TABLE OF CONTENTS

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Acknowledgements

This report contains most of the asparagus research program at Michigan State University (MSU) and the Michigan Asparagus Industry Research Farm (Research Farm). It represents a strong cooperative effort between all stakeholders working together for the betterment of Michigan's asparagus industry.

The information in this book comes from research done at the Research Farm near Hart, Michigan; trials on individual farms; and MSU trial plots.

Funds to operate the Research Farm, as well as most other asparagus research projects are generated from many sources including voluntary contributions from Michigan asparagus processors and fresh packers, MSU Project GREEEN, Specialty Crop Block Grant awards and grower assessments. A significant funding stream also comes from profits on the sale of hybrid asparagus seed.

The Research Farm is part owned and part leased by Michigan Asparagus Research, Inc which is made up of growers, processors and packers who meet as needed throughout the year. MARI has purchased equipment to operate the Research Farm, installed a well and hires individuals to oversee the daily operations. We wish to express our sincere appreciation to the farm manager, John Bakker, research assistant, Marijo Bakker and the 2022 Board:

Nick Oomen, Chairman
Brock Oomen, Vice Chairman
Gerrit Herrygers, Treasurer
Todd Greiner
Vince Miskosky
Jordon Walsworth
Glenn Rogers
Tim Tubbs
Ben Werling, ex-officio (MSUE)
John Bakker, ex-officio (Farm Manager)
Jamie Clover Adams, ex-officio (Secretary)

We also receive guidance and input on the industry's research efforts from the Michigan Asparagus Industry Research Farm Advisory Committee. A special thanks goes to Committee members:

Kevin Burmeister (Shelby)
Eugene Kokx, Jr. (Hart)
Ben Byl (Shelby)
Nick Oomen (Hart)
Matt Woller (Montague)
Paul Lound (Industry Rep.)
Ben Werling, ex-officio (MSUE) – Secretary
Jamie Clover Adams, ex-officio (MAAB)
John Bakker, ex-officio (Farm Manager)

Thank you!

The Michigan Asparagus Research, Inc (MARI) wishes to thank the following processors, fresh packers and shippers whose $3 per ton contribution helps fund asparagus research.

Coloma Frozen Foods
Honee Bear Canning
New Era's American Asparagus
Richter Farms
Shafer Lake Fruit
West MI Produce
Greiner Farms, Inc
Michigan Freeze Pack
North Bay Produce
Ridgeview Packing
Todd Greiner Farms Packing

A strong research effort benefits all involved in the industry. The MARI Board asks you, as growers, to thank those processors, fresh packers and shippers that contribute to our research effort and to encourage those not listed to contribute in the future.

This annual publication is funded by grower check-off dollars collected by the Michigan Asparagus Advisory Board and granted to MARI and through voluntary contributions made by Michigan processors, fresh packers and shippers.

Questions can be directed to:

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(517) 881-3971

John Bakker, Farm Consultant
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(231) 923-6725

About the Graphs & Data Tables

The graphs and data tables in this year's asparagus research book were generated from data collected by the Christiaens automated asparagus sorter. You'll recall that the research farm received a Rural Development Fund grant in 2019 to purchase this machine. It is designed specifically for research and data collection. It examines every spear harvested and measures the weight, diameter, and tip quality. This has enabled us to provide more data for you as you assess asparagus varieties for your farm.

For the first time, we are including several yield distribution charts. In addition, the traditional charts and tables have some new features. They include:

Error Bars. These are skinny lines extending from the top of bars in the charts. They are a graphical representation of the variability of the data. The error bars represent +/- one standard error unit around the mean (average). The standard error measures the variability in the data for a treatment. In other words, how different from each other were the four replicate measurements (plots) in the field for each treatment?

Capital Letters Associated with Error Bars. Some of the charts representing annual and cumulative data have capital letters associated with each error bar. The letters tell you whether we would judge treatments as "statistically significantly" different from each other at the 0.05 probability level (see below). Different chart bars that share the same letter are not statistically different. Those that do not share any of the same letters are significantly different. If there are no letters, there were no significant differences among any of the treatments.

P-Values. These are found at the bottom of most of the data tables. In a basic sense, P-values represent the level of statistical significance. If the p-value is less than 0.05 (a typical standard for judging "significant" differences), we can interpret it to mean there is a 95% chance there are some real differences among the treatments. The lower the p-value, the more confident we are that there are real differences. The higher the p-value (especially greater than 0.10), the more confident we are in saying there probably aren't meaningful differences between the treatments.

LSD.05 Values. These are found at the bottom of most of the data tables. This is the "Least Significant Difference" determined at the 0.05 probability level. If two treatment means differ by more than this number, they would be considered significantly different. If they differ by less than this number, they are not considered significantly different. Bolding is used in the tables to highlight treatments not significantly different from the highest value, but the LSD can be used to compare any other treatments you may be interested in.

Questions can be directed to:

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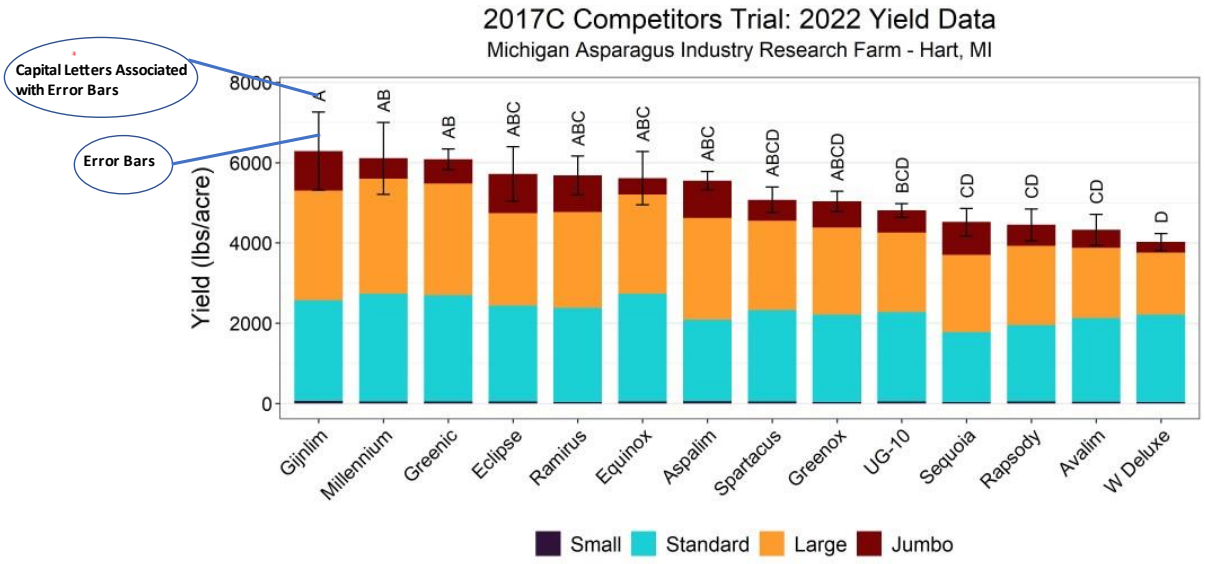
(517) 353-0410



2015A Crown Trial: 2022 Yield Data

Michigan Asparagus Industry Research Farm - Hart, MI

Variety	Mean Yields in lbs. per acre					Spear Tip Quality	
	Small	Standard	Large	Jumbo	Total	Avg Flowering[1]	Invalid[2]
WB-206	19	2529	3391	927	6867	28%	5%
Millennium	14	1864	2969	1842	6689	30%	7%
Rosalie	18	1765	2627	1736	6146	29%	5%
P Challenger-2	33	2352	2817	792	5994	30%	5%
UG-24	20	1726	2587	1530	5863	29%	5%
WB-203	17	1892	2397	1547	5854	28%	6%
WB-201	18	2069	2496	1172	5755	30%	5%
Voltare	22	1997	2576	911	5506	29%	5%
UG-25	18	1783	2532	955	5288	29%	6%
p Value	0.8245	0.2318	0.1489	0.2394	0.2730	0.7383	0.8502
LSD.05	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.

P-Values

LSDs

Quantities not significantly different from the maximum in each column shown in bold.

[1] Measured as mean of flowering percentage of individual spears.

[2] Measured as percentage of individual spears with invalid flowering readings.

Hybrid Asparagus Yield Trials
2022 Results

John Bakker

Objectives:

To evaluate the yield, quality, disease resistance, and longevity of selected asparagus hybrids.

Methods:

The trials established during 2012, 2015 (Transplants) and 2017 (Cultivar & Competitor) consisted of transplants which were sown in the greenhouse in April and transplanted into the trial plots during June or early July.

The in-row plant spacing for each trial was:

- 2012 International – 12”
- 2015 Transplant – 12”
- 2017 Cultivar – 12”
- 2017 Competitors – 9”

The 2015 Crown trial was planted in early May with 1 year old crowns with in-row spacing of 9.4”. apart. The row spacing for all trials is 54”.

All trials were planted in a randomized, complete block design with 4 replications except for 2017 Cultivar which has 3 replications. Plots are harvested for 3-4 weeks during the third growing season and around 6 weeks in subsequent seasons. Beginning in the Spring of 2020 the weight, diameter, and length of each spear harvested was measured and recorded using an automated data collection system. In addition, quality measures to assess tip quality were collected from each spear harvested.

Results:

Guelph Millennium is used as an industry standard or “control” in all variety trials. During the 2022 harvest season, no variety had significantly higher yield than Millennium.

2012 International Cultivar Trial: 2022 Yield Data

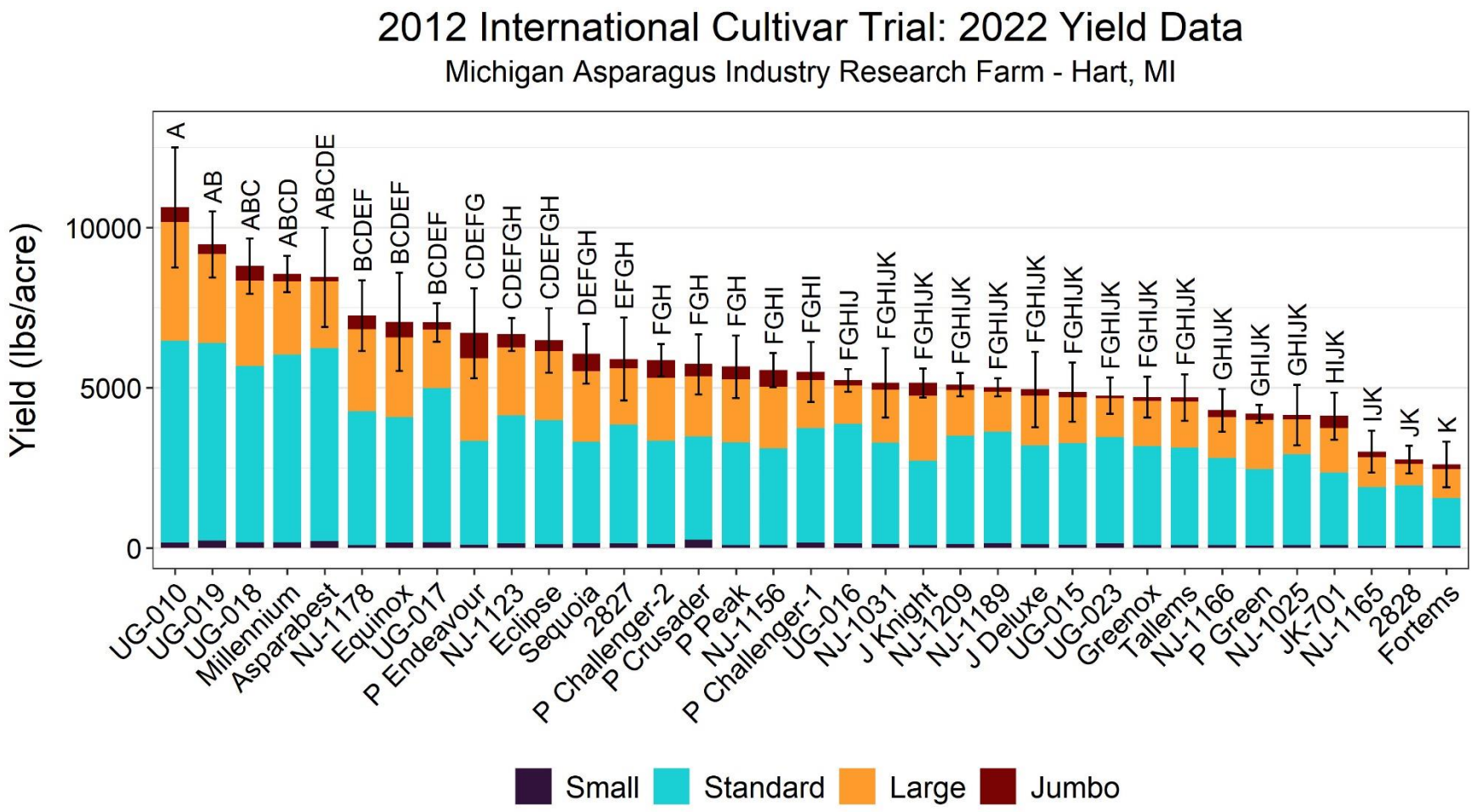
Michigan Asparagus Industry Research Farm - Hart, MI

Variety	Mean Yields in lbs./acre					Spear Tip Quality	
	Small	Standard	Large	Jumbo	Total	Avg Flowering[1]	Invalid[2]
UG-010	160	**6316**	**3697**	463	**10636**	28%	3%
UG-019	231	**6161**	**2781**	302	**9476**	29%	4%
UG-018	170	**5513**	**2665**	452	**8801**	25%	2%
Millennium	178	**5854**	2285	240	**8557**	28%	3%
Asparabest	215	**6031**	2078	133	**8457**	26%	2%
NJ-1178	88	4180	**2555**	435	7258	28%	2%
Equinox	166	3916	2495	480	7058	27%	3%
UG-017	180	**4812**	1820	231	7043	25%	3%
P Endeavour	100	3240	**2577**	790	6707	26%	3%
NJ-1123	137	3995	2120	415	6668	23%	3%
Eclipse	108	3875	2152	348	6482	26%	3%
Sequoia	146	3158	2210	546	6060	27%	2%
2827	132	3713	1752	300	5897	29%	3%
P Challenger-2	127	3217	1966	554	5863	25%	4%
P Crusader	250	3227	1884	378	5738	28%	3%
P Peak	89	3206	1968	400	5663	25%	3%
NJ-1156	86	3026	1922	520	5553	28%	4%
P Challenger-1	157	3588	1486	265	5495	23%	3%
UG-016	135	3729	1203	165	5232	27%	3%
NJ-1031	120	3169	1646	227	5162	31%	4%
J Knight	83	2634	2027	409	5153	26%	4%
NJ-1209	121	3382	1422	172	5097	28%	3%
NJ-1189	145	3488	1243	140	5016	28%	3%
J Deluxe	115	3077	1561	200	4952	25%	4%
UG-015	96	3180	1421	170	4867	26%	3%
UG-023	141	3326	1210	77	4754	27%	3%
Greenox	89	3099	1395	131	4713	25%	2%
Tallems	80	3050	1437	132	4698	25%	3%
NJ-1166	83	2724	1276	215	4298	26%	4%
P Green	74	2377	1550	187	4189	25%	3%
NJ-1025	89	2841	1084	139	4153	26%	3%
JK-701	86	2271	1382	382	4122	28%	3%
NJ-1165	58	1840	926	182	3007	24%	5%
2828	70	1871	684	136	2761	28%	5%
Fortems	63	1483	916	147	2609	29%	3%
p Value	0.0632	< 0.0001	0.0007	0.4508	< 0.0001	0.1193	0.6627
LSD.05	n.s.	1820	1178	n.s.	2606	n.s.	n.s.

Quantities not significantly different from the maximum in each column shown in bold.

[1] Measured as mean of flowering percentage of individual spears.

[2] Measured as percentage of individual spears with invalid flowering readings.


