MICHIGAN ASPARAGUS RESEARCH 2023

RESEARCH IS SUPPORTED BY:
Michigan Asparagus Research Committee; Michigan State University AgBioResearch; Michigan State University Extension

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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. New this year on page 46 is climate and weather data to put the trial results into perspective. And for the second year, yield distribution graphs are also included for each trial.

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, USDA/MDARD Specialty Crop Block Grant awards and grower assessments. A 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 (MARI) 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 funds the daily operation of the farm during asparagus season in cooperation with MSU. We wish to express our sincere appreciation to the farm manager, Ashley Fleser, assistant farm manager, Justin Adams and the 2023 Board:

Nick Oomen, Chairman
Brock Oomen, Vice Chairman
Gerrit Herrygers, Treasurer
Todd Greiner
Alex Arellano
Jordon Walsworth
Glenn Rogers
Tim Tubbs
Ben Werling, ex-officio (MSUE)
Ashley Fleser, 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)
Ashley Fleser, 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.

Honee Bear Canning	Michigan Freeze Pack
North Bay Produce	Richter Farms
Ridgeview Packing	Shafer Lake Fruit
Todd Greiner Farms Packing	West MI Produce

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:

Jamie Clover Adams, Executive Director
jamie@michiganasparagus.org
(517) 881-3971

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

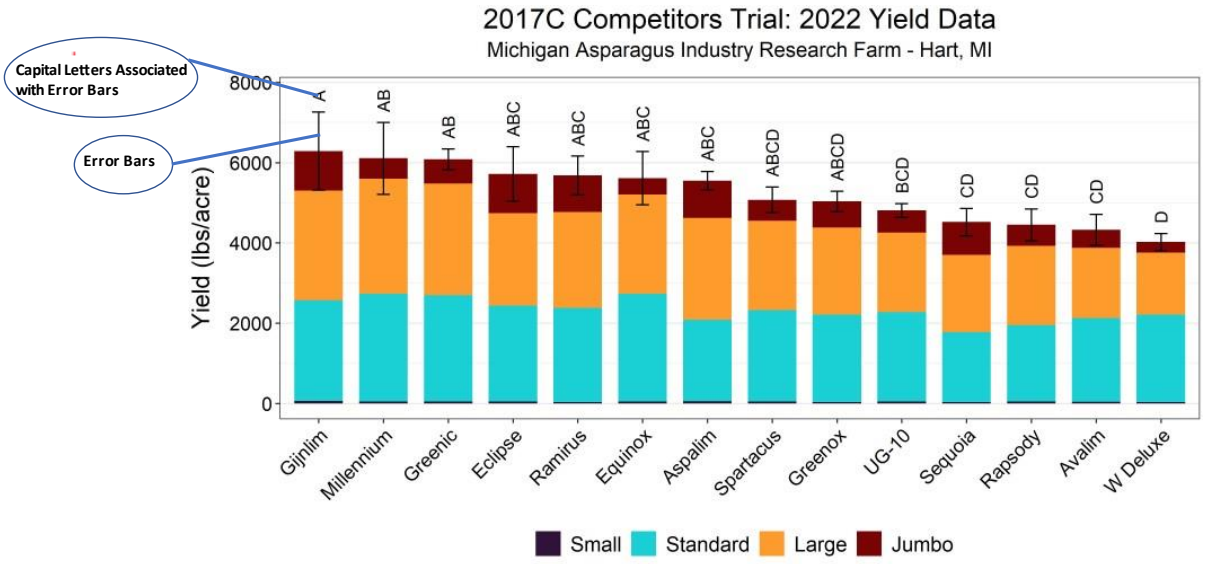
Error Bars. These are skinny lines extending from the top of bars in the charts. They are a graphical representation of the variability of the data. The error bars represent +/- one standard error unit around the mean (average). The standard error measures the variability in the data for a treatment. 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 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, 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: Zack Hayden, MSU Department of Horticulture
haydenza@msu.edu
(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 2023 Results

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. It continued to match or exceed annual and cumulative yields of alternative varieties during the 2023 season.

2012 International Cultivar Trial: 2023 Yield Data

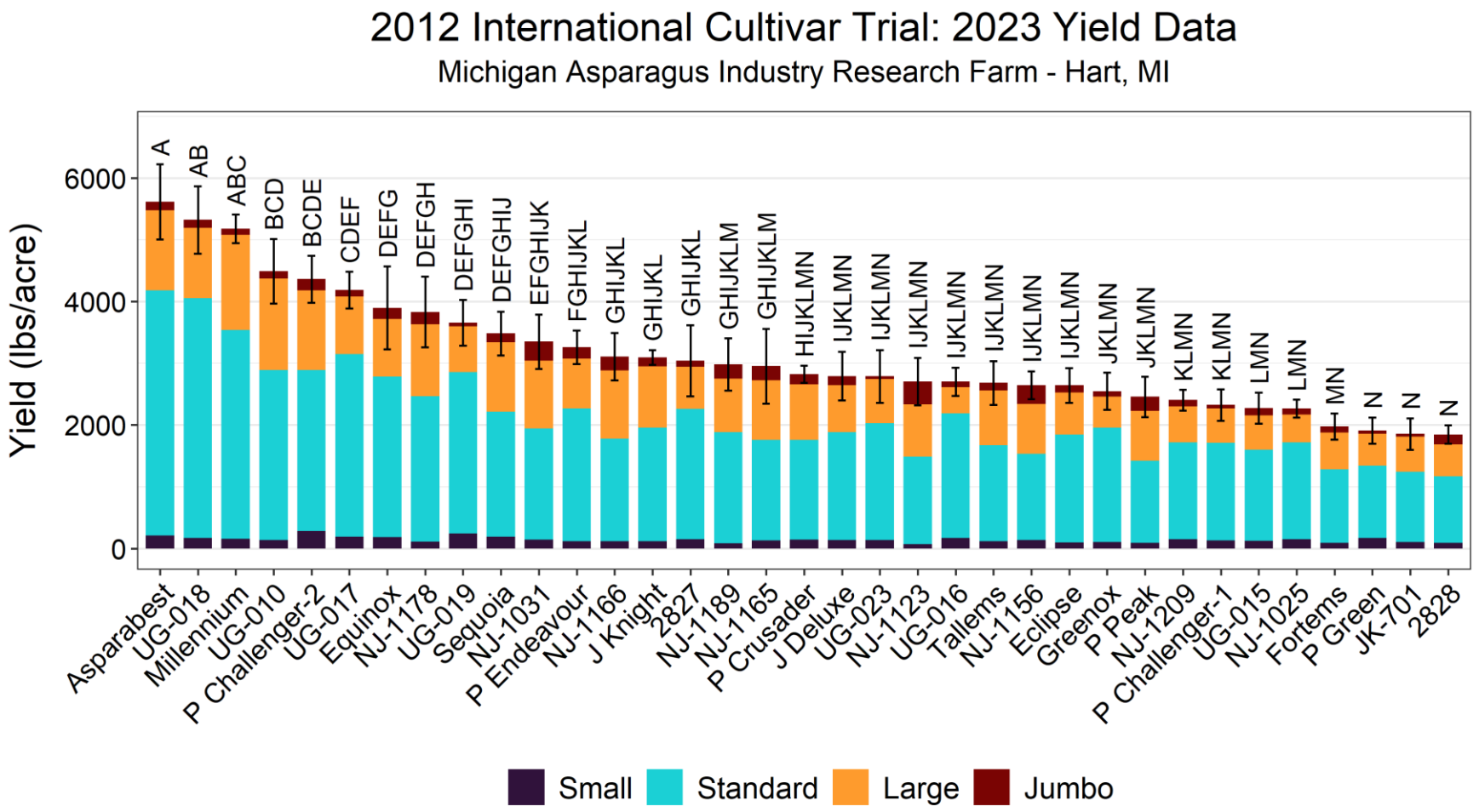
Michigan Asparagus Industry Research Farm - Hart, MI

Variety	Mean Yields in lbs./acre					Spear Tip Quality	
	Small	Standard	Large	Jumbo	Total	Avg Flowering[1]	Invalid[2]
Asparabest	**208**	**3971**	**1300**	137	**5616**	25%	23%
UG-018	171	**3883**	**1138**	133	**5324**	24%	21%
Millennium	159	**3381**	**1542**	95	**5177**	26%	20%
UG-010	135	2755	**1479**	121	4490	26%	23%
P Challenger-2	**279**	2613	**1286**	186	4363	23%	22%
UG-017	190	2958	930	107	4185	24%	21%
Equinox	185	2597	935	180	3896	26%	20%
NJ-1178	114	2350	**1170**	198	3832	26%	20%
UG-019	**242**	2618	741	55	3656	26%	26%
Sequoia	189	2025	**1123**	146	3483	24%	23%
NJ-1031	144	1798	**1101**	309	3352	25%	24%
P Endeavour	114	2153	805	186	3258	24%	21%
NJ-1166	115	1664	**1104**	225	3108	23%	21%
J Knight	119	1836	994	148	3097	26%	24%
2827	149	2112	682	98	3042	23%	23%
NJ-1189	81	1803	864	232	2980	25%	22%
NJ-1165	131	1625	965	232	2953	26%	24%
P Crusader	142	1619	896	164	2820	23%	21%
J Deluxe	140	1743	761	150	2793	26%	27%
UG-023	134	1895	714	47	2790	26%	21%
NJ-1123	71	1417	845	370	2703	23%	22%
UG-016	167	2020	425	89	2702	23%	26%
Tallems	118	1557	885	123	2683	25%	21%
NJ-1156	137	1396	808	303	2645	25%	23%
Eclipse	98	1745	683	117	2642	26%	21%
Greenox	104	1853	500	90	2547	23%	23%
P Peak	90	1328	808	232	2457	23%	21%
NJ-1209	152	1567	580	104	2404	23%	26%
P Challenger-1	129	1582	559	53	2324	23%	27%
UG-015	126	1470	561	118	2275	23%	23%
NJ-1025	149	1567	453	101	2269	27%	27%
Fortems	93	1186	599	97	1976	24%	21%
P Green	171	1171	518	51	1911	26%	25%
JK-701	102	1143	564	47	1856	24%	22%
2828	92	1080	513	160	1846	24%	18%
p Value	< 0.0001	< 0.0001	< 0.0001	0.1219	< 0.0001	0.7326	0.0911
LSD.05	77	772	494	n.s.	1069	n.s.	n.s.

