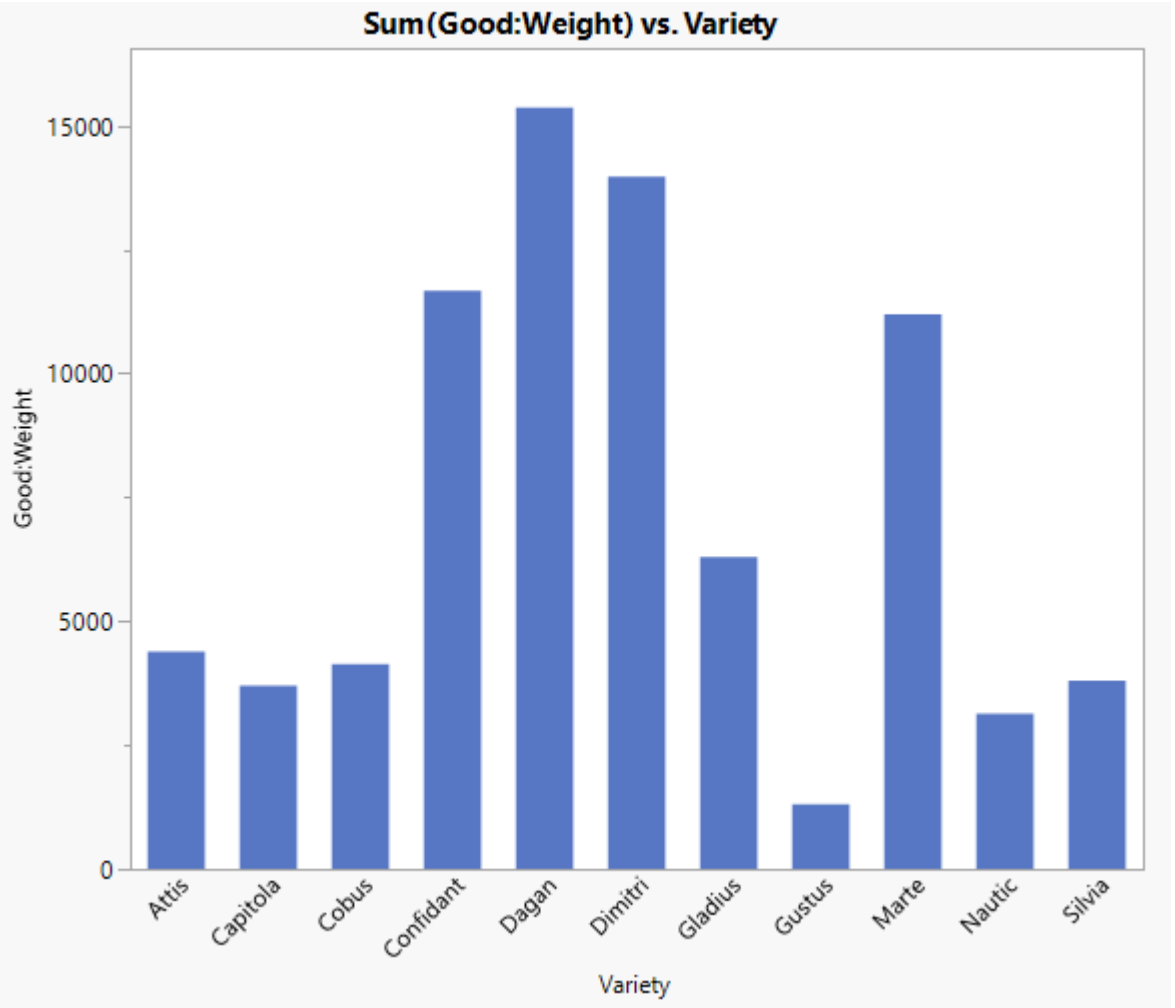
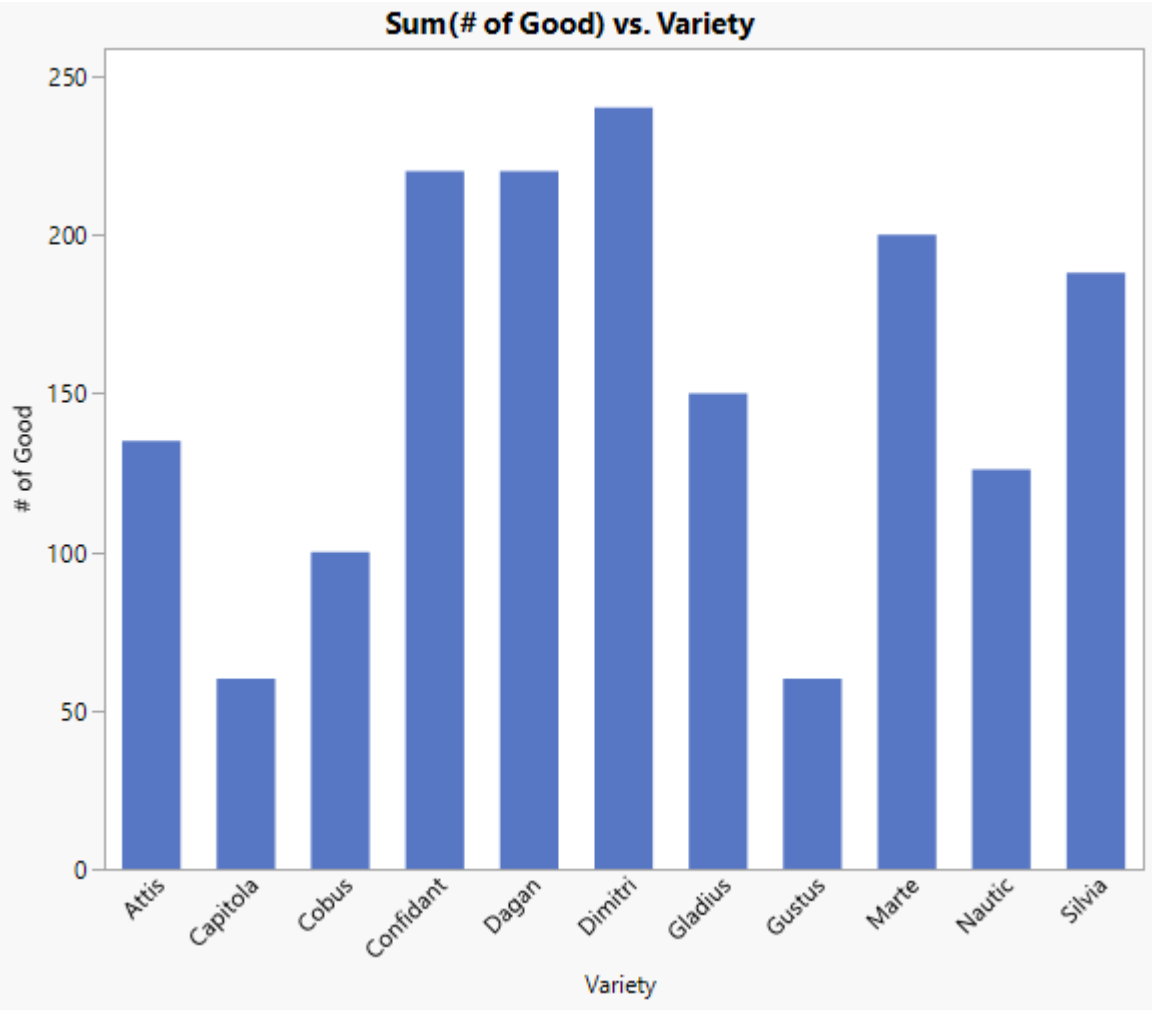