2012 International Cultivar Trial: 2022 Yield Data
Michigan Asparagus Industry Research Farm - Hart, MI
Yield (lbs/acre)
10000
5000
0
A
AB
ABC
ABCD
ABCDE
BCDEF
BCDEF
BCDEF
CDEFG
CDEFGH
CDEFGH
DEFGH
EFGH
FGH
FGH
FGH
FGHI
FGHI
FGHIJ
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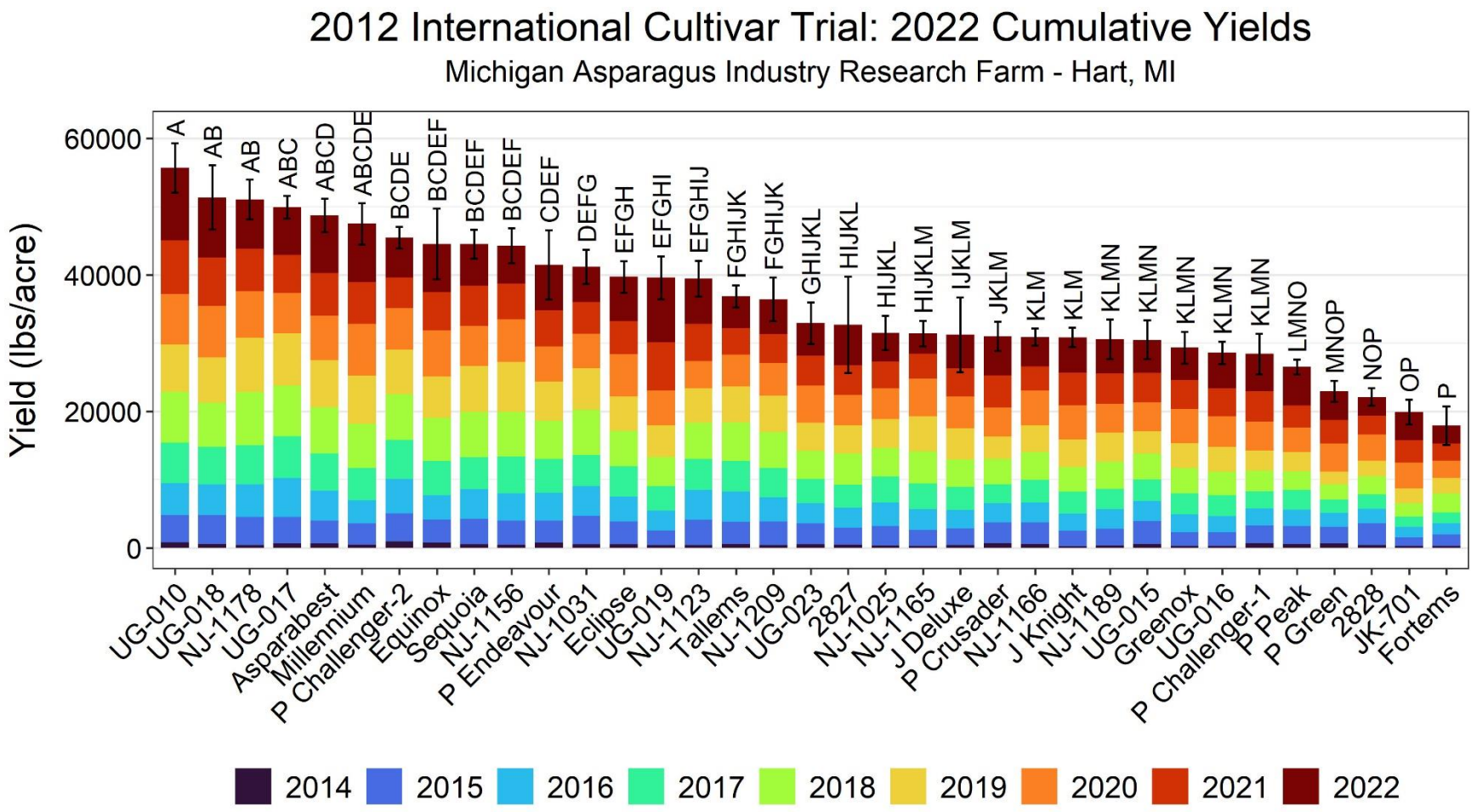
FGHIJK
FGHIJK
FGHIJK
FGHIJK
GHIJK
GHIJK
GHIJK
HIJK
IJK
JK
K
UG-010
UG-019
UG-018
Millennium
Asparabest
NJ-1178
Equinox
UG-017
P Endeavour
NJ-1123
Eclipse
Sequoia
2827
P Challenger-2
P Crusader
P Peak
NJ-1156
P Challenger-1
UG-016
NJ-1031
J Knight
NJ-1209
NJ-1189
J Deluxe
UG-015
UG-023
Greenox
Tallems
NJ-1166
P Green
NJ-1025
JK-701
NJ-1165
2828
Fortems
Small
Standard
Large
Jumbo

2012 International Cultivar Trial: 2022 Cumulative Yields

Michigan Asparagus Industry Research Farm - Hart, MI

Variety	Mean Yields in lbs./acre									
	2014	2015	2016	2017	2018	2019	2020	2021	2022	Total
UG-010	**799**	**4024**	4641	**5921**	**7472**	**6963**	**7375**	**7866**	**10636**	**55696**
UG-018	588	**4254**	4495	**5477**	**6451**	**6655**	**7516**	**7139**	**8801**	**51376**
NJ-1178	376	**4127**	**4831**	**5704**	**7761**	**7974**	**6791**	**6239**	7258	**51062**
UG-017	616	**3939**	**5628**	**6184**	**7440**	**7623**	5915	5549	7043	**49937**
Asparabest	612	**3375**	4350	**5519**	**6762**	**6868**	**6527**	**6259**	**8457**	**48729**
Millennium	442	3118	3411	4717	**6466**	**7072**	**7587**	**6128**	**8557**	**47498**
P Challenger-2	**945**	**4147**	**4993**	**5748**	**6682**	6545	**6085**	4463	5863	45471
Equinox	**738**	**3447**	3525	4995	6337	6066	**6731**	5639	7058	44537
Sequoia	502	**3738**	4346	4669	**6688**	**6683**	5902	5932	6060	44520
NJ-1156	435	**3579**	3988	**5382**	**6580**	**7276**	**6249**	5240	5553	44282
P Endeavour	**758**	**3251**	4046	4965	5616	5743	5170	5221	6707	41477
NJ-1031	507	**4217**	4333	4573	**6648**	6046	5056	4633	5162	41175
Eclipse	514	**3347**	3662	4406	5233	5014	**6219**	4844	6482	39722
UG-019	391	2161	2916	3628	4216	4654	5097	**7067**	**9476**	39605
NJ-1123	401	**3723**	4370	4512	5318	5060	3999	5404	6668	39456
Tallems	549	**3249**	4416	4483	5690	5294	4627	3878	4698	36883
NJ-1209	414	**3464**	3543	4305	5256	5323	4767	4256	5097	36425
UG-023	526	3029	2993	3550	4139	4079	5473	4387	4754	32929
2827	460	2526	2901	3381	4601	4082	4451	4395	5897	32694
NJ-1025	336	2854	3425	3807	4179	4255	4475	4003	4153	31489
NJ-1165	270	2351	3055	3746	4723	5167	5462	3648	3007	31428
J Deluxe	377	2484	2709	3393	3996	4522	4669	4144	4952	31246
P Crusader	679	3074	2826	2726	3778	3238	4230	4721	5738	31008
NJ-1166	580	3166	2851	3386	4050	3946	5077	3546	4298	30899
J Knight	243	2261	2514	3192	3644	4048	5030	4770	5153	30855
NJ-1189	365	2424	2898	2949	3999	4282	4180	4472	5016	30587
UG-015	596	**3354**	2897	3151	3778	3318	4243	4290	4867	30493
Greenox	280	2011	2584	3129	3671	3696	4990	4280	4713	29353
UG-016	300	2019	2296	3096	3454	3645	4477	4095	5232	28614
P Challenger-1	675	2571	2525	2508	3074	2946	4210	4438	5495	28442
P Peak	574	2612	2441	2842	2764	2774	3620	3226	5663	26516
P Green	628	2492	1981	1991	2194	1849	4143	3507	4189	22973
2828	407	3227	2106	2095	2675	2265	3848	2747	2761	22133
JK-701	270	1295	1549	1451	2007	2135	3800	3290	4122	19918
Fortems	299	1629	1709	1539	2791	2286	2500	2556	2609	17917
p Value	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
LSD.05	245	1009	964	1056	1315	1344	1512	1889	2606	8689

Quantities not significantly different from the maximum in each column shown in bold.


2012 International Cultivar Trial: 2022 Cumulative Yields
Michigan Asparagus Industry Research Farm - Hart, MI
Yield (lbs/acre)
60000
40000
20000
0
A
AB
AB
ABC
ABCD
ABCDE
BCDE
BCDEF
BCDEF
BCDEF
CDEF
DEFG
EFGH
EFGHI
EFGHIJ
FGHIJK
FGHIJK
GHIJKL
HIJKL
HIJKL
HIJKLM
IJKLM
JKLM
KLM
KLM
KLMN
KLMN
KLMN
KLMN
KLMN
LMNO
MNOP
NOP
OP
P
UG-010
UG-018
NJ-1178
UG-017
Asparabest
Millennium
P Challenger-2
Equinox
Sequoia
NJ-1156
P Endeavour
NJ-1031
Eclipse
UG-019
NJ-1123
Tallems
NJ-1209
UG-023
2827
NJ-1025
NJ-1165
J Deluxe
P Crusader
NJ-1166
J Knight
NJ-1189
UG-015
Greenox
UG-016
P Challenger-1
P Peak
P Green
2828
JK-701
Fortems
2014
2015
2016
2017
2018
2019
2020
2021
2022

2015A Crown Trial: 2022 Yield Data

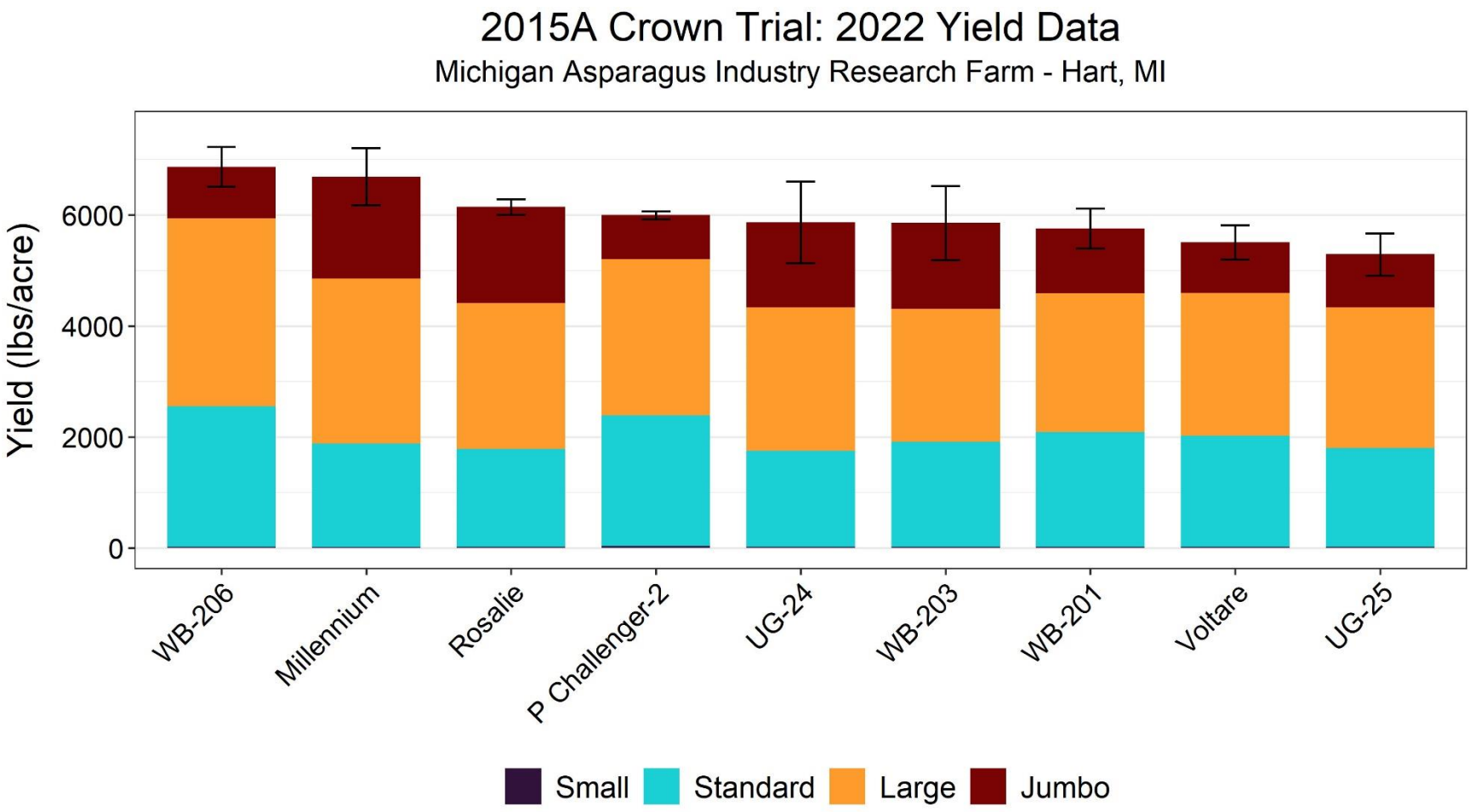
Michigan Asparagus Industry Research Farm - Hart, MI

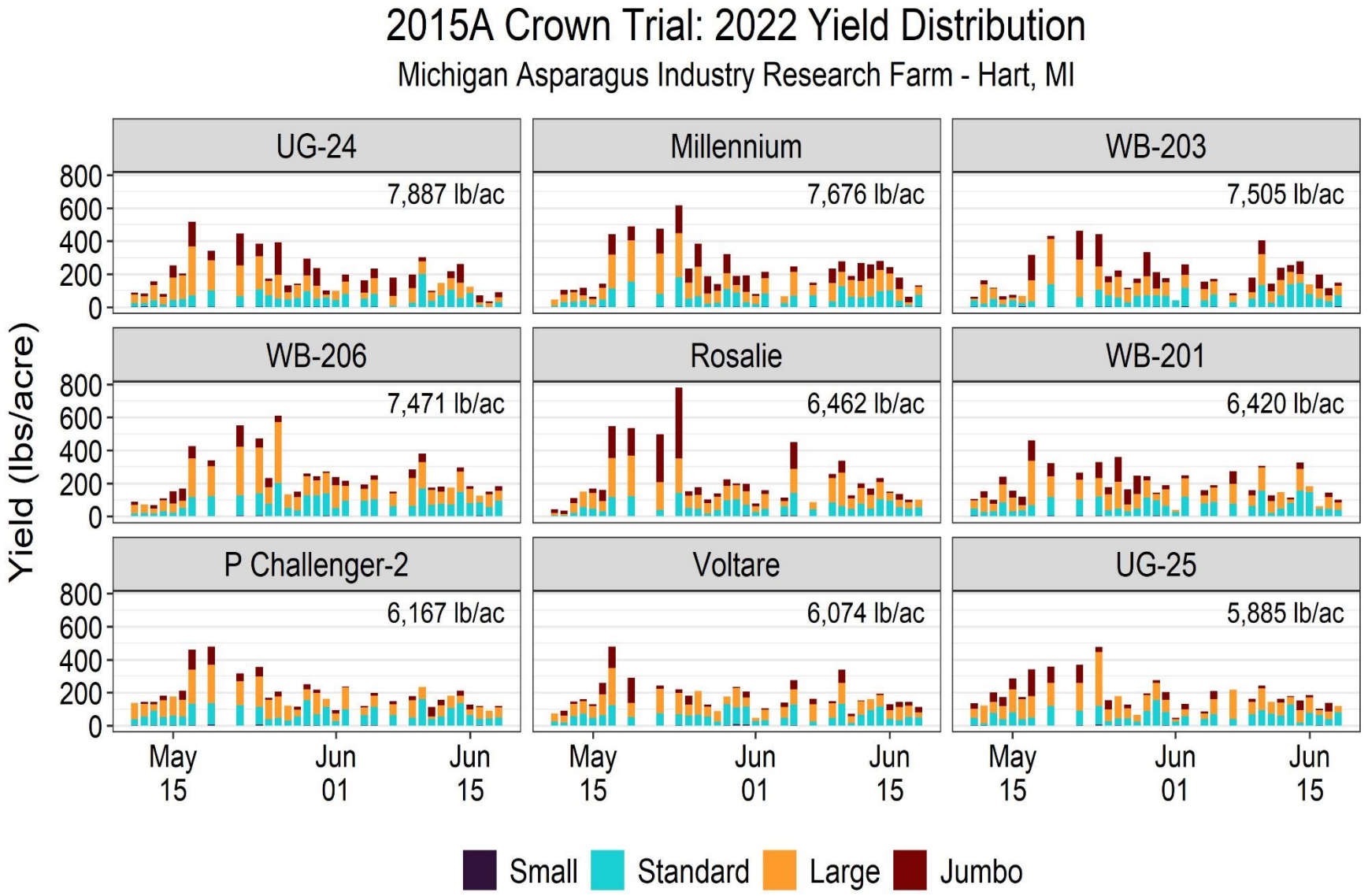
Variety	Mean Yields in lbs./acre					Spear Tip Quality	
	Small	**Standard**	**Large**	**Jumbo**	**Total**	**Avg Flowering[1]**	**Invalid[2]**
WB-206	19	2529	3391	927	6867	28%	5%
Millennium	14	1864	2969	1842	6689	30%	7%
Rosalie	18	1765	2627	1736	6146	29%	5%
P Challenger-2	33	2352	2817	792	5994	30%	5%
UG-24	20	1726	2587	1530	5863	29%	5%
WB-203	17	1892	2397	1547	5854	28%	6%
WB-201	18	2069	2496	1172	5755	30%	5%
Voltare	22	1997	2576	911	5506	29%	5%
UG-25	18	1783	2532	955	5288	29%	6%
p Value	0.8245	0.2318	0.1489	0.2394	0.2730	0.7383	0.8502
LSD.05	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.