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

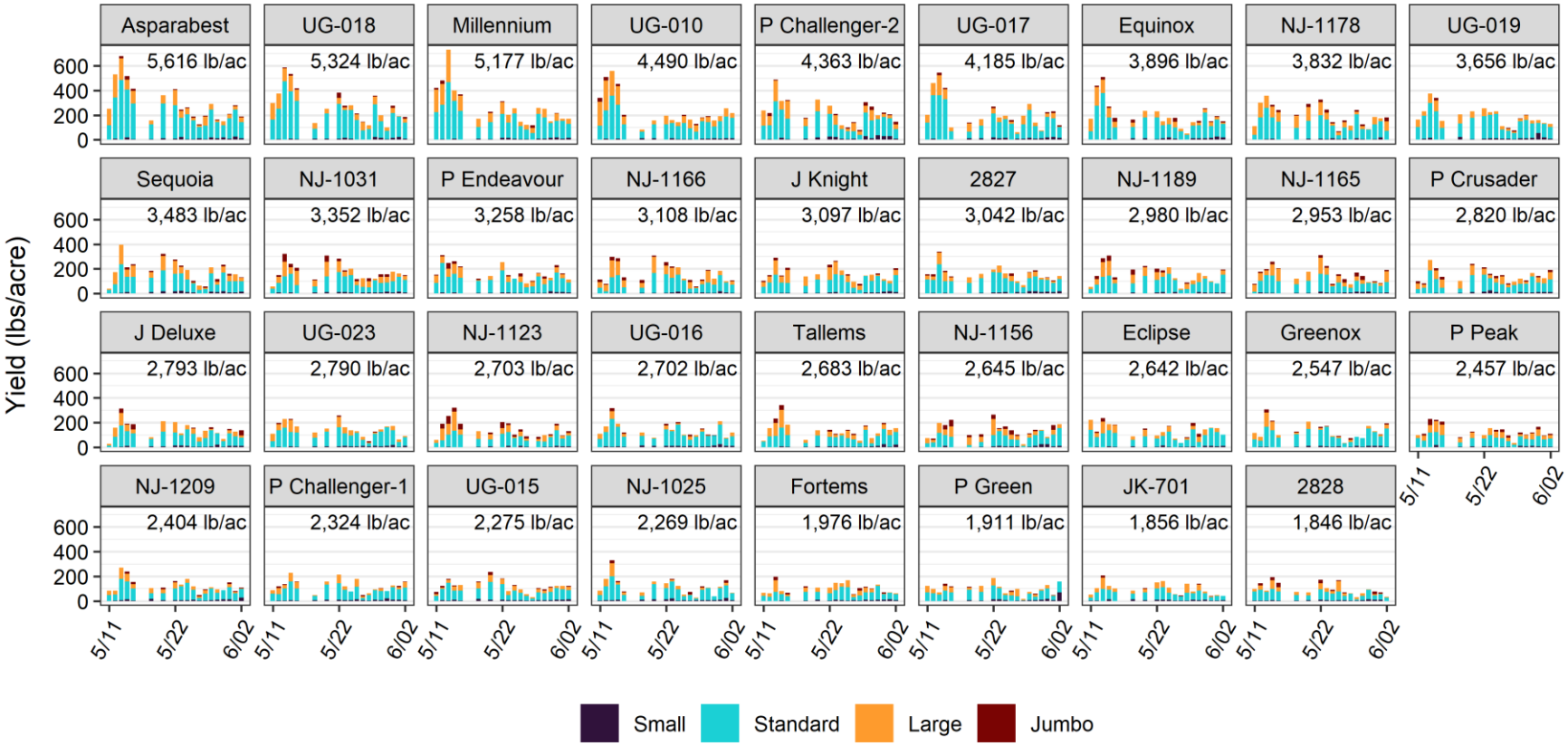
[1] Measured as mean of flowering percentage of individual spears.

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


2012 International Cultivar Trial: 2023 Yield Data
Michigan Asparagus Industry Research Farm - Hart, MI
Yield (lbs/acre)
6000
4000
2000
0
A
AB
ABC
BCD
BCDE
CDEF
DEFG
DEFGH
DEFGHI
DEFGHIJ
EFGHIJK
FGHIJKL
GHIJKL
GHIJKL
GHIJKL
GHIJKLM
GHIJKLM
HIJKLMN
IJKLMN
IJKLMN
IJKLMN
IJKLMN
IJKLMN
IJKLMN
IJKLMN
JKLMN
JKLMN
KLMN
KLMN
LMN
LMN
MN
N
N
N
Asparabest
UG-018
Millennium
UG-010
P Challenger-2
UG-017
Equinox
NJ-1178
UG-019
Sequoia
NJ-1031
P Endeavour
NJ-1166
J Knight
2827
NJ-1189
NJ-1165
P Crusader
J Deluxe
UG-023
NJ-1123
UG-016
Tallems
NJ-1156
Eclipse
Greenox
P Peak
NJ-1209
P Challenger-1
UG-015
NJ-1025
Fortems
P Green
JK-701
2828
Small
Standard
Large
Jumbo

2012 International Cultivar Trial: 2023 Yield Distribution

Michigan Asparagus Industry Research Farm - Hart, MI



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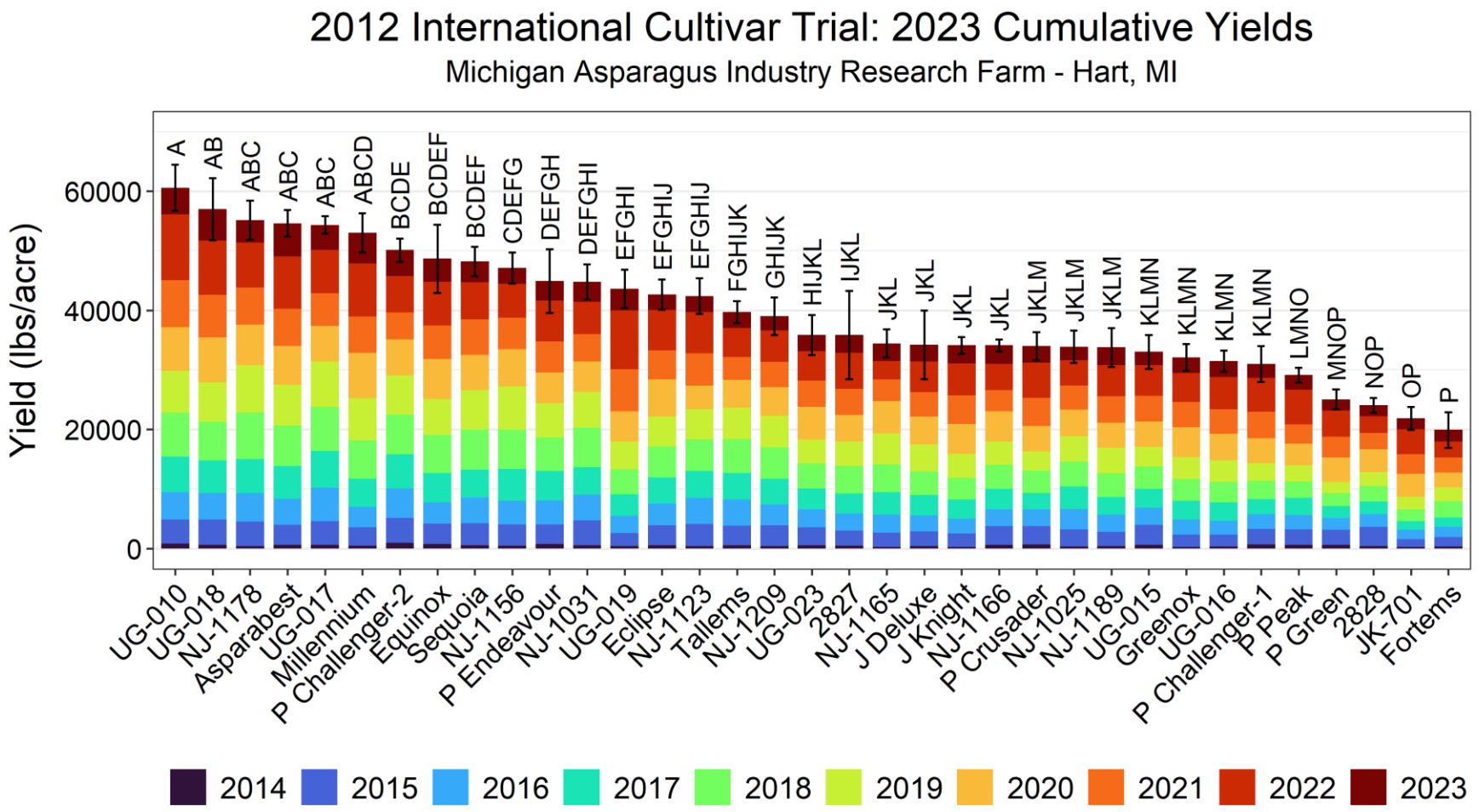
2012 International Cultivar Trial: 2023 Cumulative Yields