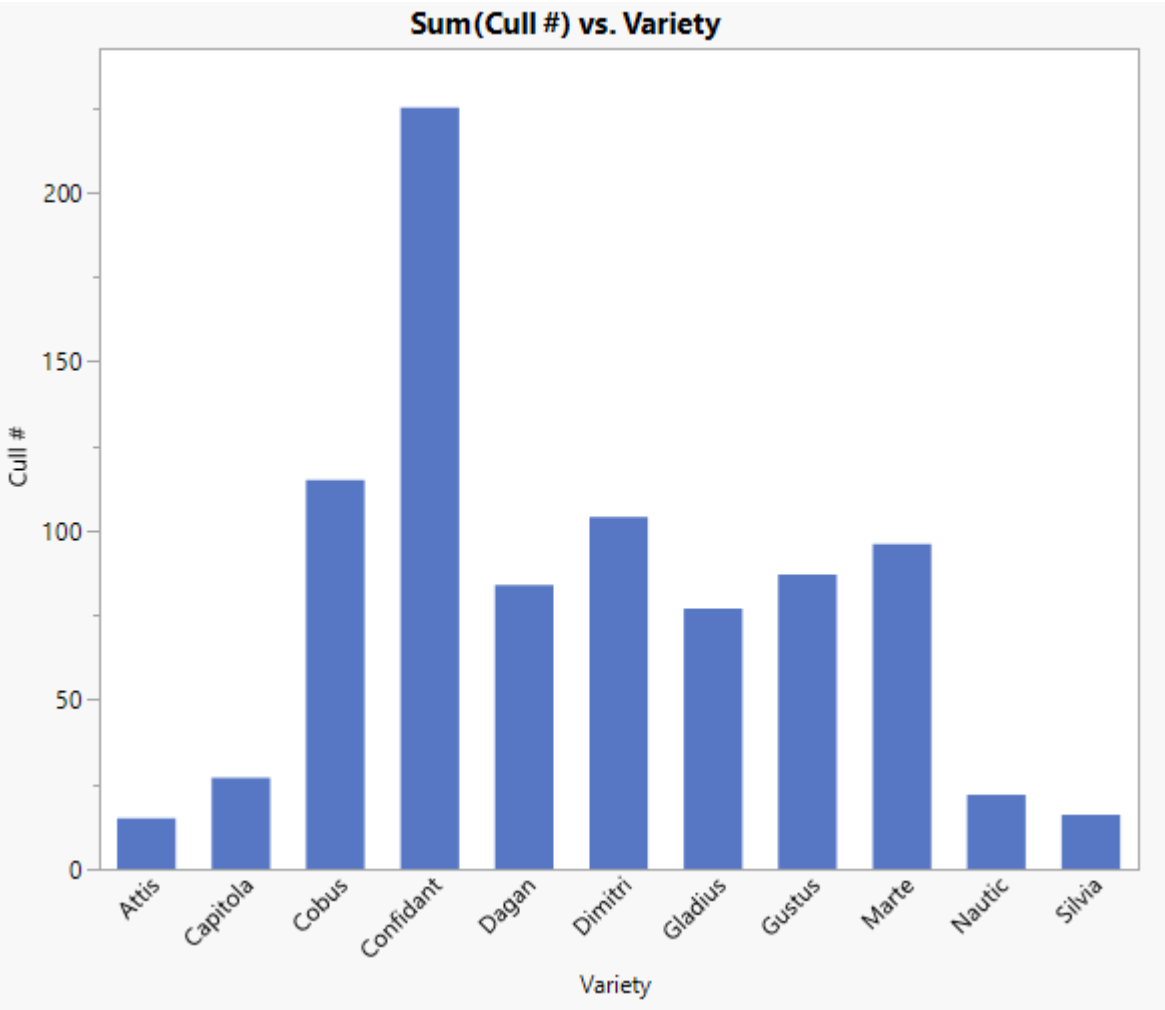
Brussels Sprouts 2023