Quantities not significantly different from the maximum in each column shown in bold.

[1] Measured as mean of flowering percentage of individual spears.

[2] Measured as percentage of individual spears with invalid flowering readings.


2015A Crown Trial: 2022 Yield Data
Michigan Asparagus Industry Research Farm - Hart, MI
Yield (lbs/acre)
6000
4000
2000
0
WB-206
Millennium
Rosalie
P Challenger-2
UG-24
WB-203
WB-201
Voltare
UG-25
Small
Standard
Large
Jumbo


2015A Crown Trial: 2022 Yield Distribution
Michigan Asparagus Industry Research Farm - Hart, MI
Yield (lbs/acre)
UG-24
7,887 lb/ac
Millennium
7,676 lb/ac
WB-203
7,505 lb/ac
WB-206
7,471 lb/ac
Rosalie
6,462 lb/ac
WB-201
6,420 lb/ac
P Challenger-2
6,167 lb/ac
Voltare
6,074 lb/ac
UG-25
5,885 lb/ac
0
200
400
600
800
May 15
Jun 01
Jun 15
Small
Standard
Large
Jumbo

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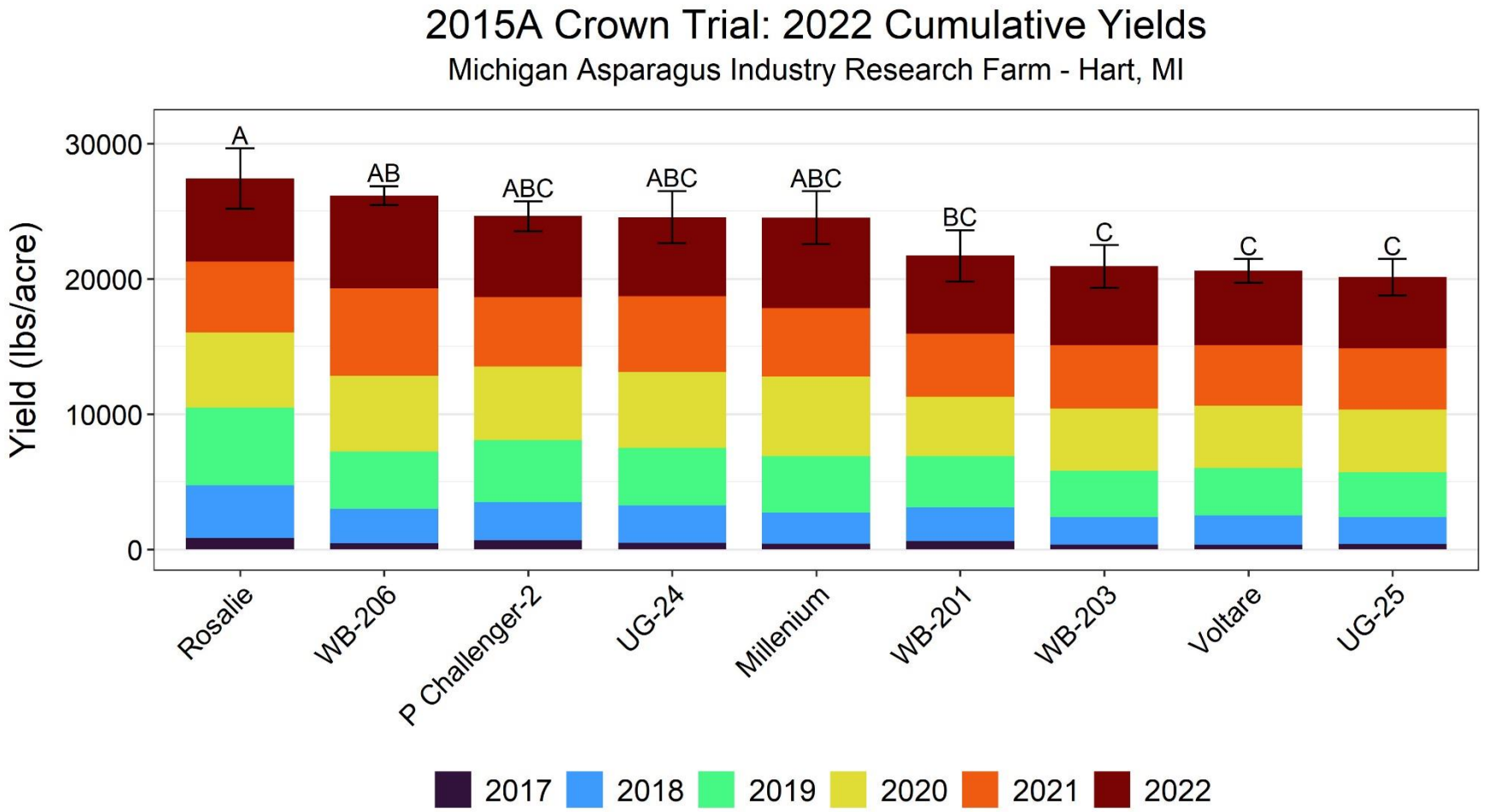
2015A Crown Trial: 2022 Cumulative Yields

Michigan Asparagus Industry Research Farm - Hart, MI

Variety	Mean Yields in lbs./acre						
	2017	**2018**	**2019**	**2020**	**2021**	**2022**	**Total**
Rosalie	**842**	**3891**	**5730**	5580	5226	6146	**27416**
WB-206	444	2559	4210	5610	6466	6867	**26156**
P Challenger-2	**654**	2844	**4563**	5445	5130	5994	**24630**
UG-24	474	2781	4244	5612	5584	5863	**24558**
Millennium	408	2328	4159	5884	5060	6689	**24528**
WB-201	588	2503	3803	4368	4691	5755	21708
WB-203	344	2042	3396	4639	4659	5854	20934
Voltare	328	2194	3494	4595	4476	5506	20594
UG-25	396	1980	3314	4632	4516	5288	20126
p Value	0.0002	0.0006	0.0002	0.4997	0.0514	0.2730	0.0279
LSD.05	205	797	1189	n.s.	n.s.	n.s.	4948

Quantities not significantly different from the maximum in each column shown in bold.


2015A Crown Trial: 2022 Cumulative Yields
Michigan Asparagus Industry Research Farm - Hart, MI
Yield (lbs/acre)
30000
20000
10000
0
A
AB
ABC
ABC
ABC
BC
C
C
C
Rosalie
WB-206
P Challenger-2
UG-24
Millenium
WB-201
WB-203
Voltare
UG-25
2017
2018
2019
2020
2021
2022

2015B Transplant Trial: 2022 Yield Data

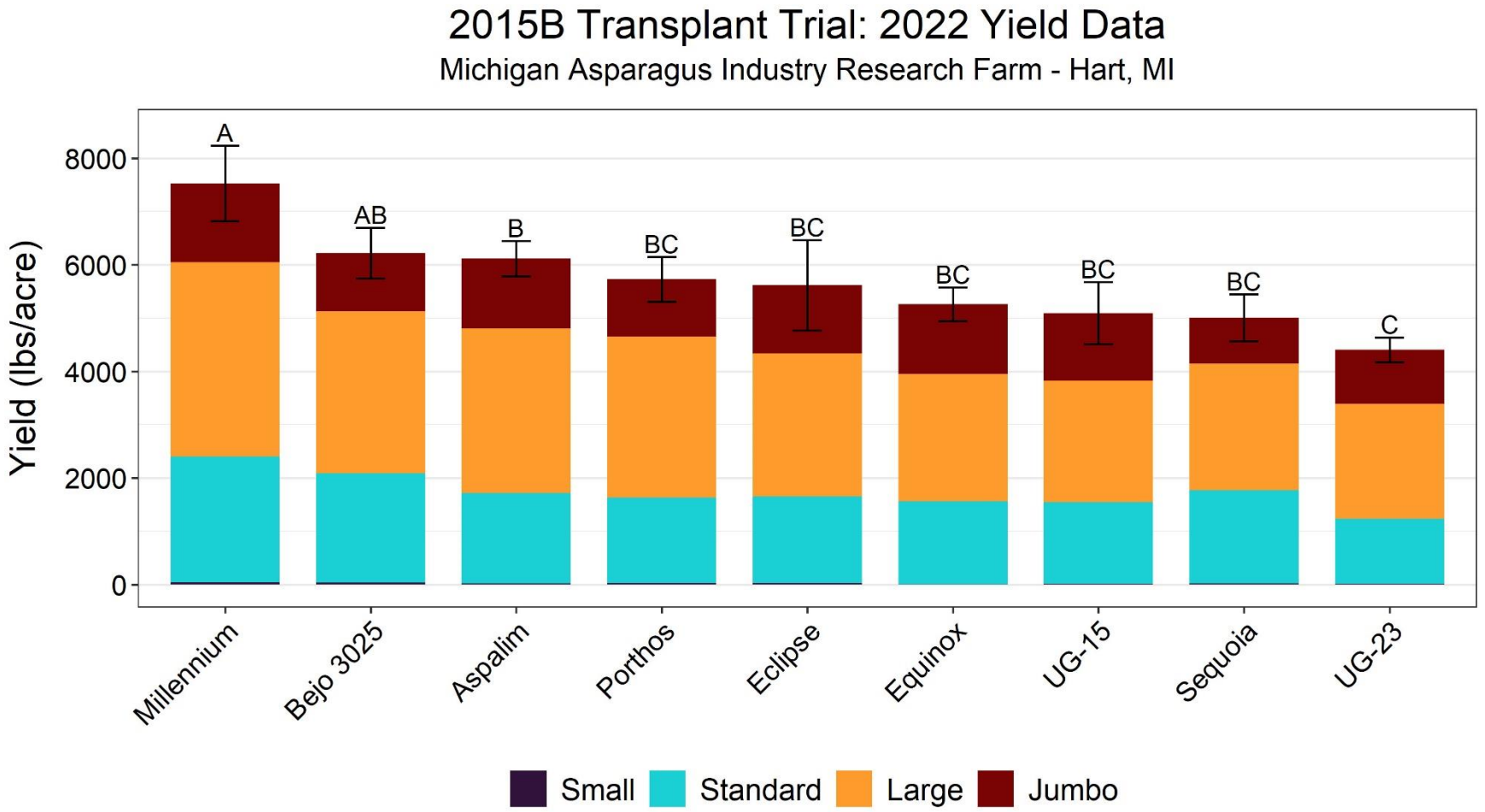
Michigan Asparagus Industry Research Farm - Hart, MI

Variety	Mean Yields in lbs./acre					Spear Tip Quality	
	Small	Standard	Large	Jumbo	Total	Avg Flowering[1]	Invalid[2]
Millennium	42	2358	**3647**	1479	**7525**	28%	7%
Bejo 3025	33	2055	**3042**	1091	**6220**	29%	6%
Aspalim	19	1700	**3085**	1316	**6119**	29%	7%
Porthos	28	1600	**3028**	1075	5731	29%	5%
Eclipse	26	1632	2676	1284	5618	29%	7%
Equinox	9	1553	2391	1307	5261	30%	6%
UG-15	14	1534	2280	1268	5095	31%	6%
Sequoia	21	1752	2369	864	5006	30%	6%
UG-23	13	1220	2157	1014	4405	30%	4%
p Value	0.2868	0.1546	0.0068	0.2560	0.0058	0.5694	0.5580
LSD.05	n.s.	n.s.	874	n.s.	1606	n.s.	n.s.

Quantities not significantly different from the maximum in each column shown in bold.

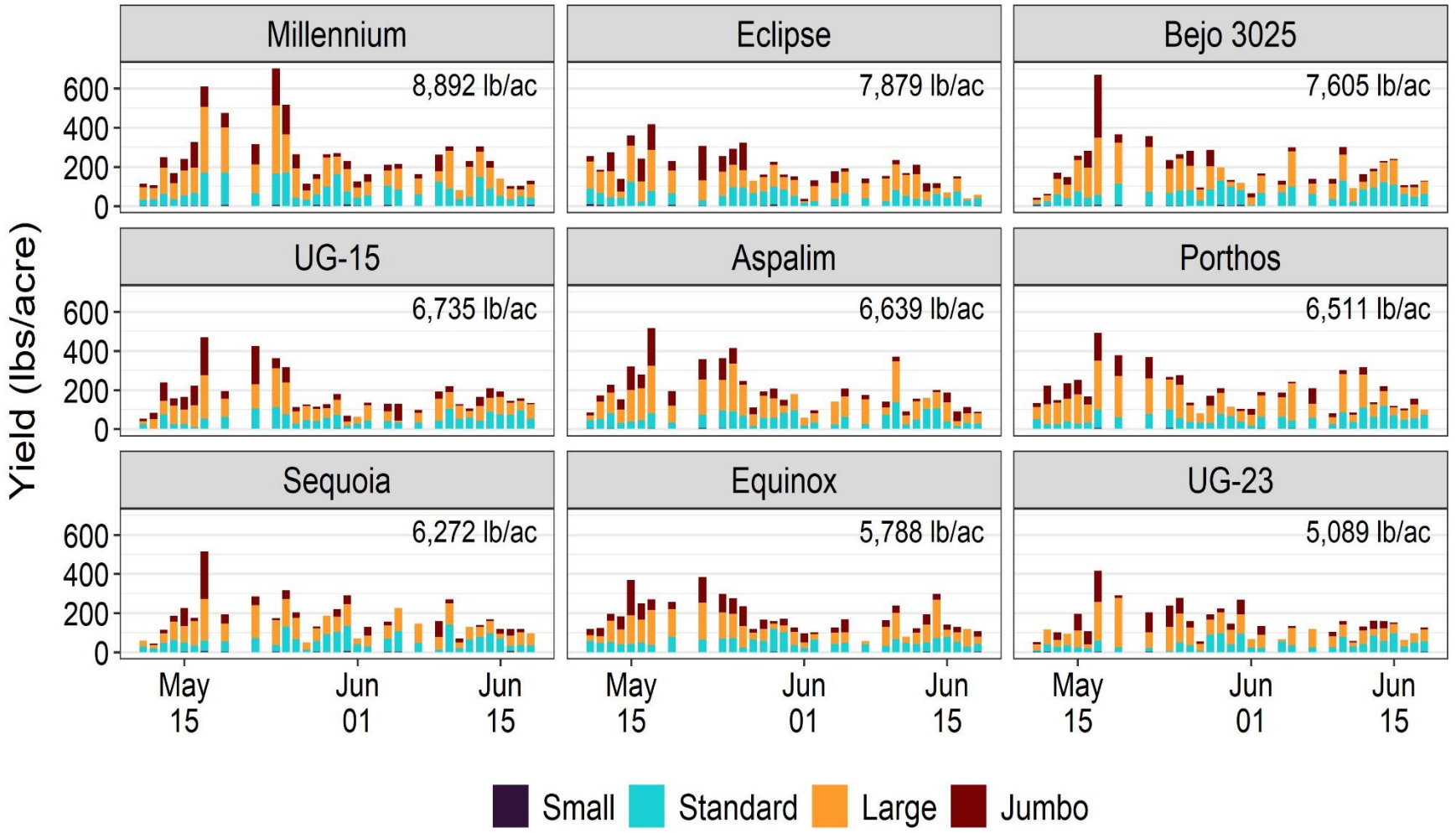
[1] Measured as mean of flowering percentage of individual spears.

[2] Measured as percentage of individual spears with invalid flowering readings.