Michigan Asparagus Industry Research Farm - Hart, MI

Variety	Mean Yields in lbs./acre										
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Total
UG-010	**799**	**4024**	4641	**5921**	**7472**	**6963**	**7375**	**7866**	**11037**	4490	**60586**
UG-018	588	**4254**	4495	**5477**	**6451**	**6655**	**7516**	**7139**	**9124**	**5324**	**57023**
NJ-1178	376	**4127**	**4831**	**5704**	**7761**	**7974**	**6791**	**6239**	7542	3832	**55178**
Asparabest	612	**3375**	4350	**5519**	**6762**	**6868**	**6527**	**6259**	**8743**	**5616**	**54631**
UG-017	616	**3939**	**5628**	**6184**	**7440**	**7623**	5915	5549	7276	4185	**54355**
Millennium	442	3118	3411	4717	**6466**	**7072**	**7587**	**6128**	**8914**	**5177**	**53033**
P Challenger-2	**945**	**4147**	**4993**	**5748**	**6682**	6545	**6085**	4463	6141	4363	50112
Equinox	**738**	**3447**	3525	4995	6337	6066	**6731**	5639	7300	3896	48676
Sequoia	502	**3738**	4346	4669	**6688**	**6683**	5902	5932	6260	3483	48203
NJ-1156	435	**3579**	3988	**5382**	**6580**	**7276**	**6249**	5240	5732	2645	47106
P Endeavour	**758**	**3251**	4046	4965	5616	5743	5170	5221	6878	3258	44905
NJ-1031	507	**4217**	4333	4573	**6648**	6046	5056	4633	5427	3352	44792
UG-019	391	2161	2916	3628	4216	4654	5097	**7067**	**9847**	3656	43632
Eclipse	514	**3347**	3662	4406	5233	5014	**6219**	4844	6782	2642	42665
NJ-1123	401	**3723**	4370	4512	5318	5060	3999	5404	6925	2703	42417
Tallems	549	**3249**	4416	4483	5690	5294	4627	3878	4866	2683	39734
NJ-1209	414	**3464**	3543	4305	5256	5323	4767	4256	5275	2404	39007
UG-023	526	3029	2993	3550	4139	4079	5473	4387	4929	2790	35893
2827	460	2526	2901	3381	4601	4082	4451	4395	6027	3042	35866
NJ-1165	270	2351	3055	3746	4723	5167	5462	3648	3085	2953	34460
J Deluxe	377	2484	2709	3393	3996	4522	4669	4144	5123	2793	34209
J Knight	243	2261	2514	3192	3644	4048	5030	4770	5341	3097	34139
NJ-1166	580	3166	2851	3386	4050	3946	5077	3546	4408	3108	34117
P Crusader	679	3074	2826	2726	3778	3238	4230	4721	5901	2820	33991
NJ-1025	336	2854	3425	3807	4179	4255	4475	4003	4304	2269	33909
NJ-1189	365	2424	2898	2949	3999	4282	4180	4472	5227	2980	33777
UG-015	596	**3354**	2897	3151	3778	3318	4243	4290	5133	2275	33035
Greenox	280	2011	2584	3129	3671	3696	4990	4280	4877	2547	32065
UG-016	300	2019	2296	3096	3454	3645	4477	4095	5408	2702	31491
P Challenger-1	675	2571	2525	2508	3074	2946	4210	4438	5723	2324	30994
P Peak	574	2612	2441	2842	2764	2774	3620	3226	5825	2457	29135
P Green	628	2492	1981	1991	2194	1849	4143	3507	4360	1911	25056
2828	407	3227	2106	2095	2675	2265	3848	2747	2847	1846	24065
JK-701	270	1295	1549	1451	2007	2135	3800	3290	4192	1856	21843
Fortems	299	1629	1709	1539	2791	2286	2500	2556	2653	1976	19937
p Value	< 0.0001	< 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	2713	1069	9286

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


2012 International Cultivar Trial: 2023 Cumulative Yields
Michigan Asparagus Industry Research Farm - Hart, MI
Yield (lbs/acre)
60000
40000
20000
0
A
AB
ABC
ABC
ABC
ABCD
BCDE
BCDEF
BCDEF
CDEFG
DEFGH
DEFGHI
EFGHI
EFGHIJ
EFGHIJ
FGHIJK
GHIJK
HIJKL
IJKL
JKL
JKL
JKL
JKL
JKLM
JKLM
JKLM
KLMN
KLMN
KLMN
KLMN
LMNO
MNOP
NOP
OP
P
UG-010
UG-018
NJ-1178
Asparabest
UG-017
Millennium
P Challenger-2
Equinox
Sequoia
NJ-1156
P Endeavour
NJ-1031
UG-019
Eclipse
NJ-1123
Tallems
NJ-1209
UG-023
2827
NJ-1165
J Deluxe
J Knight
NJ-1166
P Crusader
NJ-1025
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
2023

2015A Crown Trial: 2023 Yield Data

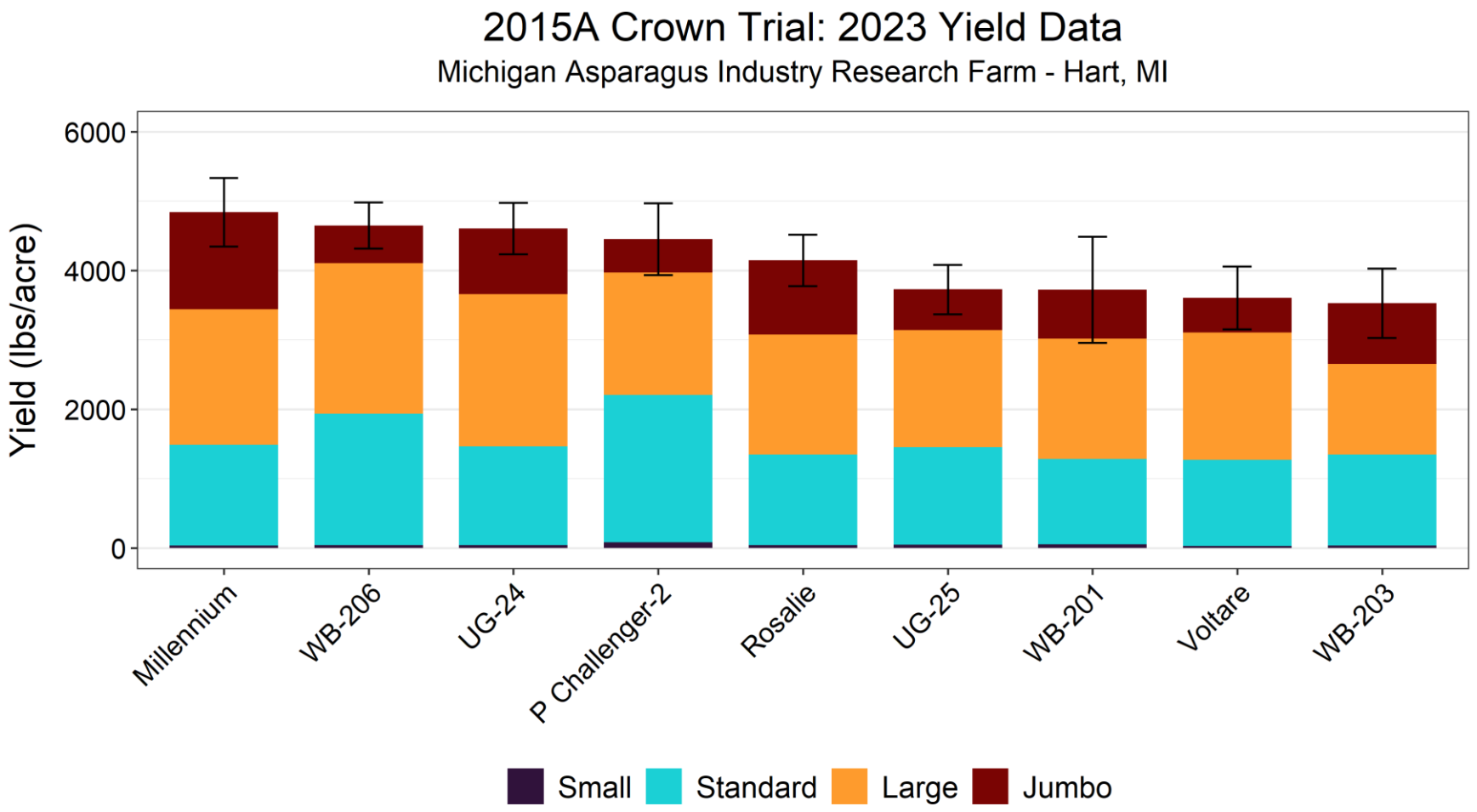
Michigan Asparagus Industry Research Farm - Hart, MI

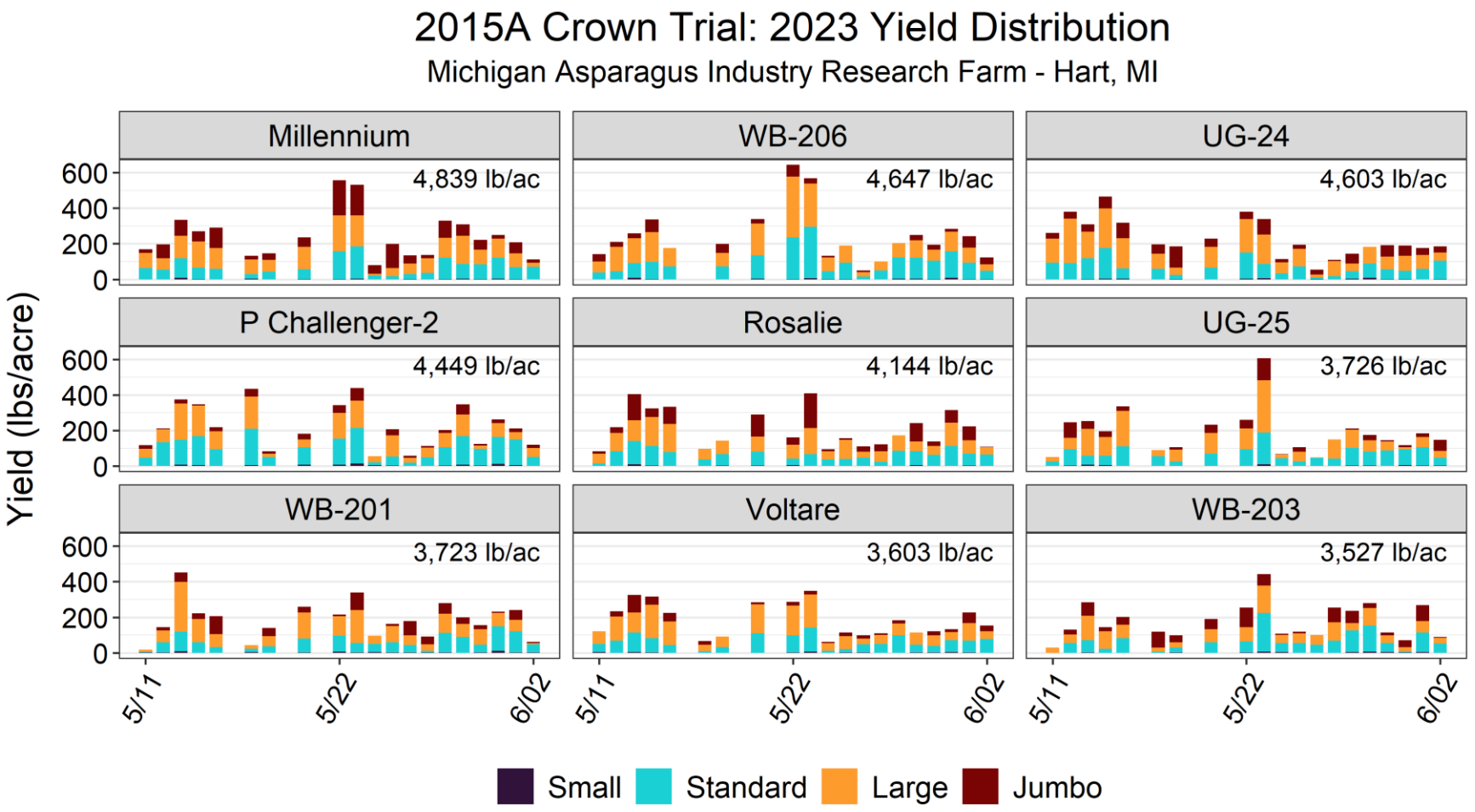
Variety	Mean Yields in lbs./acre					Spear Tip Quality	
	Small	Standard	Large	Jumbo	Total	Avg Flowering[1]	Invalid[2]
Millennium	34	1450	1954	1402	4839	28%	19%
WB-206	42	1891	2171	543	4647	25%	16%
UG-24	38	1423	2195	946	4603	28%	21%
P Challenger-2	**82**	2119	1768	481	4449	25%	20%
Rosalie	39	1306	1727	1071	4144	29%	23%
UG-25	46	1407	1683	589	3726	27%	24%
WB-201	50	1233	1734	706	3723	27%	24%
Voltare	28	1240	1838	496	3603	27%	21%
WB-203	31	1312	1308	877	3527	27%	23%
p Value	0.0207	0.1266	0.1909	0.2192	0.3799	0.3540	0.4446
LSD.05	29	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: 2023 Yield Data
Michigan Asparagus Industry Research Farm - Hart, MI
Yield (lbs/acre)
6000
4000
2000
0
Millennium
WB-206
UG-24
P Challenger-2
Rosalie
UG-25
WB-201
Voltare
WB-203
Small
Standard
Large
Jumbo