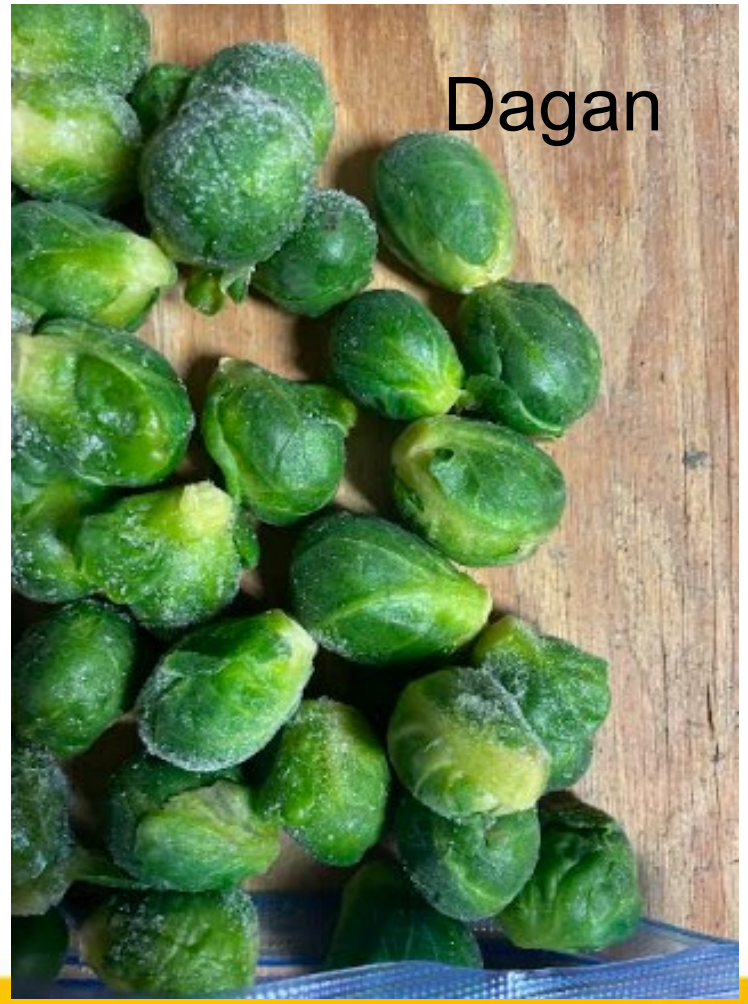





Sum(# of Good) vs. Variety
# of Good
250
200
150
100
50
0
Attis
Capitola
Cobus
Confidant
Dagan
Dimitri
Gladius
Gustus
Marte
Nautic
Silvia
Variety


Sum(Cull #) vs. Variety
Cull #
200
150
100
50
0
Attis
Capitola
Cobus
Confidant
Dagan
Dimitri
Gladius
Gustus
Marte
Nautic
Silvia
Variety

Frozen Samples for Evaluation



Thank you!!

- I will be retiring in June
- Programs will continue - Dr. Emmalea Ernest will be your contact.
- Wish you all good fortune.

It has been a privilege to serve you for the last 12 years as Extension Fruit and Vegetable Specialist!