2015B Transplant Trial: 2022 Yield Data
Michigan Asparagus Industry Research Farm - Hart, MI
Yield (lbs/acre)
8000
6000
4000
2000
0
A
AB
B
BC
BC
BC
BC
BC
C
Millennium
Bejo 3025
Aspalim
Porthos
Eclipse
Equinox
UG-15
Sequoia
UG-23
Small
Standard
Large
Jumbo

2015B Transplant Trial: 2022 Yield Distribution

Michigan Asparagus Industry Research Farm - Hart, MI



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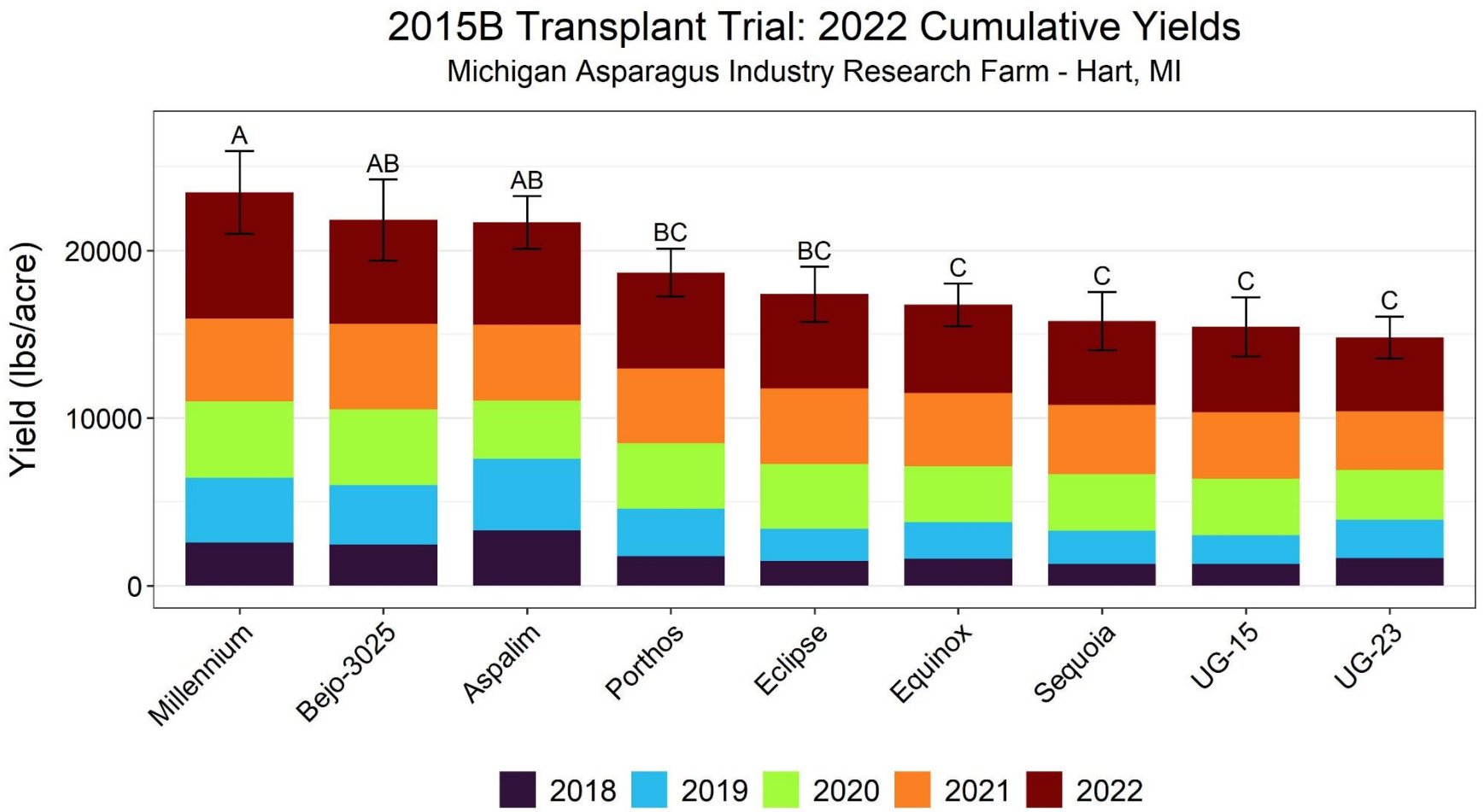
2015B Transplant Trial: 2022 Cumulative Yields

Michigan Asparagus Industry Research Farm - Hart, MI

Variety	Mean Yields in lbs./acre					
	2018	**2019**	**2020**	**2021**	**2022**	**Total**
Millennium	**2559**	**3866**	4557	4955	**7525**	**23462**
Bejo-3025	**2436**	**3558**	4529	5088	**6220**	**21831**
Aspalim	**3297**	**4265**	3478	4513	**6119**	**21672**
Porthos	1756	2836	3891	4467	5731	**18680**
Eclipse	1450	1956	3867	4499	5618	17390
Equinox	1604	2184	3319	4394	5261	16761
Sequoia	1280	2004	3376	4119	5006	15785
UG-15	1288	1718	3379	3959	5095	15440
UG-23	1624	2314	2961	3505	4405	14808
p Value	< 0.0001	0.0008	0.1377	0.6488	0.0058	0.0051
LSD.05	878	1352	n.s.	n.s.	1606	5515

Quantities not significantly different from the maximum in each column shown in bold.


2015B Transplant Trial: 2022 Cumulative Yields
Michigan Asparagus Industry Research Farm - Hart, MI
Yield (lbs/acre)
20000
10000
0
A
AB
AB
BC
BC
C
C
C
C
Millennium
Bejo-3025
Aspalim
Porthos
Eclipse
Equinox
Sequoia
UG-15
UG-23
2018
2019
2020
2021
2022

2017A Cultivar Trial – Transplants: 2022 Yield Data

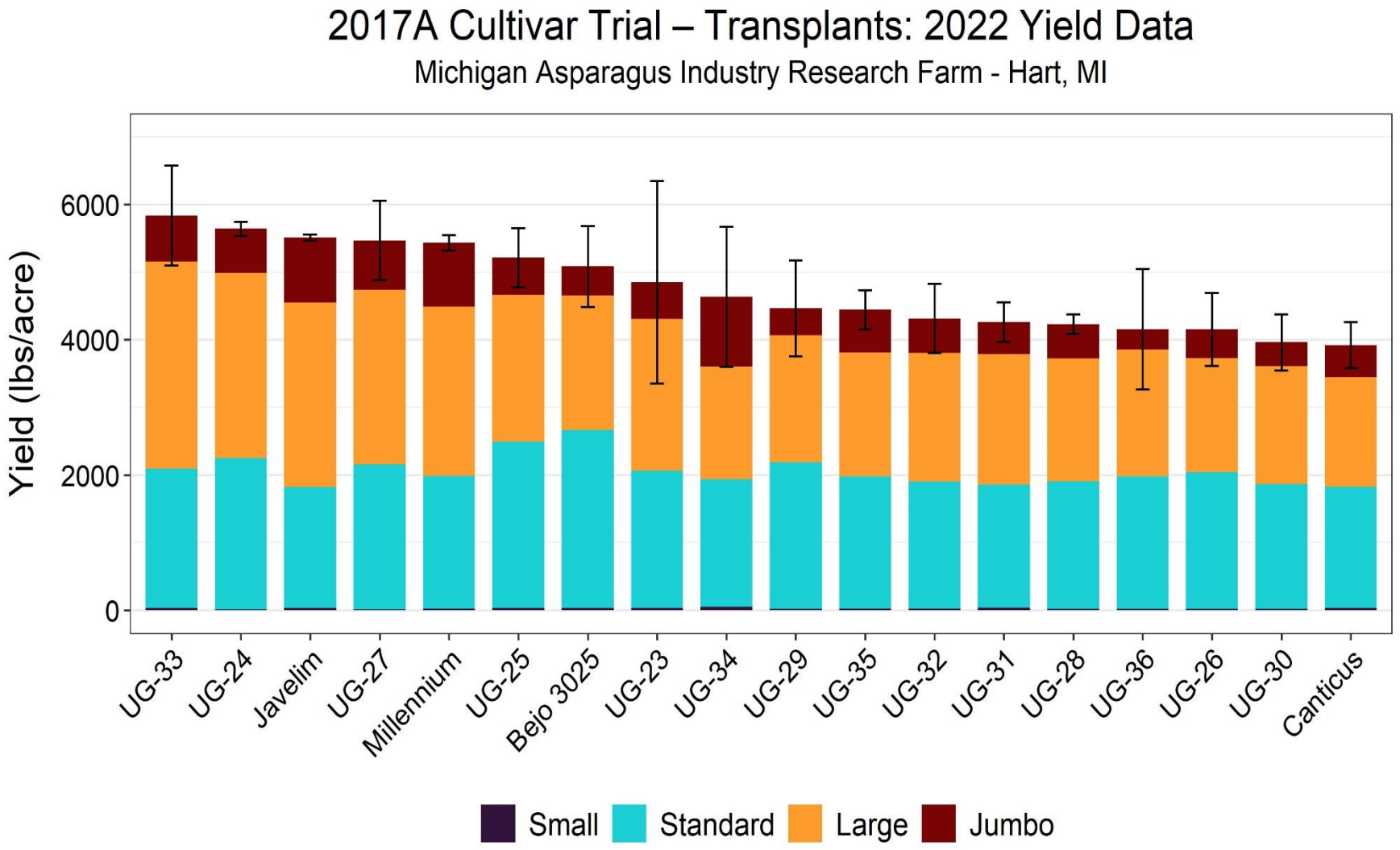
Michigan Asparagus Industry Research Farm - Hart, MI

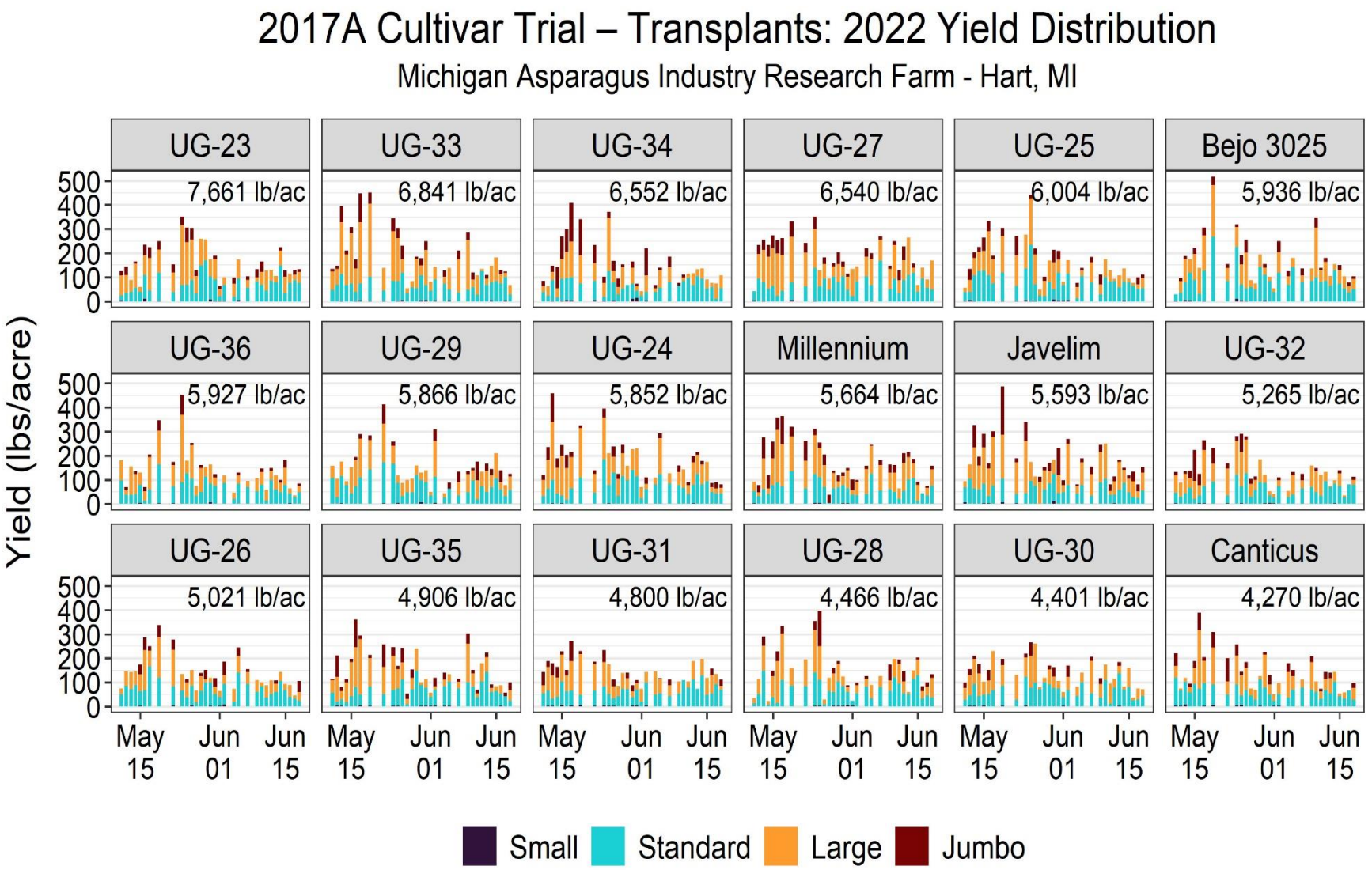
Cultivar	Mean Yields in lbs./acre					Spear Tip Quality	
	Small	Standard	Large	Jumbo	Total	Avg Flowering[1]	Invalid[2]
UG-33	30	2064	3067	678	5838	31%	6%
UG-24	10	2241	2738	656	5645	31%	6%
Javelim	32	1785	2734	961	5513	32%	7%
UG-27	12	2142	2584	734	5471	32%	5%
Millennium	21	1963	2507	946	5438	32%	7%
UG-25	33	2461	2169	554	5218	31%	5%
Bejo 3025	28	2634	1996	428	5086	31%	6%
UG-23	27	2036	2246	544	4854	32%	6%
UG-34	46	1885	1669	1036	4636	33%	7%
UG-29	17	2172	1876	403	4466	32%	7%
UG-35	24	1955	1833	634	4446	31%	4%
UG-32	22	1883	1901	511	4317	31%	5%
UG-31	35	1826	1929	474	4264	31%	4%
UG-28	18	1893	1811	511	4233	32%	7%
UG-36	19	1959	1882	298	4158	32%	6%
UG-26	17	2025	1688	425	4155	31%	4%
UG-30	14	1850	1746	353	3963	34%	6%
Canticus	31	1792	1622	475	3921	30%	6%
p Value	0.1935	0.5955	0.1665	0.3815	0.4703	0.9418	0.4687
LSD.05	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.

Quantities not significantly different from the maximum in each column shown in bold.

[1] Measured as mean of flowering percentage of individual spears.

[2] Measured as percentage of individual spears with invalid flowering readings.