2015A Crown Trial: 2023 Yield Distribution
Michigan Asparagus Industry Research Farm - Hart, MI
Millennium
4,839 lb/ac
WB-206
4,647 lb/ac
UG-24
4,603 lb/ac
P Challenger-2
4,449 lb/ac
Rosalie
4,144 lb/ac
UG-25
3,726 lb/ac
WB-201
3,723 lb/ac
Voltare
3,603 lb/ac
WB-203
3,527 lb/ac
Yield (lbs/acre)
600
400
200
0
5/11
5/22
6/02
Small
Standard
Large
Jumbo

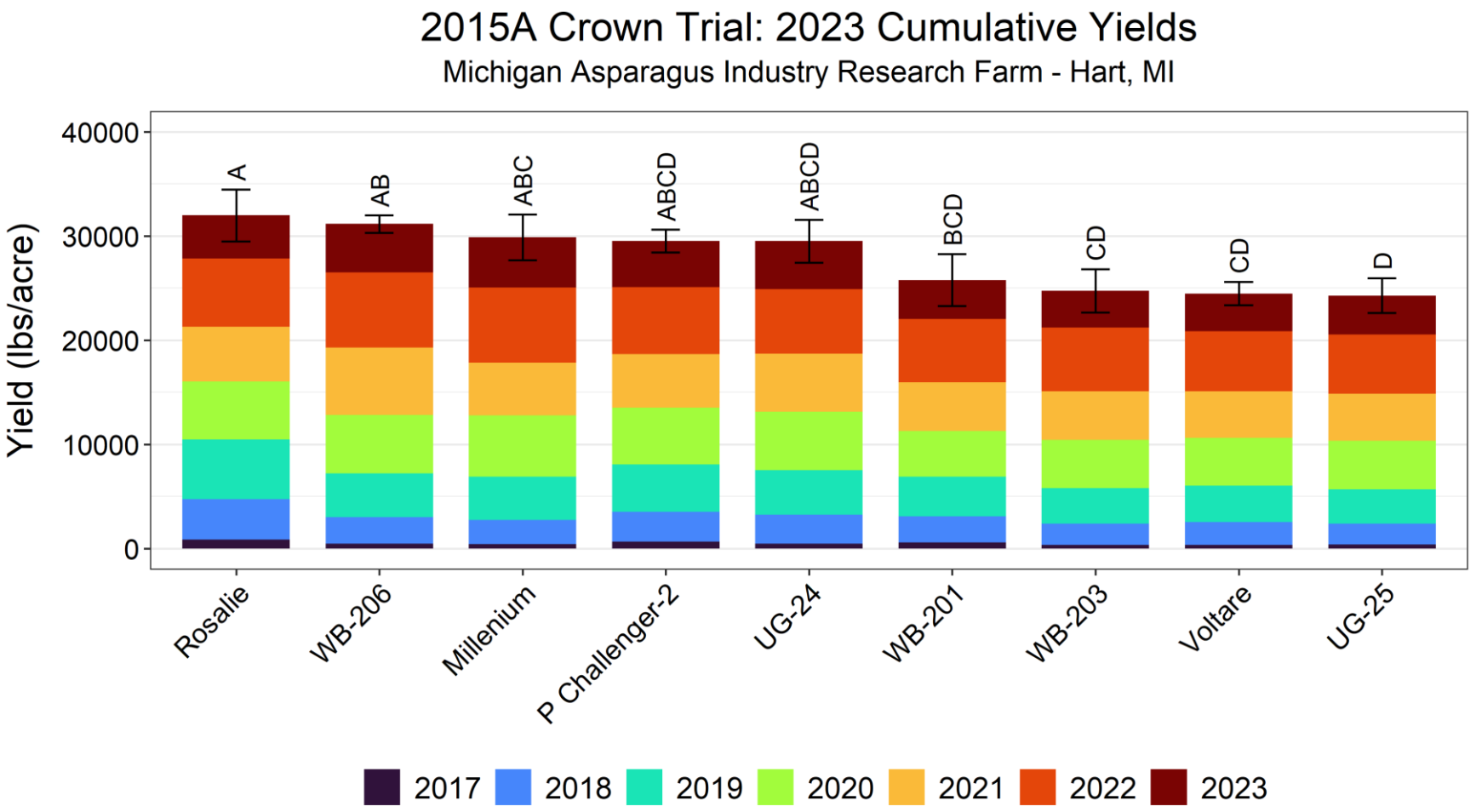
Intentionally Left Blank

2015A Crown Trial: 2023 Cumulative Yields

Michigan Asparagus Industry Research Farm - Hart, MI

Variety	Mean Yields in lbs./acre							
	2017	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**Total**
Rosalie	**842**	**3891**	**5730**	5580	5226	6553	4144	**31966**
WB-206	444	2559	4210	5610	6466	7209	4647	**31144**
Millenium	408	2328	4159	5884	5060	7192	4839	**29871**
P Challenger-2	**654**	2844	**4563**	5445	5130	6438	4449	**29523**
UG-24	474	2781	4244	5612	5584	6202	4603	**29500**
WB-201	588	2503	3803	4368	4691	6079	3723	25756
WB-203	344	2042	3396	4639	4659	6123	3527	24731
Voltare	328	2194	3494	4595	4476	5774	3603	24464
UG-25	396	1980	3314	4632	4516	5713	3726	24277
p Value	0.0002	0.0006	0.0002	0.4997	0.0514	0.2218	0.3799	0.0293
LSD.05	205	797	1189	n.s.	n.s.	n.s.	n.s.	5815

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


2015A Crown Trial: 2023 Cumulative Yields
Michigan Asparagus Industry Research Farm - Hart, MI
Yield (lbs/acre)
40000
30000
20000
10000
0
A
AB
ABC
ABCD
ABCD
BCD
CD
CD
D
Rosalie
WB-206
Millenium
P Challenger-2
UG-24
WB-201
WB-203
Voltare
UG-25
2017
2018
2019
2020
2021
2022
2023

2015B Transplant Trial: 2023 Yield Data

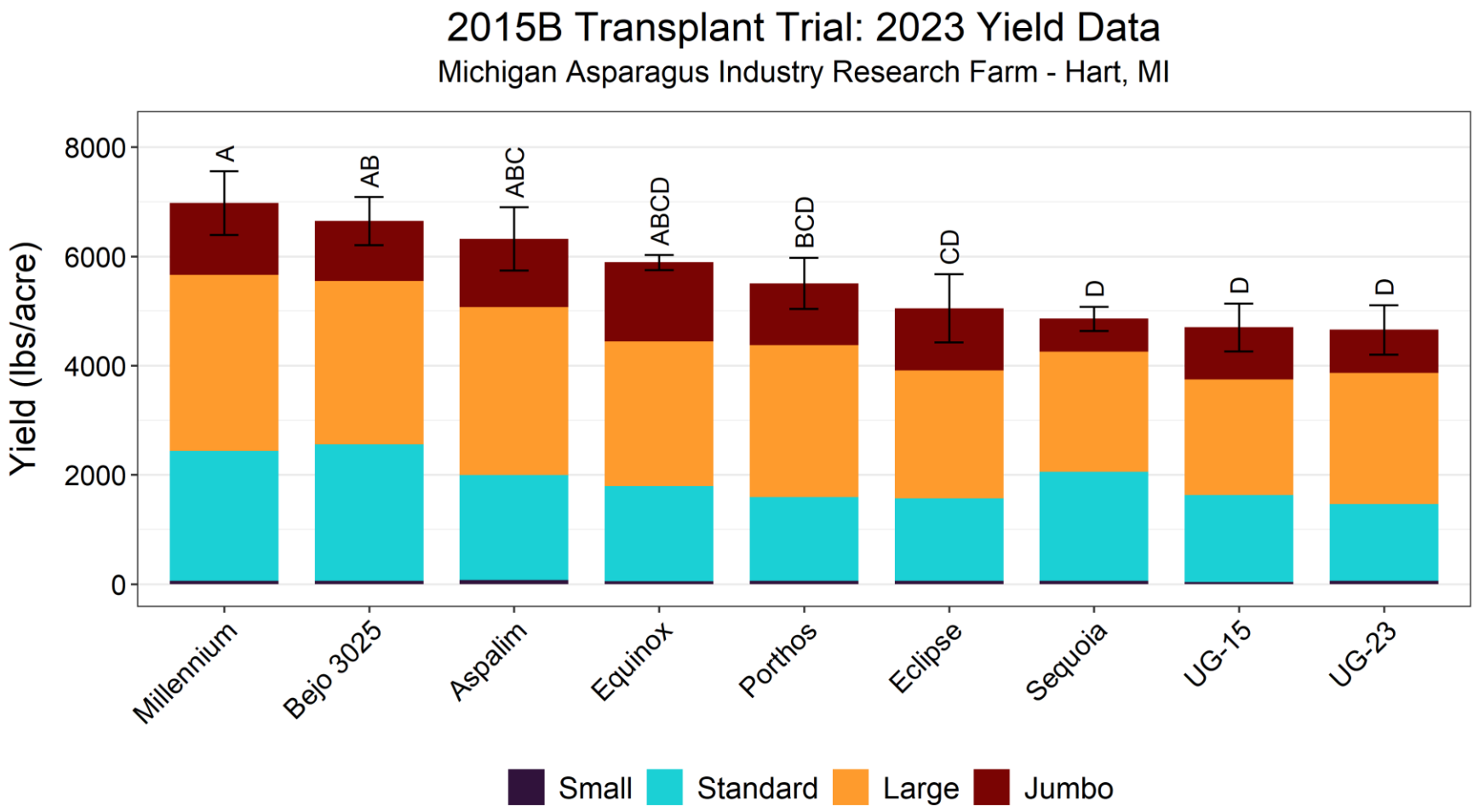
Michigan Asparagus Industry Research Farm - Hart, MI

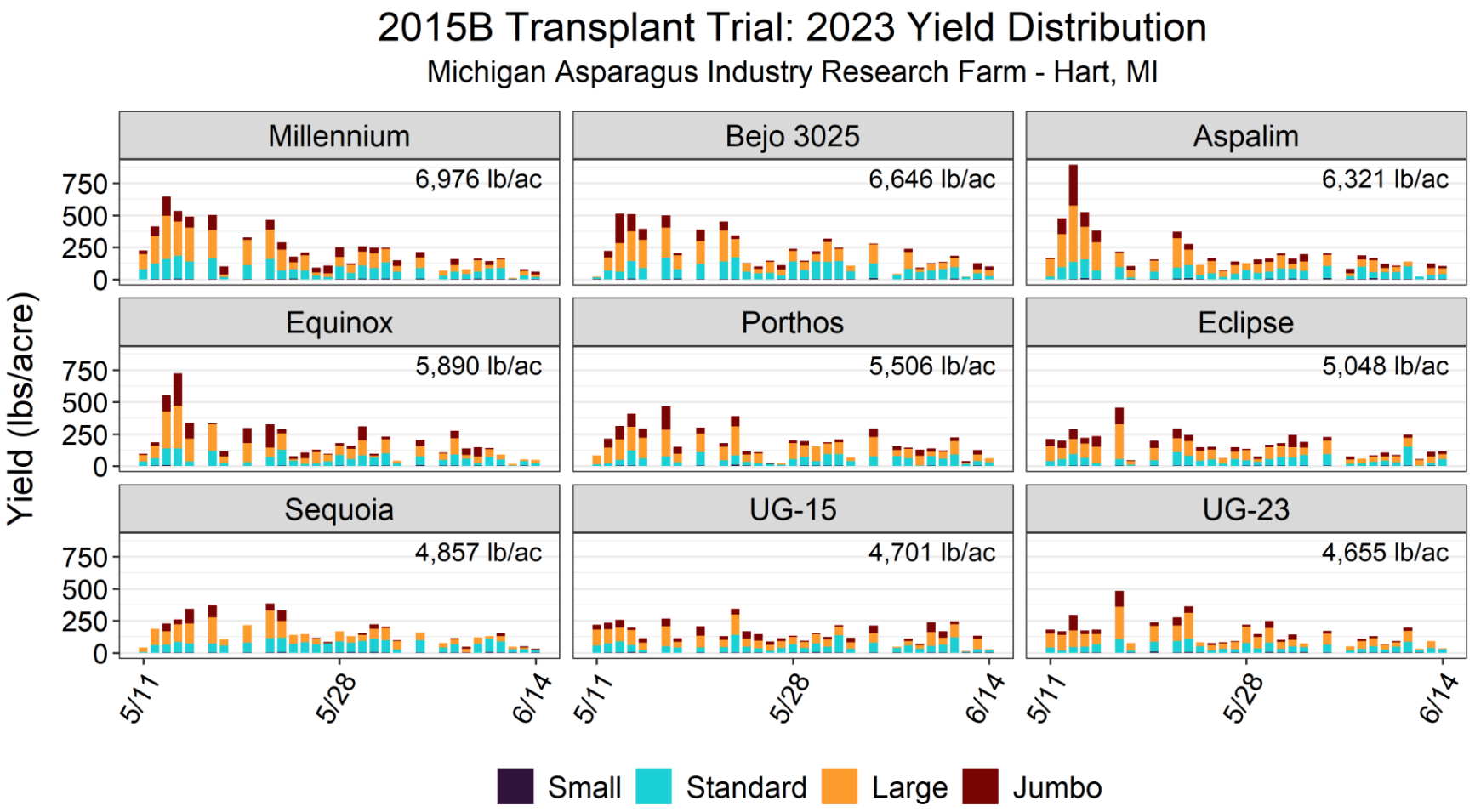
Variety	Mean Yields in lbs./acre					Spear Tip Quality	
	Small	Standard	Large	Jumbo	Total	Avg Flowering[1]	Invalid[2]
Millennium	59	**2375**	3226	1316	**6976**	24%	14%
Bejo 3025	59	**2499**	2988	1100	**6646**	25%	16%
Aspalim	74	**1923**	3071	1253	**6321**	**26%**	15%
Equinox	50	1742	2651	1446	**5890**	**27%**	12%
Porthos	57	1535	2779	1135	5506	25%	14%
Eclipse	58	1514	2339	1137	5048	**28%**	16%
Sequoia	54	**1998**	2203	603	4857	**27%**	18%
UG-15	38	1592	2115	955	4701	**28%**	16%
UG-23	57	1408	2402	788	4655	**28%**	15%
p Value	0.8813	0.0057	0.0635	0.1202	0.0055	0.0395	0.2902
LSD.05	n.s.	637	n.s.	n.s.	1440	3	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: 2023 Yield Data
Michigan Asparagus Industry Research Farm - Hart, MI
Yield (lbs/acre)
8000
6000
4000
2000
0
A
AB
ABC
ABCD
BCD
CD
D
D
D
Millennium
Bejo 3025
Aspalim
Equinox
Porthos
Eclipse
Sequoia
UG-15
UG-23
Small
Standard
Large
Jumbo


2015B Transplant Trial: 2023 Yield Distribution
Michigan Asparagus Industry Research Farm - Hart, MI
Yield (lbs/acre)
Millennium
6,976 lb/ac
Bejo 3025
6,646 lb/ac
Aspalim
6,321 lb/ac
Equinox
5,890 lb/ac
Porthos
5,506 lb/ac
Eclipse
5,048 lb/ac
Sequoia
4,857 lb/ac
UG-15
4,701 lb/ac
UG-23
4,655 lb/ac
0
250
500
750
5/11
5/28
6/14
Small
Standard
Large
Jumbo

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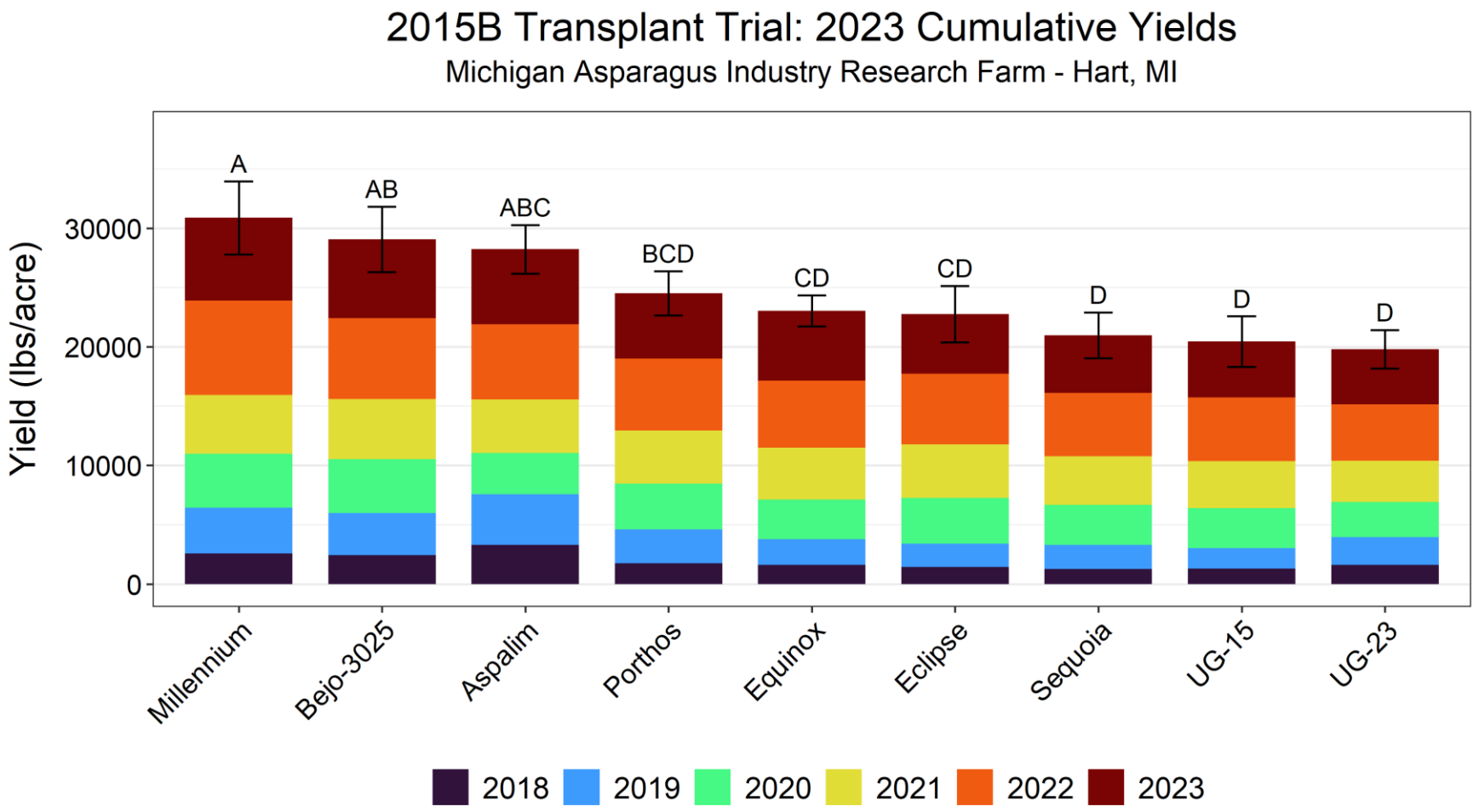
2015B Transplant Trial: 2023 Cumulative Yields

Michigan Asparagus Industry Research Farm - Hart, MI

Variety	Mean Yields in lbs./acre						
	2018	**2019**	**2020**	**2021**	**2022**	**2023**	**Total**
Millennium	**2559**	**3866**	4557	4955	**7971**	**6976**	**30884**
Bejo-3025	**2436**	**3558**	4529	5088	**6825**	**6646**	**29082**
Aspalim	**3297**	**4265**	3478	4513	**6354**	**6321**	**28228**
Porthos	1756	2836	3891	4467	6068	5506	**24523**
Equinox	1604	2184	3319	4394	5649	**5890**	23039
Eclipse	1450	1956	3867	4499	5959	5048	22778
Sequoia	1280	2004	3376	4119	5333	4857	20968
UG-15	1288	1718	3379	3959	5399	4701	20445
UG-23	1624	2314	2961	3505	4743	4655	19801
p Value	< 0.0001	0.0008	0.1377	0.6488	0.0109	0.0055	0.0029
LSD.05	878	1352	n.s.	n.s.	1845	1440	6781