2017A Cultivar Trial – Transplants: 2022 Yield Data
Michigan Asparagus Industry Research Farm - Hart, MI
Yield (lbs/acre)
6000
4000
2000
0
UG-33
UG-24
Javelim
UG-27
Millennium
UG-25
Bejo 3025
UG-23
UG-34
UG-29
UG-35
UG-32
UG-31
UG-28
UG-36
UG-26
UG-30
Canticus
Small
Standard
Large
Jumbo


2017A Cultivar Trial – Transplants: 2022 Yield Distribution
Michigan Asparagus Industry Research Farm - Hart, MI
Yield (lbs/acre)
UG-23
7,661 lb/ac
UG-33
6,841 lb/ac
UG-34
6,552 lb/ac
UG-27
6,540 lb/ac
UG-25
6,004 lb/ac
Bejo 3025
5,936 lb/ac
UG-36
5,927 lb/ac
UG-29
5,866 lb/ac
UG-24
5,852 lb/ac
Millennium
5,664 lb/ac
Javelim
5,593 lb/ac
UG-32
5,265 lb/ac
UG-26
5,021 lb/ac
UG-35
4,906 lb/ac
UG-31
4,800 lb/ac
UG-28
4,466 lb/ac
UG-30
4,401 lb/ac
Canticus
4,270 lb/ac
0
100
200
300
400
500
May 15
Jun 01
Jun 15
Small
Standard
Large
Jumbo

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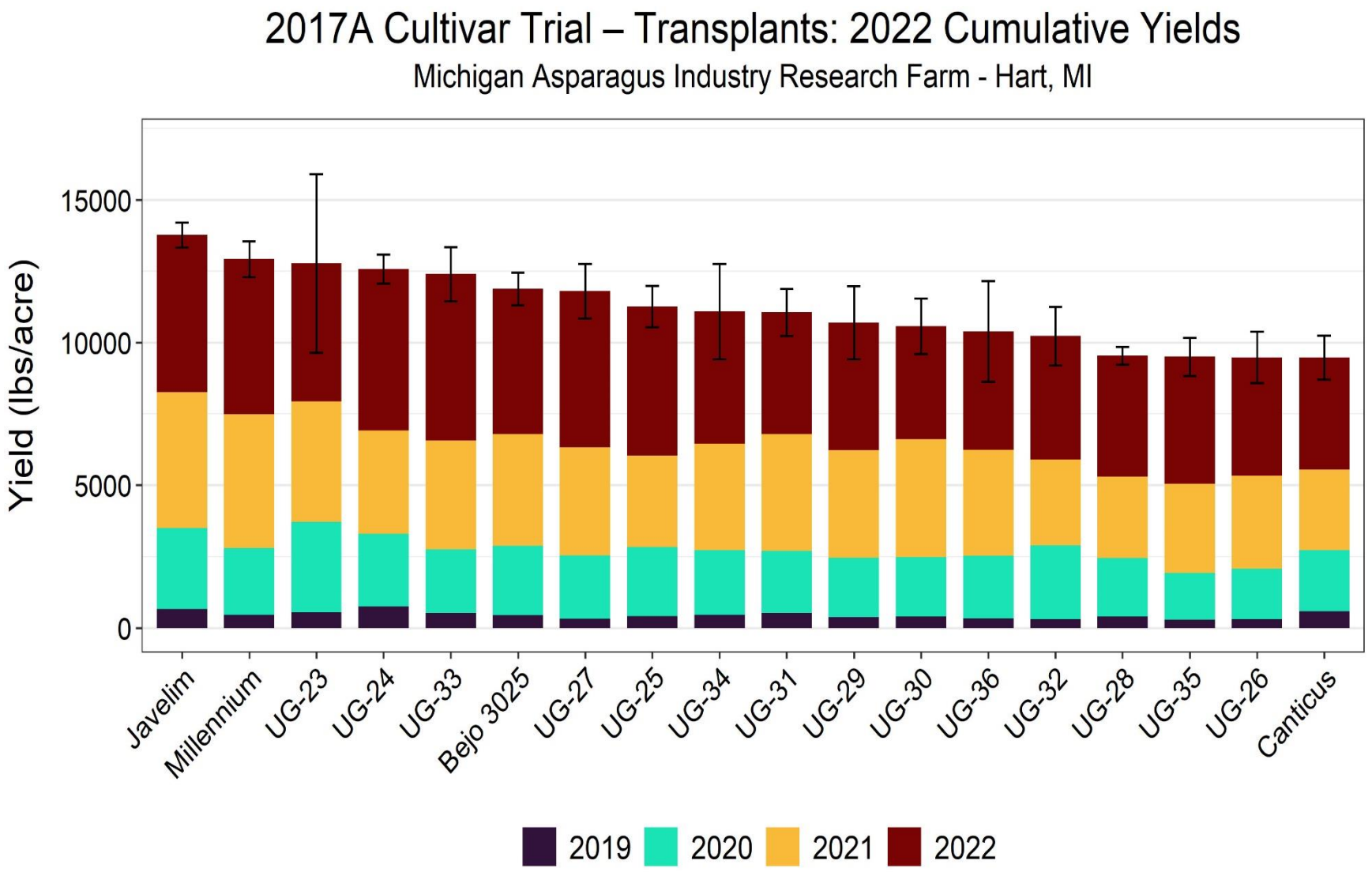
2017A Cultivar Trial – Transplants: 2022 Cumulative Yields

Michigan Asparagus Industry Research Farm - Hart, MI

Cultivar	Mean Yields in lbs./acre				
	2019	**2020**	**2021**	**2022**	**Total**
Javelim	**666**	2834	4758	5513	13771
Millennium	461	2346	4678	5438	12923
UG-23	**558**	3146	4221	4854	12780
UG-24	**750**	2551	3622	5645	12569
UG-33	525	2223	3810	5838	12396
Bejo 3025	438	2440	3914	5086	11877
UG-27	313	2219	3796	5471	11800
UG-25	416	2422	3200	5218	11256
UG-34	457	2263	3731	4636	11088
UG-31	513	2186	4093	4264	11055
UG-29	387	2073	3764	4466	10691
UG-30	390	2081	4137	3963	10571
UG-36	332	2186	3715	4158	10391
UG-32	297	2598	3011	4317	10223
UG-28	400	2052	2848	4233	9533
UG-35	282	1648	3125	4446	9501
UG-26	299	1772	3257	4155	9482
Canticus	**588**	2134	2830	3921	9473
p Value	0.0006	0.1803	0.4656	0.4703	0.2798
LSD.05	207	n.s.	n.s.	n.s.	n.s.

Quantities not significantly different from the maximum in each column shown in bold.


2017A Cultivar Trial – Transplants: 2022 Cumulative Yields
Michigan Asparagus Industry Research Farm - Hart, MI
Yield (lbs/acre)
15000
10000
5000
0
Javelim
Millennium
UG-23
UG-24
UG-33
Bejo 3025
UG-27
UG-25
UG-34
UG-31
UG-29
UG-30
UG-36
UG-32
UG-28
UG-35
UG-26
Canticus
2019
2020
2021
2022

2017C Competitors Trial: 2022 Yield Data

Michigan Asparagus Industry Research Farm - Hart, MI

Variety	Mean Yields in lbs./acre					Spear Tip Quality	
	Small	Standard	Large	Jumbo	Total	Avg Flowering[1]	Invalid[2]
Gijnlim	62	2509	**2732**	986	**6290**	25%	**8%**
Millennium	44	2685	**2872**	507	**6108**	**26%**	6%
Greenic	47	2647	**2788**	602	**6084**	**26%**	7%
Eclipse	45	2394	**2304**	977	**5721**	**27%**	6%
Ramirus	36	2342	**2391**	912	**5682**	24%	4%
Equinox	46	2687	**2474**	408	**5615**	**27%**	5%
Aspalim	55	2029	**2537**	931	**5552**	**27%**	6%
Spartacus	48	2279	**2224**	523	**5074**	**28%**	7%
Greenox	31	2177	**2175**	650	**5034**	**28%**	7%
UG-10	47	2230	1977	555	**4809**	**26%**	**10%**
Sequoia	36	1736	1930	819	4520	**28%**	**8%**
Rapsody	46	1907	1973	524	4450	25%	4%
Avalim	42	2084	1751	448	4325	**28%**	7%
W Deluxe	31	2184	1543	267	4025	**27%**	5%
p Value	0.8073	0.1927	0.0418	0.2390	0.0306	0.0308	0.0079
LSD.05	n.s.	n.s.	848	n.s.	1521	3	3

Quantities not significantly different from the maximum in each column shown in bold.

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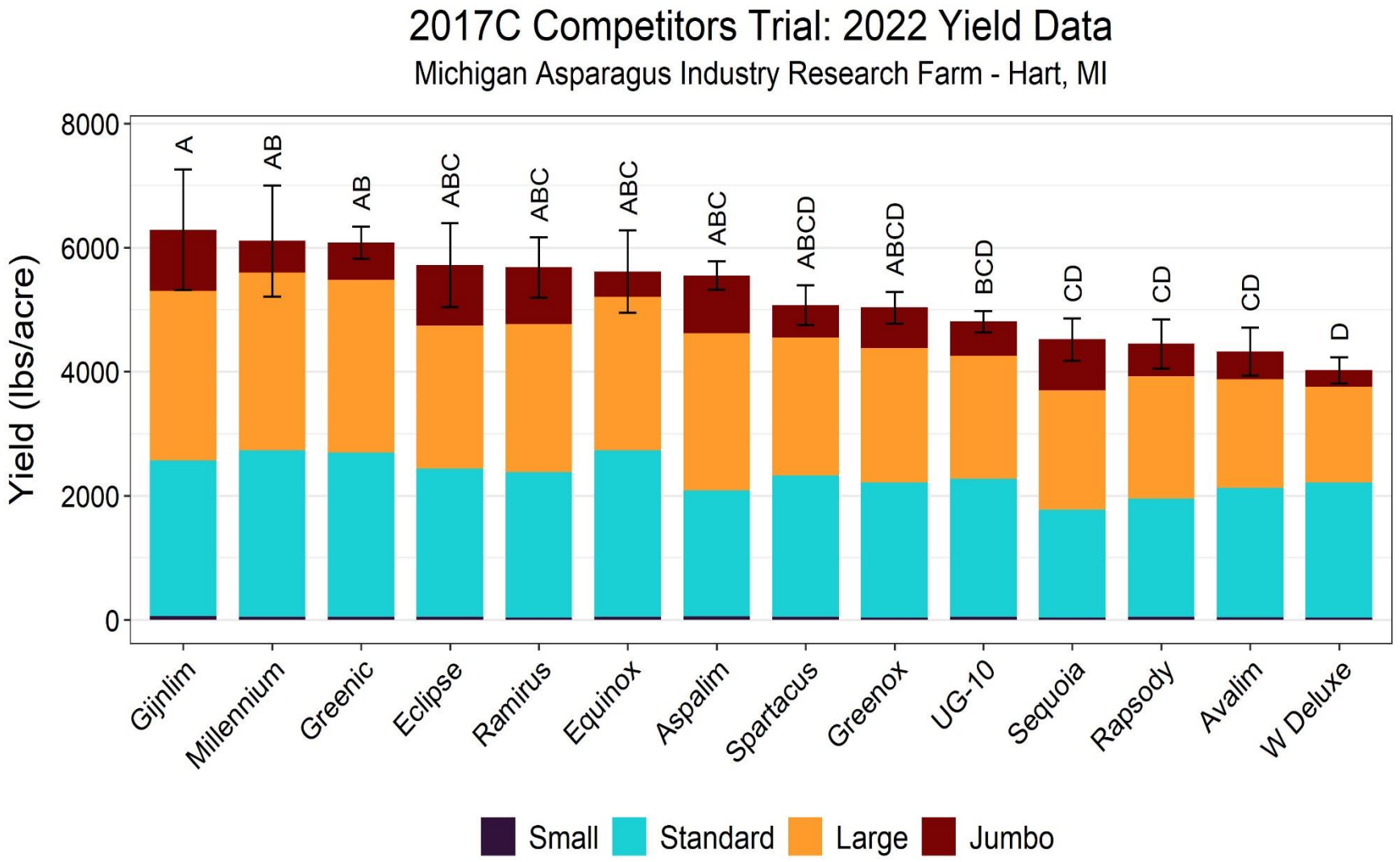
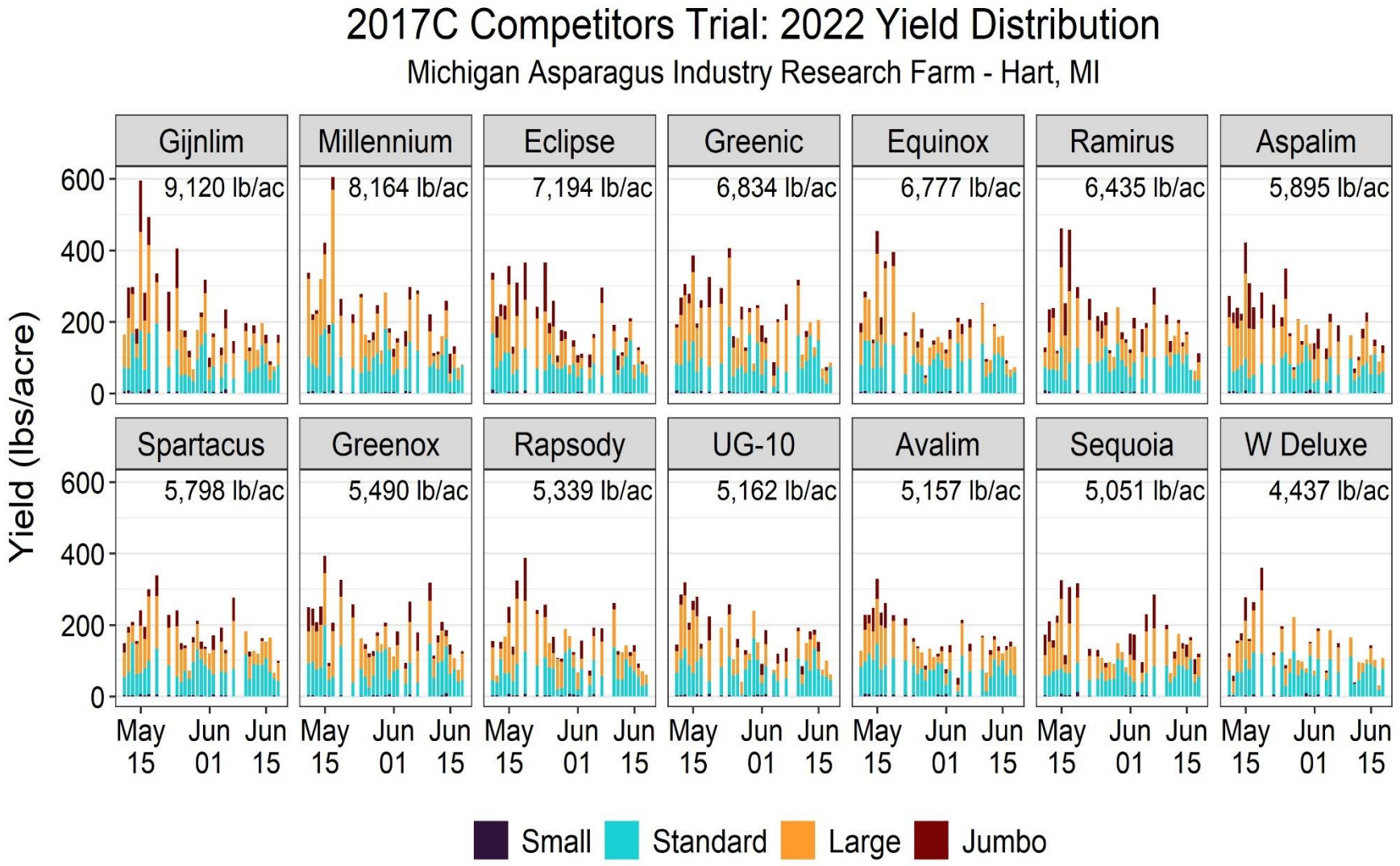
[2] Measured as percentage of individual spears with invalid flowering readings.