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


2015B Transplant Trial: 2023 Cumulative Yields
Michigan Asparagus Industry Research Farm - Hart, MI
Yield (lbs/acre)
30000
20000
10000
0
A
AB
ABC
BCD
CD
CD
D
D
D
Millennium
Bejo-3025
Aspalim
Porthos
Equinox
Eclipse
Sequoia
UG-15
UG-23
2018
2019
2020
2021
2022
2023

2017A Cultivar Trial – Transplants: 2023 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]
Javelim	55	1933	2732	785	5504	28%	13%
Millennium	71	2224	2257	951	5503	28%	13%
UG-25	68	2561	2201	616	5447	28%	11%
UG-27	59	2476	2291	255	5082	28%	15%
UG-33	43	1545	2358	1059	5005	30%	14%
UG-24	53	2186	2307	395	4940	27%	10%
UG-31	74	2164	1889	714	4840	26%	12%
UG-30	78	2431	1950	332	4790	26%	15%
UG-23	71	1585	2246	498	4400	29%	13%
Bejo 3025	41	2262	1808	279	4390	27%	11%
UG-32	38	1884	2027	416	4364	29%	13%
UG-36	69	1949	1939	395	4352	30%	15%
UG-29	77	1916	1709	584	4285	28%	12%
Canticus	78	1950	1600	402	4031	27%	13%
UG-35	53	2013	1504	413	3982	28%	11%
UG-28	44	1897	1596	224	3761	28%	10%
UG-34	77	1570	1400	617	3664	29%	16%
UG-26	46	1550	1166	343	3105	26%	15%
p Value	0.5622	0.1588	0.1946	0.1797	0.2063	0.8119	0.1192
LSD.05	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.

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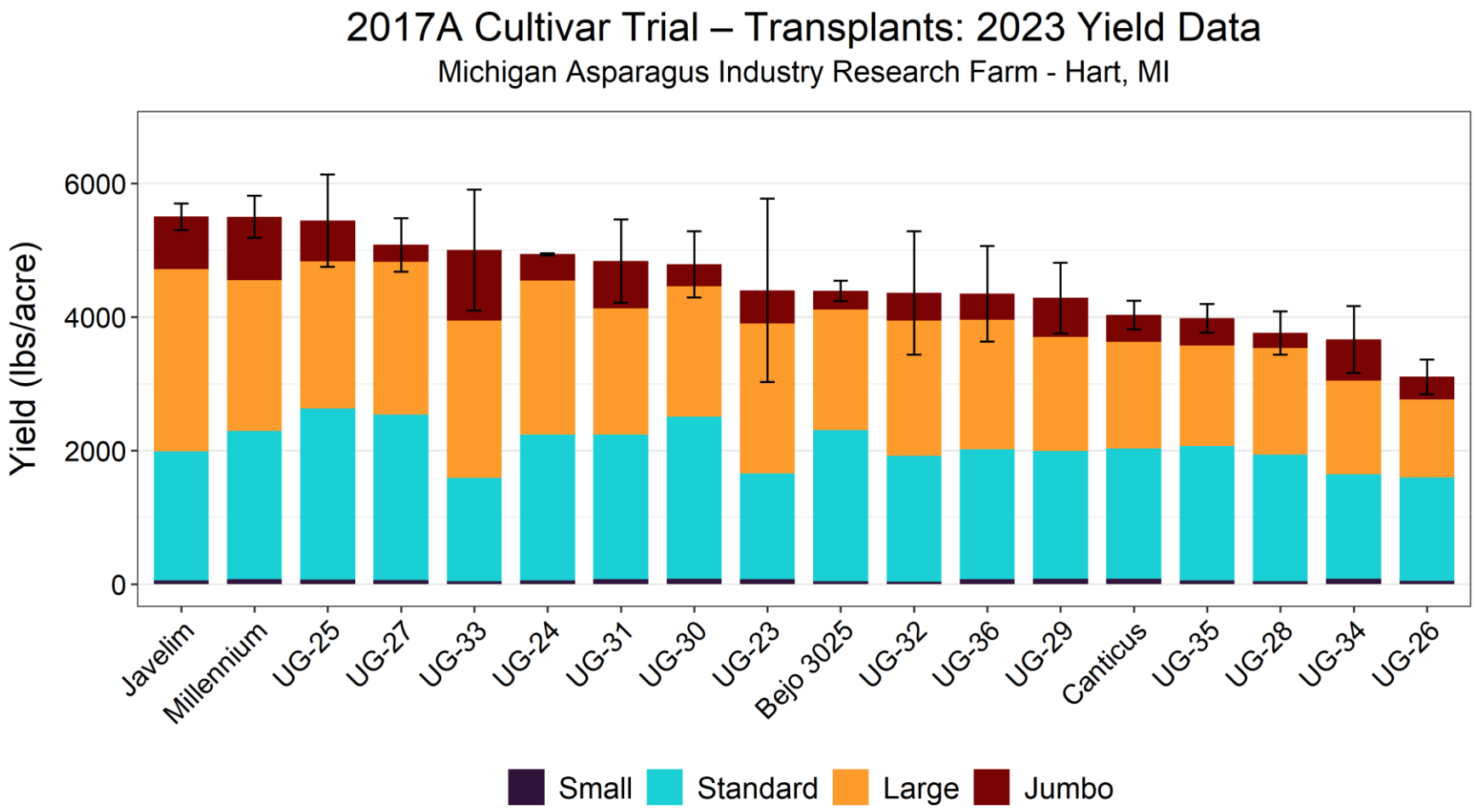
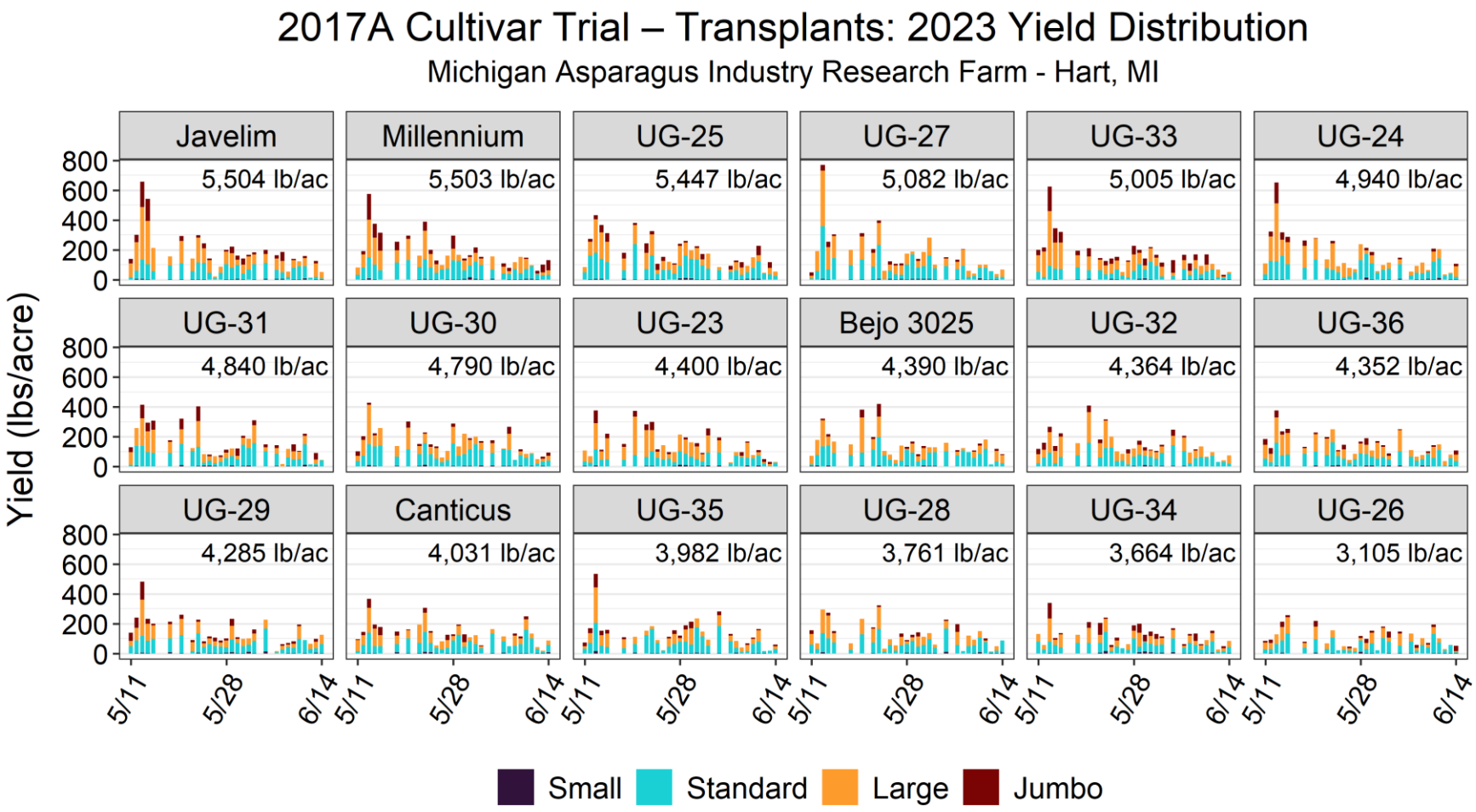

2017A Cultivar Trial – Transplants: 2023 Yield Data
Michigan Asparagus Industry Research Farm - Hart, MI
Yield (lbs/acre)
6000
4000
2000
0
Javelim
Millennium
UG-25
UG-27
UG-33
UG-24
UG-31
UG-30
UG-23
Bejo 3025
UG-32
UG-36
UG-29
Canticus
UG-35
UG-28
UG-34
UG-26
Small
Standard
Large
Jumbo


2017A Cultivar Trial – Transplants: 2023 Yield Distribution
Michigan Asparagus Industry Research Farm - Hart, MI
Yield (lbs/acre)
Javelim
5,504 lb/ac
Millennium
5,503 lb/ac
UG-25
5,447 lb/ac
UG-27
5,082 lb/ac
UG-33
5,005 lb/ac
UG-24
4,940 lb/ac
UG-31
4,840 lb/ac
UG-30
4,790 lb/ac
UG-23
4,400 lb/ac
Bejo 3025
4,390 lb/ac
UG-32
4,364 lb/ac
UG-36
4,352 lb/ac
UG-29
4,285 lb/ac
Canticus
4,031 lb/ac
UG-35
3,982 lb/ac
UG-28
3,761 lb/ac
UG-34
3,664 lb/ac
UG-26
3,105 lb/ac
0
200
400
600
800
5/11
5/28
6/14
Small
Standard
Large
Jumbo