2017C Competitors Trial: 2022 Yield Data
Michigan Asparagus Industry Research Farm - Hart, MI
Yield (lbs/acre)
8000
6000
4000
2000
0
A
AB
AB
ABC
ABC
ABC
ABC
ABCD
ABCD
BCD
CD
CD
CD
D
Gijnlim
Millennium
Greenic
Eclipse
Ramirus
Equinox
Aspalim
Spartacus
Greenox
UG-10
Sequoia
Rapsody
Avalim
W Deluxe
Small
Standard
Large
Jumbo


2017C Competitors Trial: 2022 Yield Distribution
Michigan Asparagus Industry Research Farm - Hart, MI
Yield (lbs/acre)
Gijnlim
9,120 lb/ac
Millennium
8,164 lb/ac
Eclipse
7,194 lb/ac
Greenic
6,834 lb/ac
Equinox
6,777 lb/ac
Ramirus
6,435 lb/ac
Aspalim
5,895 lb/ac
Spartacus
5,798 lb/ac
Greenox
5,490 lb/ac
Rapsody
5,339 lb/ac
UG-10
5,162 lb/ac
Avalim
5,157 lb/ac
Sequoia
5,051 lb/ac
W Deluxe
4,437 lb/ac
0
200
400
600
May 15
Jun 01
Jun 15
Small
Standard
Large
Jumbo

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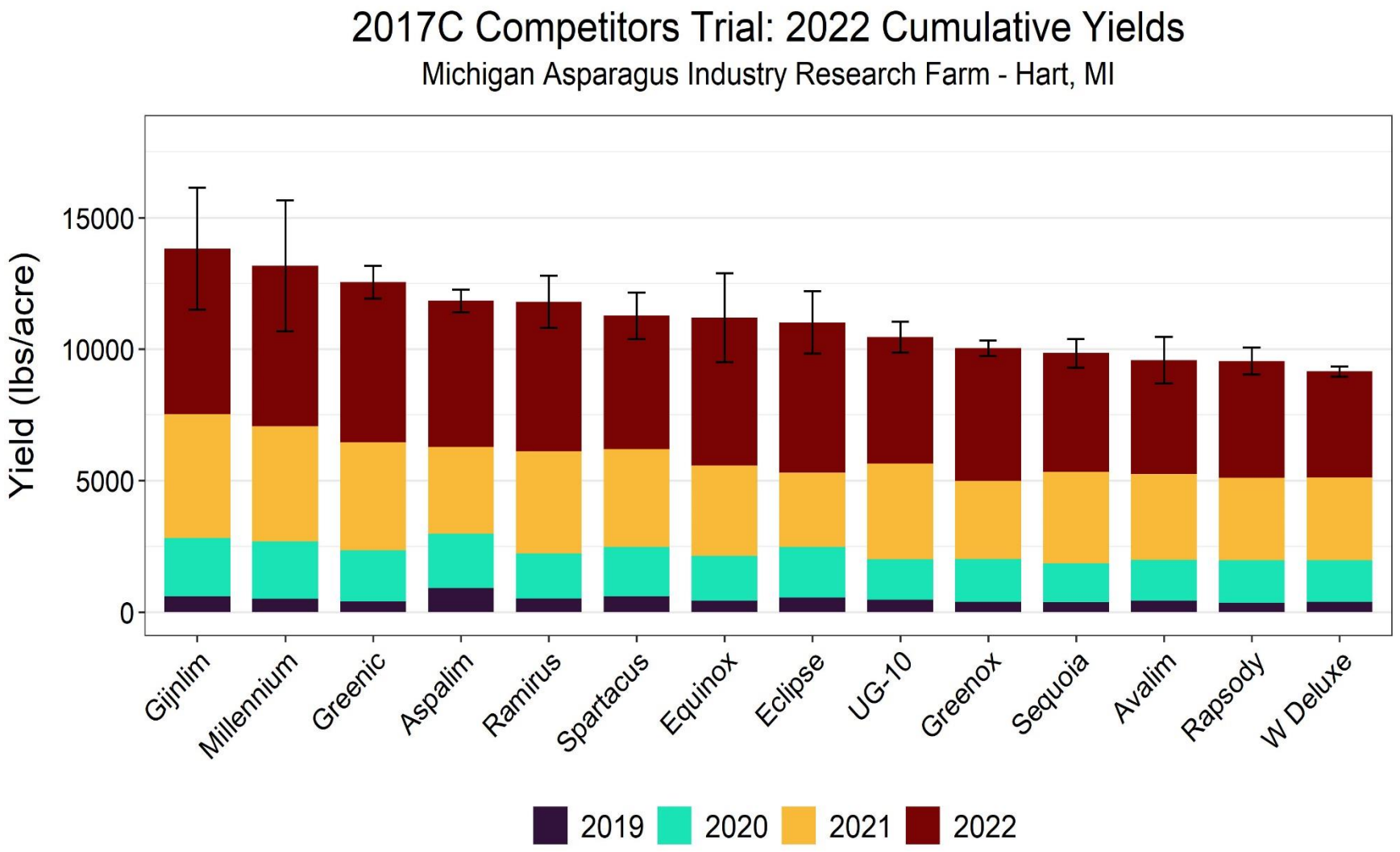
2017C Competitors Trial: 2022 Cumulative Yields

Michigan Asparagus Industry Research Farm - Hart, MI

Variety	Mean Yields in lbs./acre				
	2019	**2020**	**2021**	**2022**	**Total**
Gijnlim	604	2211	4709	**6290**	13814
Millennium	506	2175	4380	**6108**	13169
Greenic	411	1943	4104	**6084**	12542
Aspalim	**917**	2066	3301	**5552**	11836
Ramirus	524	1710	3881	**5682**	11797
Spartacus	605	1872	3726	**5074**	11276
Equinox	444	1692	3445	**5615**	11196
Eclipse	554	1917	2824	**5721**	11017
UG-10	473	1524	3648	**4809**	10453
Greenox	387	1636	2973	**5034**	10030
Sequoia	368	1484	3475	4520	9848
Avalim	438	1548	3268	4325	9579
Rapsody	354	1614	3132	4450	9549
W Deluxe	391	1575	3162	4025	9152
p Value	< 0.0001	0.4669	0.2038	0.0306	0.0561
LSD.05	206	n.s.	n.s.	1521	n.s.

Quantities not significantly different from the maximum in each column shown in bold.


2017C Competitors Trial: 2022 Cumulative Yields
Michigan Asparagus Industry Research Farm - Hart, MI
Yield (lbs/acre)
15000
10000
5000
0
Gijnlim
Millennium
Greenic
Aspalim
Ramirus
Spartacus
Equinox
Eclipse
UG-10
Greenox
Sequoia
Avalim
Rapsody
W Deluxe
2019
2020
2021
2022

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Guelph Eclipse Plant Population Study
2022 Results

John Bakker

Objectives:

To evaluate the effect of planting density on yield and spear size in a planting of the asparagus variety Guelph Eclipse.

Methods:

The trial was established in 2017 with 1 year old crowns of Guelph Eclipse planted on 13 May, 2017. The crowns are spaced 6, 9 or 12 inches apart in 54" rows. Each plot is 25" feet long. Plots with plant spacing of 6" apart consist of 50 crowns, 9" spacing have 33 crowns, and 12" spacing contain 25 crowns per plot. The planting density for the 3 treatments are 19,360, 14,520, and 9,680 crowns per acre, respectively. Fresh weight, spear number and spear size, based on diameter are measured and recorded for each harvest.

Results:

During the 2022 harvest season, there were no significant differences in either yield or spear diameter in the Guelph Eclipse plant population study.

2017B Eclipse Plant Population Trial: 2022 Yield Data

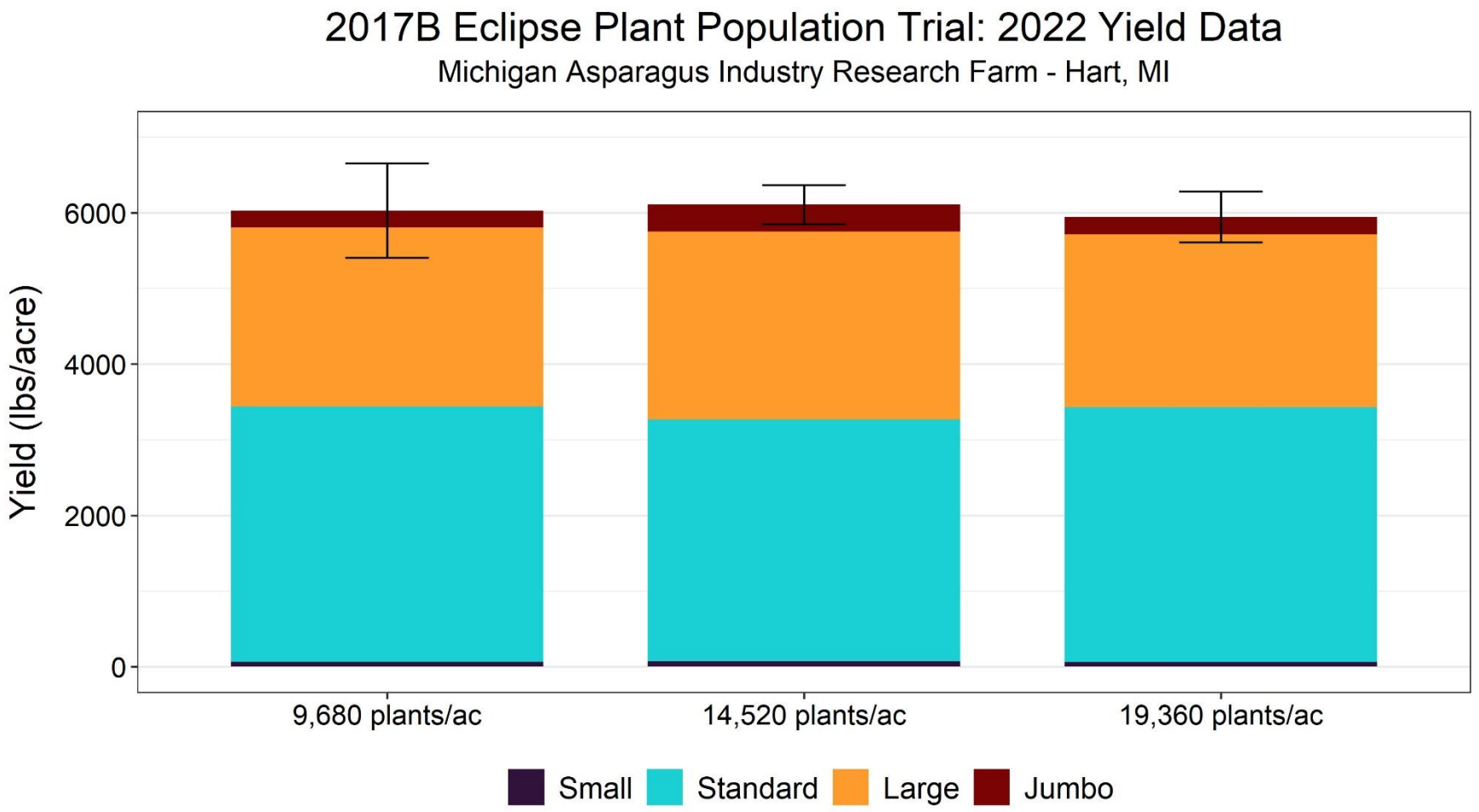
Michigan Asparagus Industry Research Farm - Hart, MI

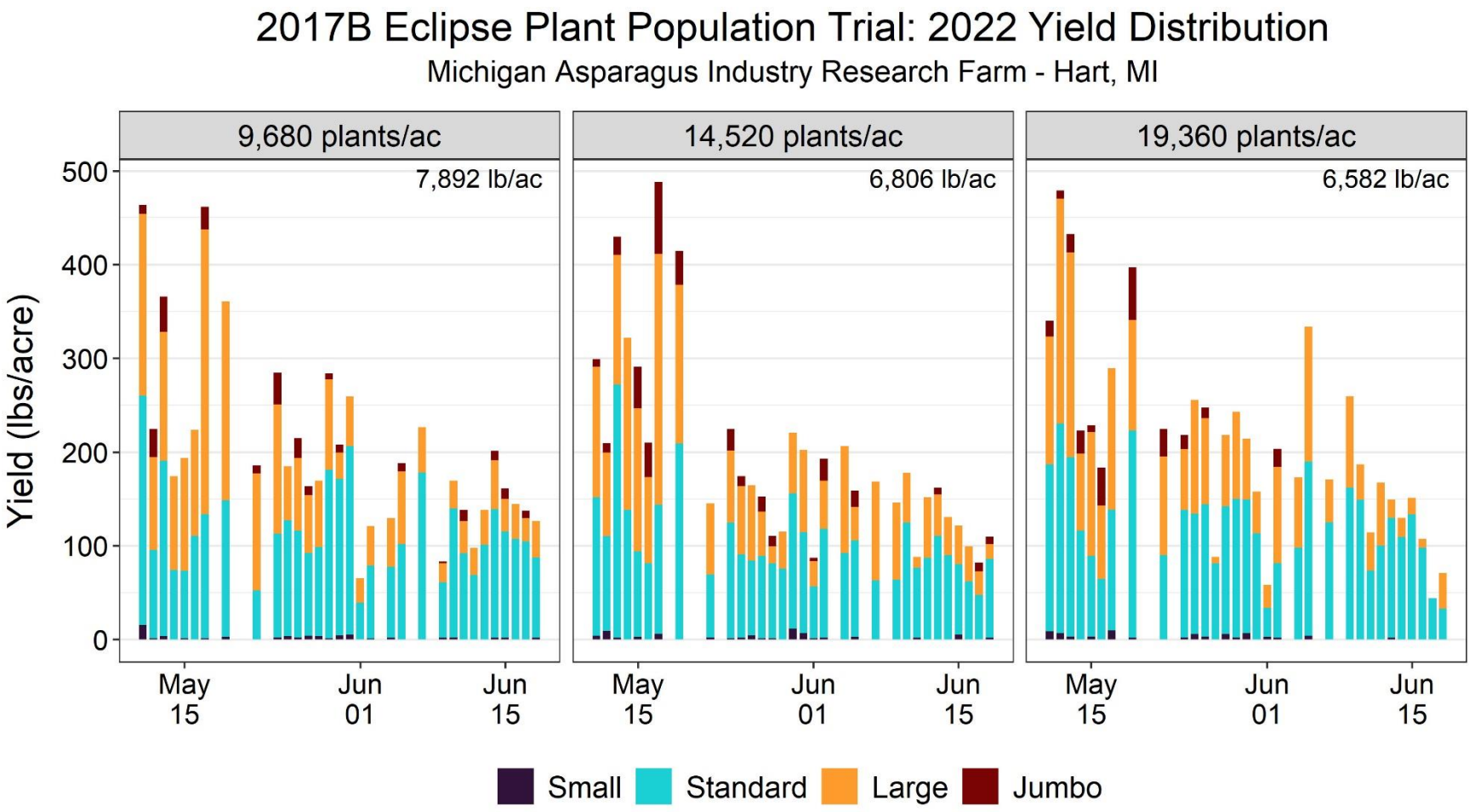
Population	Mean Yields in lbs./acre					Spear Tip Quality	
	Small	Standard	Large	Jumbo	Total	Avg Flowering[1]	Invalid[2]
9,680 plants/ac	61	3382	2367	222	6031	30%	6%
14,520 plants/ac	68	3200	2484	357	6110	32%	7%
19,360 plants/ac	59	3370	2286	233	5948	31%	7%
p Value	0.8964	0.7401	0.8705	0.4117	0.9661	0.1264	0.3811
LSD.05	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.

Quantities not significantly different from the maximum in each column shown in bold.

[1] Measured as mean of flowering percentage of individual spears.

[2] Measured as percentage of individual spears with invalid flowering readings.


2017B Eclipse Plant Population Trial: 2022 Yield Data
Michigan Asparagus Industry Research Farm - Hart, MI
Yield (lbs/acre)
6000
4000
2000
0
9,680 plants/ac
14,520 plants/ac
19,360 plants/ac
Small
Standard
Large
Jumbo


2017B Eclipse Plant Population Trial: 2022 Yield Distribution
Michigan Asparagus Industry Research Farm - Hart, MI
9,680 plants/ac
14,520 plants/ac
19,360 plants/ac
7,892 lb/ac
6,806 lb/ac
6,582 lb/ac
Yield (lbs/acre)
500
400
300
200
100
0
May 15
Jun 01
Jun 15
Small
Standard
Large
Jumbo

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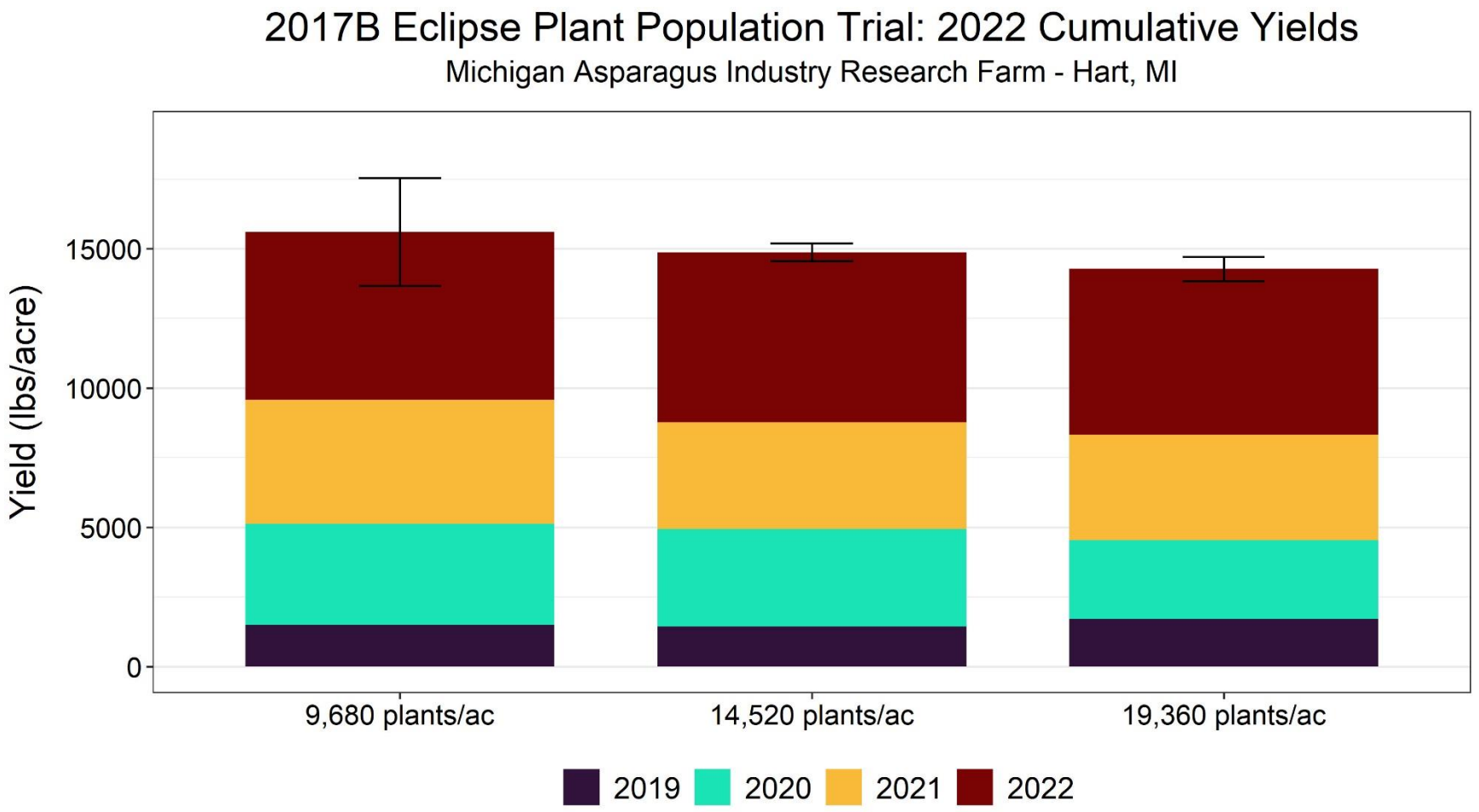
2017B Eclipse Plant Population Trial: 2022 Cumulative Yields

Michigan Asparagus Industry Research Farm - Hart, MI

Population	Mean Yields in lbs./acre				
	2019	**2020**	**2021**	**2022**	**Total**
9,680 plants/ac	1486	3638	4445	6031	15600
14,520 plants/ac	1425	3514	3825	6110	14873
19,360 plants/ac	1705	2836	3786	5948	14275
p Value	0.1822	0.3424	0.3265	0.9661	0.7059
LSD.05	n.s.	n.s.	n.s.	n.s.	n.s.