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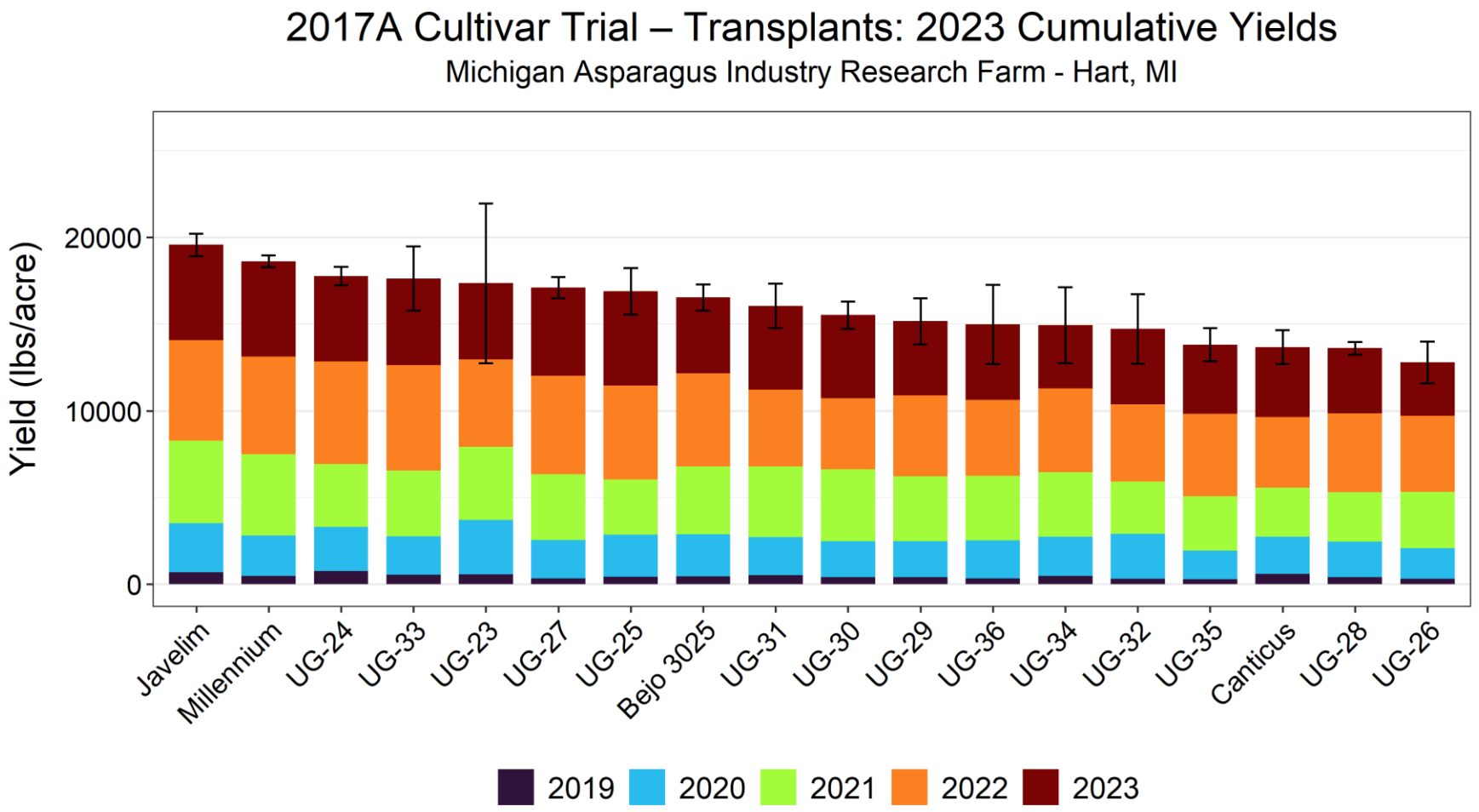
2017A Cultivar Trial – Transplants: 2023 Cumulative Yields

Michigan Asparagus Industry Research Farm - Hart, MI

Cultivar	Mean Yields in lbs./acre					
	2019	**2020**	**2021**	**2022**	**2023**	**Total**
Javelim	**666**	2834	4758	5814	5504	19576
Millennium	461	2346	4678	5636	5503	18624
UG-24	**750**	2551	3622	5914	4940	17779
UG-33	525	2223	3810	6069	5005	17632
UG-23	**558**	3146	4221	5029	4400	17355
UG-27	313	2219	3796	5690	5082	17100
UG-25	416	2422	3200	5408	5447	16893
Bejo 3025	438	2440	3914	5361	4390	16542
UG-31	513	2186	4093	4427	4840	16058
UG-30	390	2081	4137	4120	4790	15518
UG-29	387	2073	3764	4659	4285	15169
UG-36	332	2186	3715	4396	4352	14981
UG-34	457	2263	3731	4827	3664	14942
UG-32	297	2598	3011	4454	4364	14724
UG-35	282	1648	3125	4774	3982	13811
Canticus	**588**	2134	2830	4093	4031	13675
UG-28	400	2052	2848	4550	3761	13611
UG-26	299	1772	3257	4368	3105	12800
p Value	0.0006	0.1803	0.4656	0.5280	0.2063	0.2372
LSD.05	207	n.s.	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: 2023 Cumulative Yields
Michigan Asparagus Industry Research Farm - Hart, MI
Yield (lbs/acre)
20000
10000
0
Javelim
Millennium
UG-24
UG-33
UG-23
UG-27
UG-25
Bejo 3025
UG-31
UG-30
UG-29
UG-36
UG-34
UG-32
UG-35
Canticus
UG-28
UG-26
2019
2020
2021
2022
2023

2017C Competitors Trial: 2023 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]
Aspalim	136	**2513**	2804	616	**6069**	22%	13%
Ramirus	123	**2356**	2508	755	**5742**	20%	12%
Gijnlim	108	**2430**	2450	721	**5709**	22%	12%
Millennium	108	**2989**	2183	342	**5623**	22%	13%
Greenic	95	**2641**	2103	289	**5128**	22%	14%
Spartacus	119	**2729**	1727	280	**4856**	22%	13%
Equinox	125	**2642**	1705	322	**4794**	22%	14%
UG-10	77	1958	2031	661	**4726**	22%	13%
Sequoia	87	1909	1960	713	**4669**	23%	14%
Greenox	106	1833	1803	438	4179	21%	15%
Avalim	107	1875	1741	448	4171	23%	16%
Rapsody	79	1768	1704	426	3978	23%	11%
Eclipse	98	1827	1506	518	3949	22%	15%
W Deluxe	88	1918	1361	223	3590	22%	13%
p Value	0.4539	0.0341	0.0668	0.6632	0.0277	0.4543	0.7448
LSD.05	n.s.	842	n.s.	n.s.	1605	n.s.	n.s.