Quantities not significantly different from the maximum in each column shown in bold.


2017B Eclipse Plant Population Trial: 2022 Cumulative Yields
Michigan Asparagus Industry Research Farm - Hart, MI
Yield (lbs/acre)
15000
10000
5000
0
9,680 plants/ac
14,520 plants/ac
19,360 plants/ac
2019
2020
2021
2022

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Taking Asparagus Disease Management into the Future with Real-Time, In-Field Sensor Data

Younsuk Dong, MSU Biosystems and Agricultural Engineering
Mary Hausbeck, MSU Plants, Soil and Microbial Sciences
Keith Mason, MSU Geography Environment Spatial Sciences
Ben Werling, MSU Extension

Research Takeaways

- TOMCAST Disease Severity Values (DSV)s of LOCOMOS and Spectrum have been compared.
- MSU Enviroweather is currently working on developing a webpage for TOMCAST.
- Quadris SC alt Bravo WS SC with TOMCAST at 15 DSV is the recommended spray program based on the 2022 research experiment.
- Fungicide programs of Manzate Prostick alternated with Bravo WS SC at 20 DSV had a similar disease severity as the untreated control.

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Taking asparagus disease management into the future with real-time, in-field sensor data

Younsuk Dong[1], Ben Werling[4], John Spafford[2], Mary Hausbeck[2], Keith Mason[3]

[1]Biosystems and Agricultural Engineering
[2]Plants, Soil and Microbial Sciences
[3]Geography Environment Spatial Sciences
[4]Michigan State University Extension

MICHIGAN ASPARAGUS

USDA United States Department of Agriculture Agricultural Marketing Service

1

MICHIGAN STATE UNIVERSITY | Extension

Background – Purple spot

- *Stemphylium vesicarium*, or purple spot, is a foliar disease of asparagus that requires a well-timed fungicide program.
- Asparagus shoots develop into fern after harvest ends in June; purple spot can defoliate the fern, reducing the recharge of roots with carbohydrates that fuel next year's harvest.
- A purple spot outbreak in mid-summer causes premature fern defoliation, reducing subsequent yields.
- During spring harvest, purple spot can infect spears, causing blemishes that make them unmarketable.
- Periods of high relative humidity and frequent rainfall favor purple spot.

Photo Credit: Ben Werling and Mary Hausbeck

2

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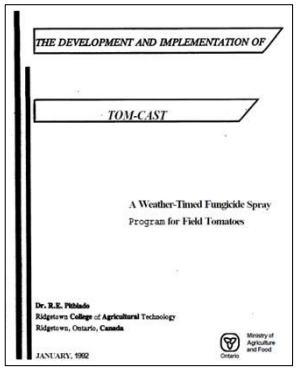
Background - Tomcast

- Is the disease forecaster, originally developed for use for tomato early blight, has been adapted to time fungicide sprays to the fern for protection from purple spot disease.
- TOMCAST-guided fungicide sprays provide satisfactory purple spot control and reduce fungicide applications compared to a calendar-based spray program.
- TOMCAST was implemented by the industry ~15 years ago and is used today but the technology needs to be updated.



THE DEVELOPMENT AND IMPLEMENTATION OF

TOM-CAST

A Weather-Timed Fungicide Spray Program for Field Tomatoes

Dr. R.E. Pitblado
Ridgetown College of Agricultural Technology
Ridgetown, Ontario, Canada

JANUARY, 1992

Ministry of Agriculture and Food Ontario

3

MICHIGAN STATE UNIVERSITY | Extension

Background - Current

Every year, crop consultants and Michigan State University Extension (MSUE) staff place out leaf wetness and temperature sensors to protect Michigan's ~10,000 acres of asparagus.

Currently,

1. Crop scouts or MSUE staff visit these sensors once a week to download weather data.
2. Open the data in proprietary software to run the TOMCAST model.
3. The software computes Disease Severity Values (DSVs) which give growers an indication of when conditions are favorable for foliar disease.
4. Scouts then print or email a report of DSVs to growers. MSUE staff collates data from MSU sensors and crop scouts into a weekly report, so growers without sensors can find one near to them and use the data.
5. Growers use the information each week to decide if and when to apply fungicides.

4

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Background - Current

- Is a time lag between when growers need to make spray decisions and when data become available.
- Need to physically visit sensors limits data downloads to once per week and limits the number of fields sensors can be deployed in.
- Leads to the issue of using “last week’s data to make this week’s spray decisions” or using data from “the neighbor’s sensor.”

Having a coupled hardware-software system that allows data to be collected and visualized over the web would alleviate the time lag, allowing growers to know what’s happening in their fields the same day they make spray decisions

5

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LOCOMOS (Low-Cost Sensor Monitoring System)

- Soil Moisture Levels
- Soil Temperature
- Leaf Surface Temperature
- Leaf Wetness Duration
- Temperature
- Humidity
- Precipitation

6

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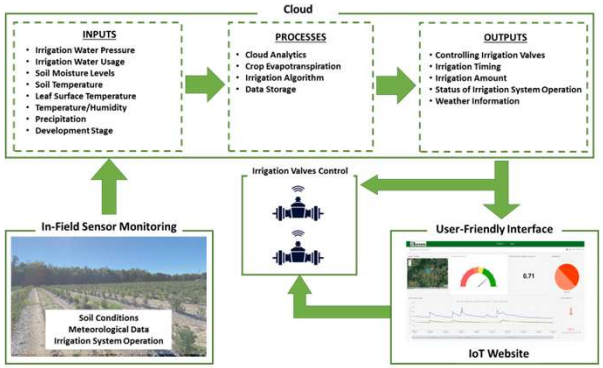
LOCOMOS



7

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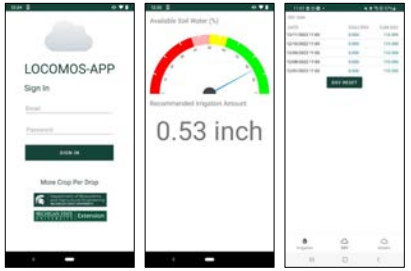
LOCOMOS



8

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Objectives

Objective 1. Compare TOMCAST data from the LOCOMOS and Spectrum sensor packages.

Objective 2. Develop an Application Programming Interface (API) to ingest data from LOCOMOS stations to be used in Enviroweather models.

Objective 3. Create a TOMCAST model on Enviroweather for use in asparagus, and code the model for the Enviroweather's new website.

Objective 4. Establish a TOMCAST demonstration plot that is sprayed for purple spot disease using data from the LOCOMOS sensor.

9

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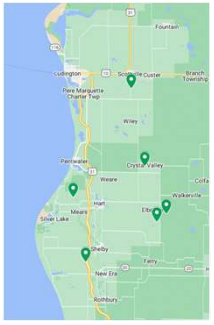
(Obj. 1). Compare TOMCAST data from the LOCOMOS and Spectrum sensor packages.

Installed 6 LOCOMOS stations in 6 asparagus fields across Michigan's main production area.



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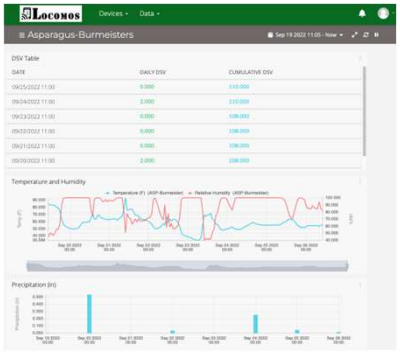
(Obj. 1). Compare TOMCAST data from the LOCOMOS and Spectrum sensor packages.



- Leaf Wetness Sensitivity
- DSV Comparison

Date	Spectrum			LOCOMOS		
	Temp C	LWD	DSV	Temp C	LWD	DSV
7/10/2022	13.4	12.8	1	17	7	1
7/11/2022	17.6	5.5	1	19	16	3
7/12/2022	19.0	15.0	2	18	12	2
7/13/2022	18.2	11.8	2	14	12	1
7/14/2022	14.2	9.8	1	11	12	0
7/15/2022	11.9	11.3	0	18	20	3
7/16/2022	18.2	19.3	3	19	13	2
7/17/2022	19.0	10.5	2	18	13	2

11

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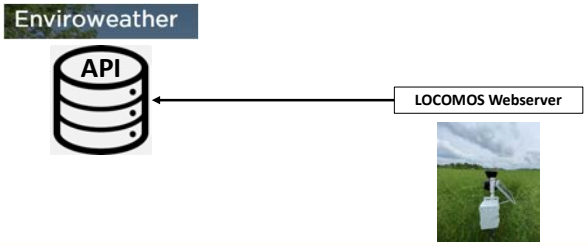
(Obj. 2). Develop an Application Programming Interface (API) to ingest data from LOCOMOS stations to be used in Enviroweather models.

- Created an API for data gathering from LOCOMOS webserver.
- Developed process automation and data storage.



12

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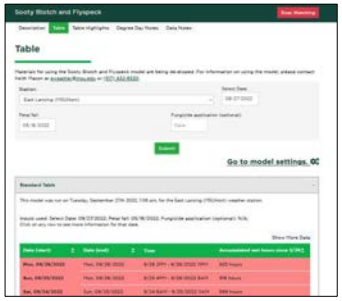
(Obj. 3). Create a TOMCAST model on Enviroweather for use in asparagus, and coc
the model for the Enviroweather's new website.

- Has reviewed and modify existing TOMCAST model.
- Will be working on recording TOMCAST model for Enviroweather's new web platform.
- The TOMCAST Model for Asparagus will look and function similarly to this model, and will allow users to enter the date of a fungicide application and reset the model.



Sooty Blotch model on Enviroweather.

13

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(Obj. 4). Establish a TOMCAST demonstration plot that is sprayed for purple spot disease using data from the LOCOMOS sensor.

- This trial was established in 2022 at a grower cooperator's established asparagus field located in Shelby, MI.
- SpecConnect sensor and LOCOMOS were installed in grower cooperator asparagus field.
- Each replicate consisted of 20 ft rows with 5 ft buffers between treatments.
- Treatments were arranged in a randomized complete block design, with four replicates.
- Treatment plots were evaluated for foliar disease severity using a 0%-100% scale.

14

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(Obj. 4). Establish a TOMCAST demonstration plot that is sprayed for purple spot disease using data from the LOCOMOS sensor.

Summary

- Grower Recommendation: Quadris SC alt Bravo WS SC with TOMCAST at 15 DSV.
- Manzate Pro Stick WP *alt* Bravo WS SC with TOMCAST at 20 DSV was similar to the Untreated Control.
- Miravis Prime SC *alt* Bravo WS SC at 20 DSV provided effective control with fewer applications compared to grower standard and similar to 15 DSV
  - Saves two applications

15

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Timeline

Objectives	Q1	Q2	Q3	Q4
(Obj. 1) Compare TOMCAST data from the LOCOMOS and Spectrum sensor packages.				
(Obj. 2) Develop an Application Programming Interface (API) to ingest data from LOCOMOS stations to be used in Enviroweather models.				
(Obj. 3) Create a TOMCAST model on Enviroweather for use in asparagus, and code the model for the Enviroweather's new website.				
(Obj. 4) Establish a TOMCAST demonstration plot that is sprayed for purple spot disease using data from the LOCOMOS sensor.				

16

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Investigating Controlled Atmosphere Storage of Asparagus

Randy Beaudry and Phil Engelgau, MSU Department of Horticulture
Ben Werling, MSU Extension
John Bakker, Michigan Asparagus Research Farm

Research Takeaways

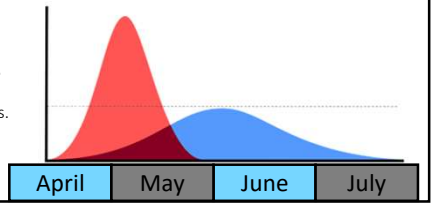
- Controlled Atmosphere (CA) storage (10% CO2 and 11% O2) can stretch the storage time for asparagus by about 10 days when the quality of the spears put into storage is good.
- CA storage results are best for spears from the first week or two of the main harvest window.
- Weak spears such as those that have endured challenging growth events (e.g., following excessive heat, blowing sand damage, freeze events) or late harvested spears should not be stored.

1

'Millennium' dominates MI production

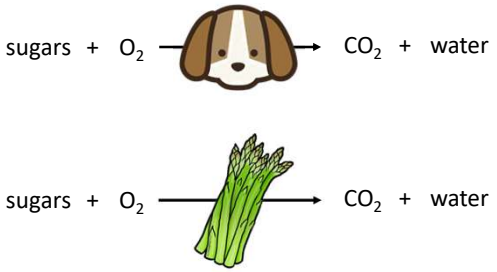
- Also known as 'Guelph Millennium', 'University of Guelph Millennium', or 'UG Millennium'. The cultivar is well tailored for MI growing conditions
- An estimated 8 out of 9 acres of MI asparagus acreage are planted with 'Millennium'
- 'Millennium' has sharp production spikes during the 3rd through 7th harvests, yielding +30% of the annual crop within these 5 of the typically 40 annual harvests
- The above leads to severe market imbalances of supply and demand, ultimately driving down prices

At a 2018 advisory meeting, growers asked us to explore controlled atmosphere storage to extend the shelf life of asparagus from production spikes and "meter it out" to reduce downward pressure on prices.



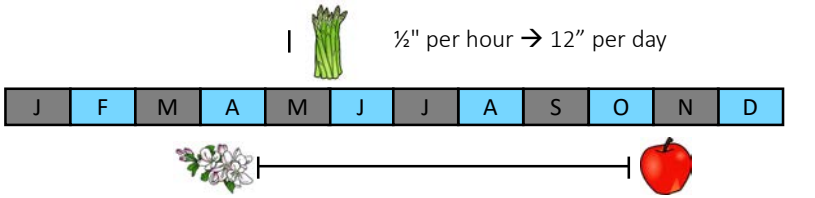
2

All living things respire, including fresh produce



3

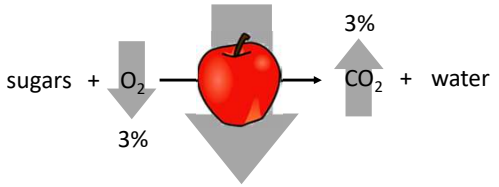
Timeline of asparagus vs apple growth



0.23 in^3 per day 'Aztec Fuji'

4

Controlled atmosphere storage

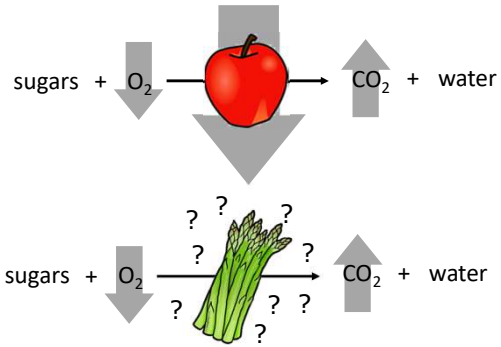


- lower O_2 limits overall metabolism
- lower O_2 and higher CO_2 decrease ethylene action (greatly slows metabolism by slowing ripening)
- higher CO_2 prevents decay

! • too low O_2 leads to fermentation and death; too high CO_2 causes several disorders

5

Controlled atmosphere storage



6

Experimental Considerations

- Asparagus has an exceptionally high respiration rate
- MI asparagus, uniquely, is harvested by snapping above ground

Literature Review

- Low O_2 not beneficial: levels of O_2 needed to reduce respiration cause fermentation in asparagus
- Elevated CO_2 can:
  - suppress soft rot at butt (needs 10 to 30% CO_2)
  - reduce the rate of toughening and degreening
  - enhance vitamin C loss
  - cause damage (time and temperature dependent)
  - reduce the rate of visual quality loss -- usually

2020 preliminary trial

7

Experimental Conditions (2021)

- 'Millennium' spears from three grower lots were placed in five target atmospheres at 34°F (1°C):
  - Air
  - 11% O_2, 10% CO_2
  - 11% O_2, 6% CO_2
  - 3% O_2, 10% CO_2
  - 3% O_2, 6% CO_2
- Analyzed spears from multiple harvest dates:
  - Early (main harvest period for 'Millennium')
  - Middle & late harvests as well
- Sampled spears that were harvested by snapping or by cutting
- Spears were held in CA for up to 4 weeks and monitored weekly for visual quality as well as for sugar and texture parameters
- Spears pulled from CA were then trimmed and stored for 6 days in air at 39°F (4°C) to simulate cold-chain and home refrigerator conditions

8

2021 Results – Visual Quality

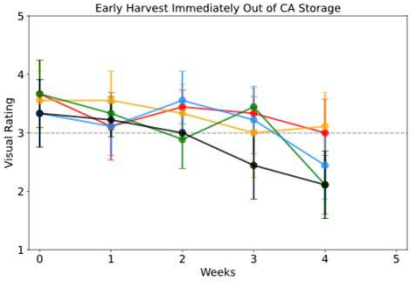
"1" rating
Majority of tips/spears rotten or shriveled

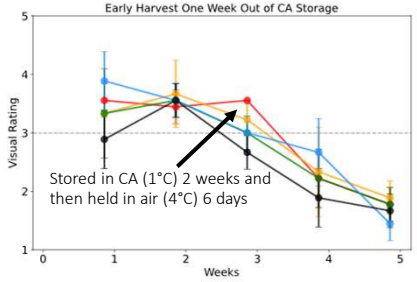
"3" rating
Limit of salability

"4" rating
Acceptable tip spread, no discoloration or dehydration, no rot

9

2021 Results – Visual Quality – CA Effects



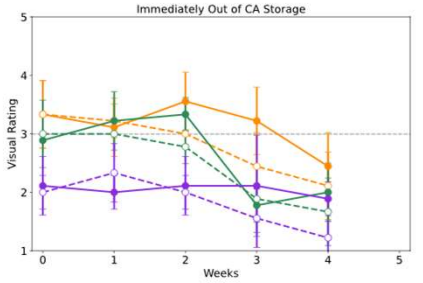


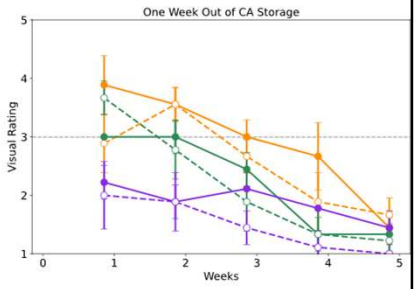
Air
11% O_2, 10% CO_2
11% O_2, 6% CO_2
3% O_2, 10% CO_2
3% O_2, 6% CO_2

- Storage beyond 2 weeks is ill-advised
- 11% O_2 atmospheres are slightly better than 3% O_2
- Air was the marginally worst atmosphere

10

2021 Results – Visual Quality – Harvest Period Effects





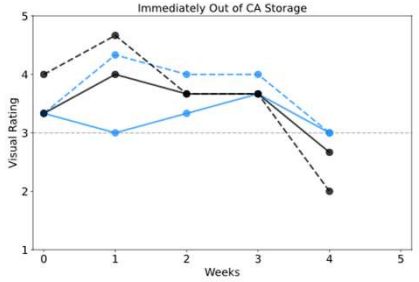
Early Harvest
Middle Harvest
Late Harvest

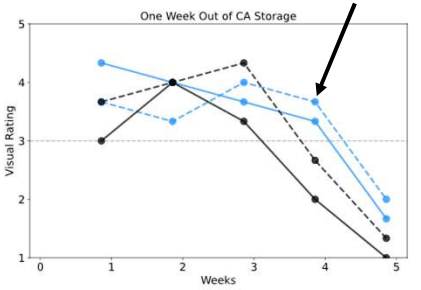
3% O_2, 6% CO_2
Air

- Quality will never increase with storage
- Only store high-grade, early season spears

11

2021 Results – Visual Quality – Harvest Method Effects





Air
3% O_2, 6% CO_2

Snapped
Cut

- Cut spears with more energy reserves store slightly better than shorter snapped spears

12

2021 Results – Sugar & Firmness Results

- Overall glucose, fructose and sucrose levels decrease slowly over time (~60% reduction)
- No clear difference between atmosphere treatments
- Cut spears may retain marginally more sugar than snapped spears

- Firmness was relatively stable throughout the study. Spears stored in air seemed to have slightly lower firmness than those in other atmospheres

13

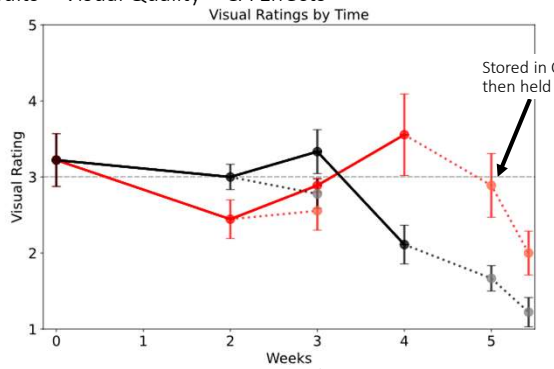
Experimental Conditions (2022)

- 'Millennium' spears from three fields of one grower were placed in two target atmospheres at 34°F (1°C):
  - Air
  - 11% O_2, 10% CO_2
- Atmospheres weren't interrupted until analysis
- Analyzed spears from 'Millennium' glut period

- Sampled spears that were harvested by snapping or by cutting
- Spears were held in continuous CA for up to 4 weeks and were monitored weekly for visual quality
- Spears pulled from CA were then trimmed and stored for 6-10 days in air at 39°F (4°C) to simulate cold-chain and home refrigerator conditions

14

2022 Results – Visual Quality – CA Effects



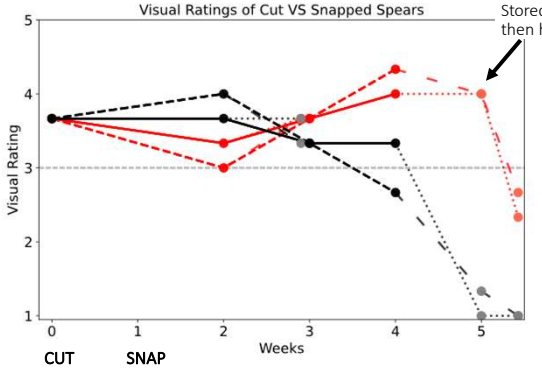
Air
11% O_2, 10% CO_2

Immediately out of (1°C) storage
Trimmed spears held in air, 4°C

- Spears in CA eventually outperformed those in air

15

2022 Results – Visual Quality – Harvest Method Effects



Air
11% O_2, 10% CO_2

CUT
SNAP

Immediately out of (1°C) storage
Trimmed spears held in air, 4°C

- Cut/Snap effect not clear in 2022

16

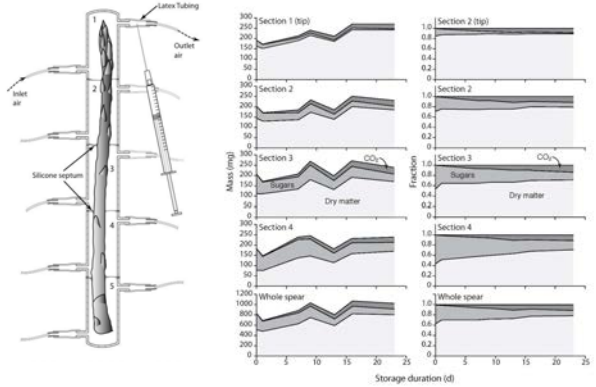
Conclusions (2021 & 2022)

- CA storage of 'Millennium' is a risky, and highly variable enterprise to endeavor
- Store only the highest quality spears
- If possible, harvest by cutting and collect as much of the butt as possible. This is more important for spears of lower initial quality. Do NOT trim spears before storage
- Storage beyond 2 weeks unadvisable but possible. Higher quality spears translate into greater storage capacity
- Spears of all initial qualities will appear saleable immediately after exiting storage, but spears of sub-supreme initial quality will deteriorate and decay very quickly in the cold-chain, possibly faster than it can even reach the buyers fridge and likely faster than consumer expectations
- We recommend 11% O_2, 10% CO_2 (agrees with most literature)
  - Keep O_2 above 3% and elevate CO_2 up to 10%
  - Do not disturb atmosphere if possible
  - Avoid prolonged air storage
- Consider an earlier-producing cultivar that does not compete during 'Millennium's glut period

17

Next Steps

- CA storage of other cultivars to evaluate cultivar differences
- Determine the nature of tip degradation (sugar loss/depletion?)
- Evaluate the influence of plant growth regulators – Abscisic acid options.



18

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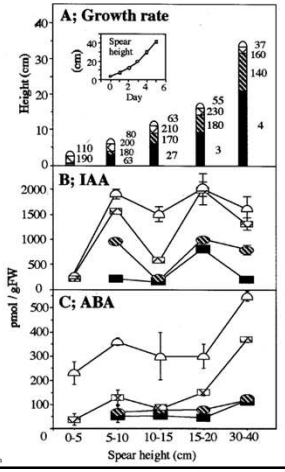


Distribution of ABA and IAA in Asparagus

K. Kojima
Faculty of Agriculture, Niigata University, Ikarashi 2-8050, Niigata, 950-2181, Japan

19

Asparagus Beetle Overwintering Biology & Management

Zsofia Szendrei, Laura Marmolejo, and Jen Roedel (formerly Jen Zavalnitskaya)
MSU, Department of Entomology

Research Takeaways

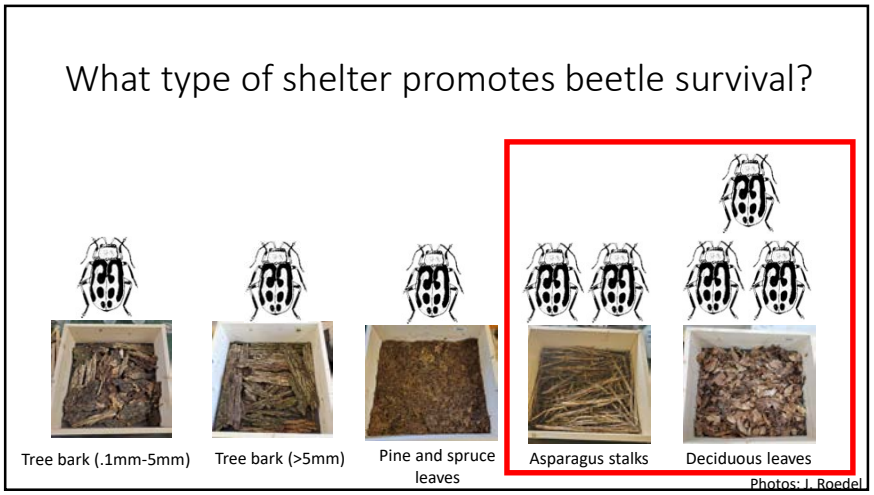
- Asparagus beetles overwinter primarily in asparagus residue and leaf litter in the field so chopping/mowing residue may be important to suppress populations.
- Asparagus beetle numbers were lower 24 hours after Coragen, Carbaryl and Entrust applications during harvest compared to the control.
- Future research will continue to investigate the impact of residue management in the field and look for effective insecticides with a 24 hour PHI for asparagus beetle management.


Asparagus Beetle Overwintering Biology and Management
Jen Roedel (Zavalnitskaya), Laura Marmolejo, Zsofia Szendrei
MICHIGAN STATE UNIVERSITY
Department of Entomology

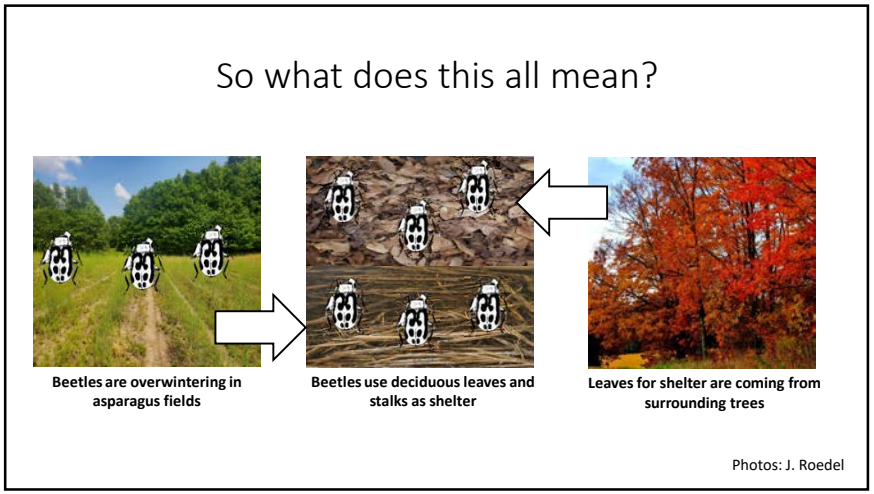
1


Photos: B. Werling

2


What type of shelter promotes beetle survival?
Tree bark (.1mm-5mm)
Tree bark (>5mm)
Pine and spruce leaves
Asparagus stalks
Deciduous leaves
Photos: J. Roedel

3


So what does this all mean?
Beetles are overwintering in asparagus fields
Beetles use deciduous leaves and stalks as shelter
Leaves for shelter are coming from surrounding trees
Photos: J. Roedel

4

Determine which method/timing of fern chopping best reduces the number of suitable stems for overwintering

Creating residue to test in controlled experiments

FALL, rotary

SPRING, flail

SPRING

FALL 2X

No mowing

5

6

7

Evaluate the impact of reside on asparagus beetle overwintering survival

8

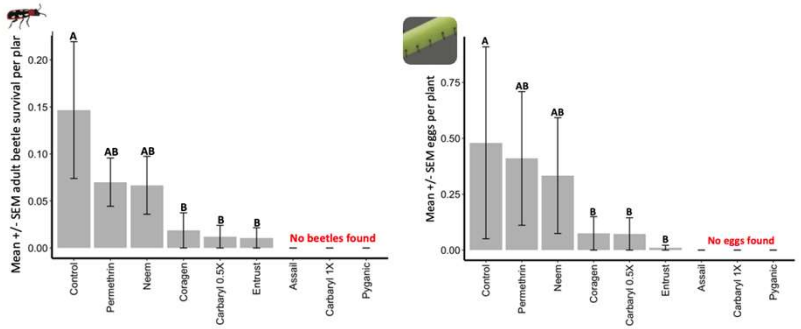
2020 Insecticide trial

- Conventional & Organic
- 24h PHI
- No enclosures
- Counted # of beetles and # of eggs on each plant

Photos: J. Roedel

9

2020 Insecticide trial



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2023 Insecticide trial

- Repeat the insecticide trial from 2020
- Add behavioral observations to determine repellency to adults

Funding

- SCBG: $98,000, ends 9/30/2024, mostly salary and some travel

11

Acknowledgements

A special thanks to:

- Members of the Szendrei lab
- Ben Werling
- John Bakker
- Michigan Asparagus Commission
- MSU Extension
- Project GREEEN
- All the participating asparagus growers

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Project GREEEN

MICHIGAN ASPARAGUS

MICHIGAN STATE UNIVERSITY
Department of Entomology

12

Asparagus Processors, Fresh Packers and Shippers
Research Contributors

Coloma Frozen Foods

North Bay Produce

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Ridgeview Packing , LLC
Conklin, MI

HoneeBear Canning Co.

Todd Greiner Farms

Michigan Freeze Pack
Your Source for Frozen Vegetables

Shafer Lake Fruit
Hartford, MI

New Era's American Asparagus

WMP West MI Produce

Ron Richter Farms
Decatur, MI