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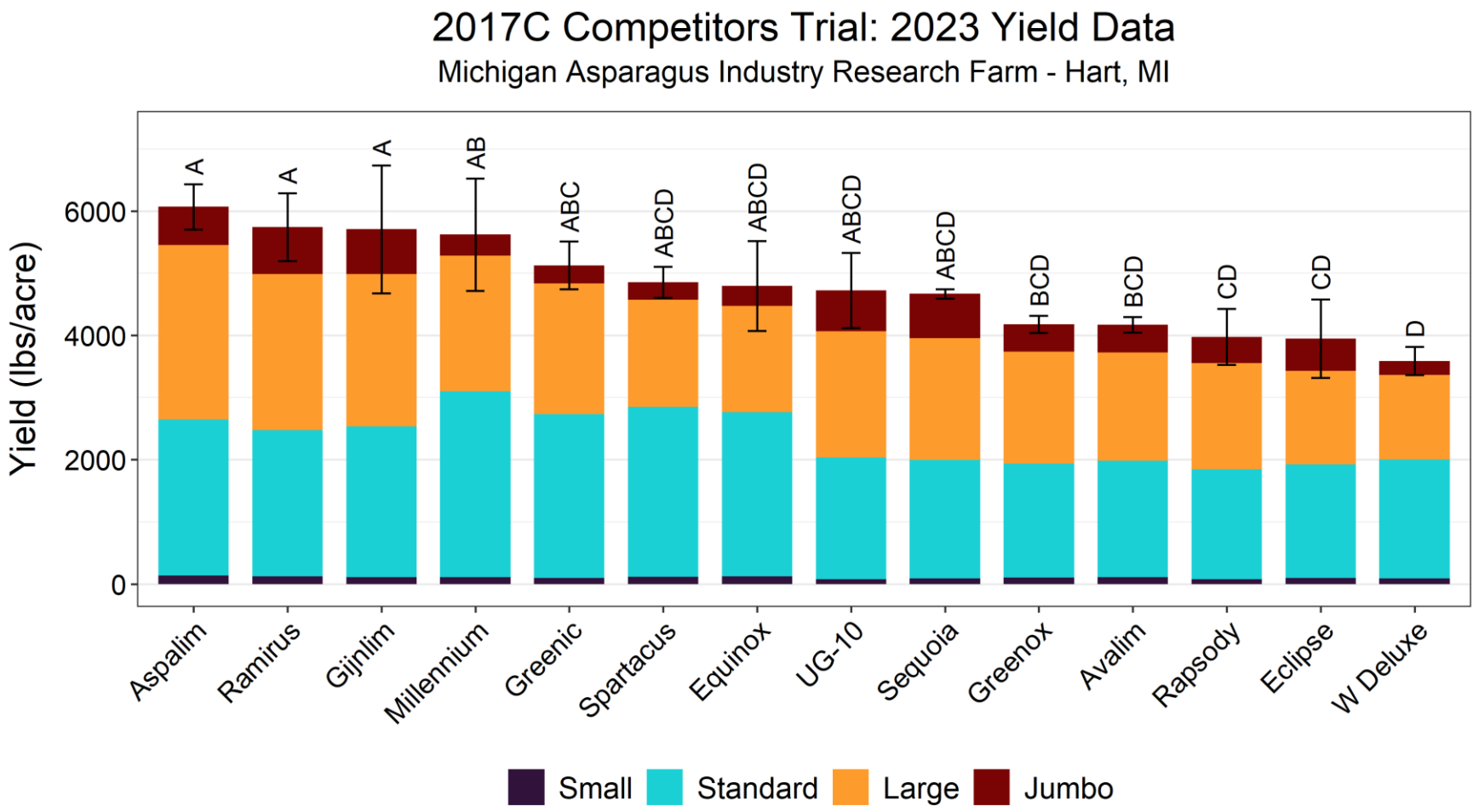
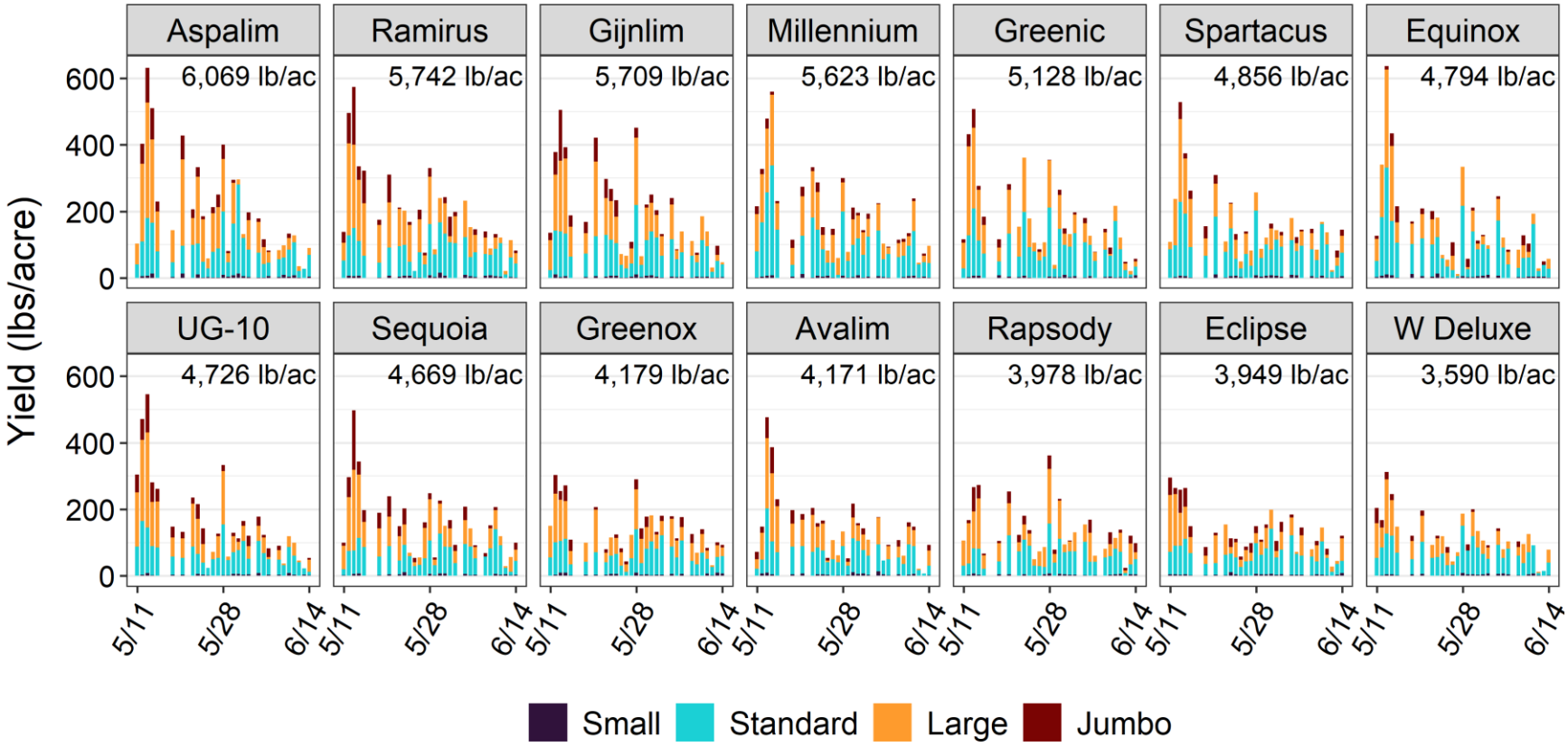
[2] Measured as percentage of individual spears with invalid flowering readings.


2017C Competitors Trial: 2023 Yield Data
Michigan Asparagus Industry Research Farm - Hart, MI
Yield (lbs/acre)
6000
4000
2000
0
A
A
A
AB
ABC
ABCD
ABCD
ABCD
ABCD
BCD
BCD
CD
CD
D
Aspalim
Ramirus
Gijnlim
Millennium
Greenic
Spartacus
Equinox
UG-10
Sequoia
Greenox
Avalim
Rapsody
Eclipse
W Deluxe
Small
Standard
Large
Jumbo

2017C Competitors Trial: 2023 Yield Distribution

Michigan Asparagus Industry Research Farm - Hart, MI



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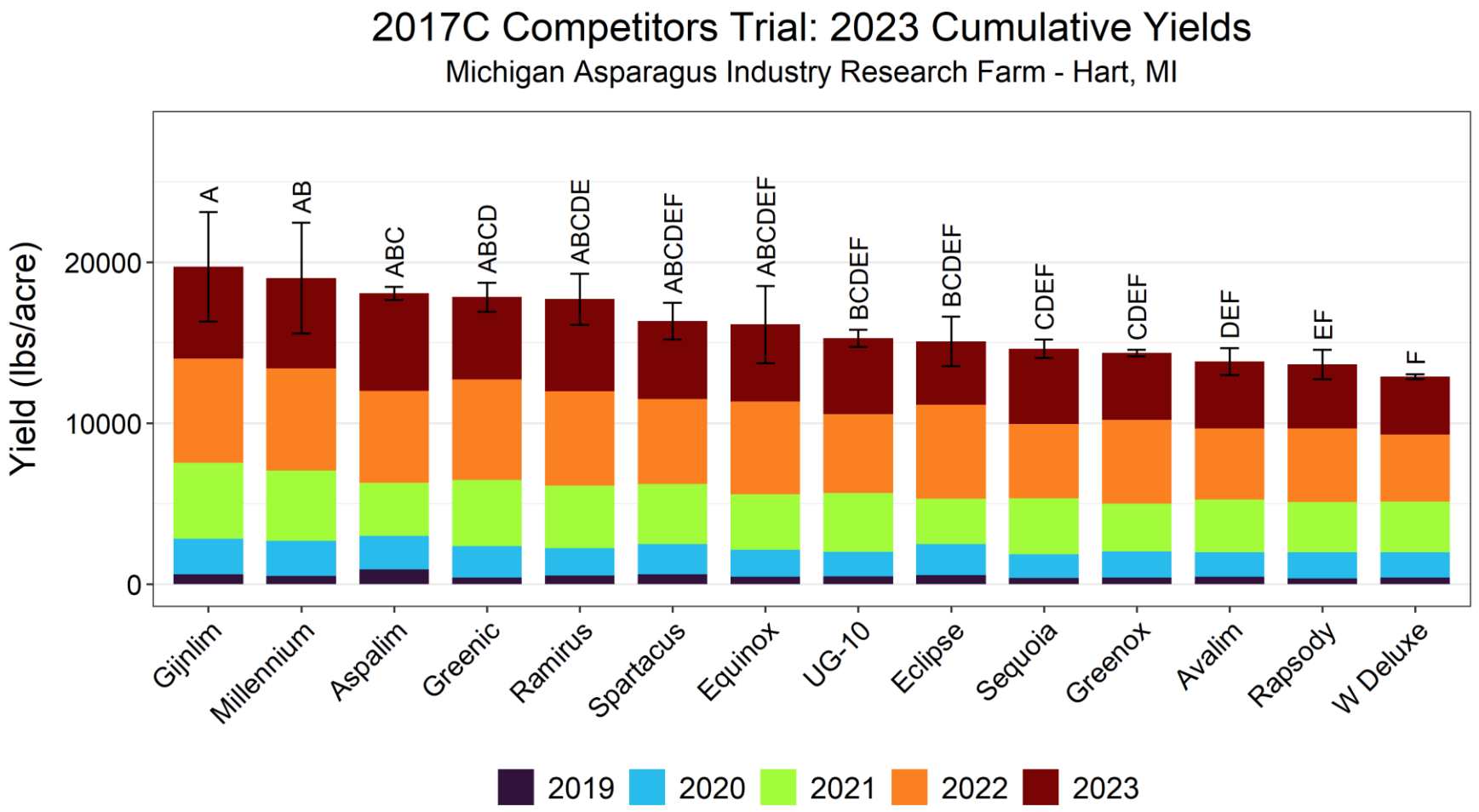
2017C Competitors Trial: 2023 Cumulative Yields

Michigan Asparagus Industry Research Farm - Hart, MI

Variety	Mean Yields in lbs./acre					
	2019	**2020**	**2021**	**2022**	**2023**	**Total**
Gijnlim	604	2211	4709	**6490**	**5709**	**19724**
Millennium	506	2175	4380	**6334**	**5623**	**19019**
Aspalim	**917**	2066	3301	**5713**	**6069**	**18066**
Greenic	411	1943	4104	**6248**	**5128**	**17834**
Ramirus	524	1710	3881	**5850**	**5742**	**17707**
Spartacus	605	1872	3726	**5290**	**4856**	**16348**
Equinox	444	1692	3445	**5752**	**4794**	**16128**
UG-10	473	1524	3648	**4902**	**4726**	**15273**
Eclipse	554	1917	2824	**5840**	3949	**15085**
Sequoia	368	1484	3475	4630	**4669**	14626
Greenox	387	1636	2973	**5193**	4179	14369
Avalim	438	1548	3268	4414	4171	13839
Rapsody	354	1614	3132	4566	3978	13644
W Deluxe	391	1575	3162	4169	3590	12886
p Value	< 0.0001	0.4669	0.2038	0.0443	0.0277	0.0332
LSD.05	206	n.s.	n.s.	1625	1605	4923

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


2017C Competitors Trial: 2023 Cumulative Yields
Michigan Asparagus Industry Research Farm - Hart, MI
Yield (lbs/acre)
20000
10000
0
A
AB
ABC
ABCD
ABCDE
ABCDEF
ABCDEF
BCDEF
BCDEF
CDEF
CDEF
DEF
EF
F
Gijnlim
Millennium
Aspalim
Greenic
Ramirus
Spartacus
Equinox
UG-10
Eclipse
Sequoia
Greenox
Avalim
Rapsody
W Deluxe
2019
2020
2021
2022
2023

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Guelph Eclipse Plant Population Study
2023 Results

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:

As in previous years, no significant differences in yield or spear diameter were observed across plant populations.

2017B Eclipse Plant Population Trial: 2023 Yield Data

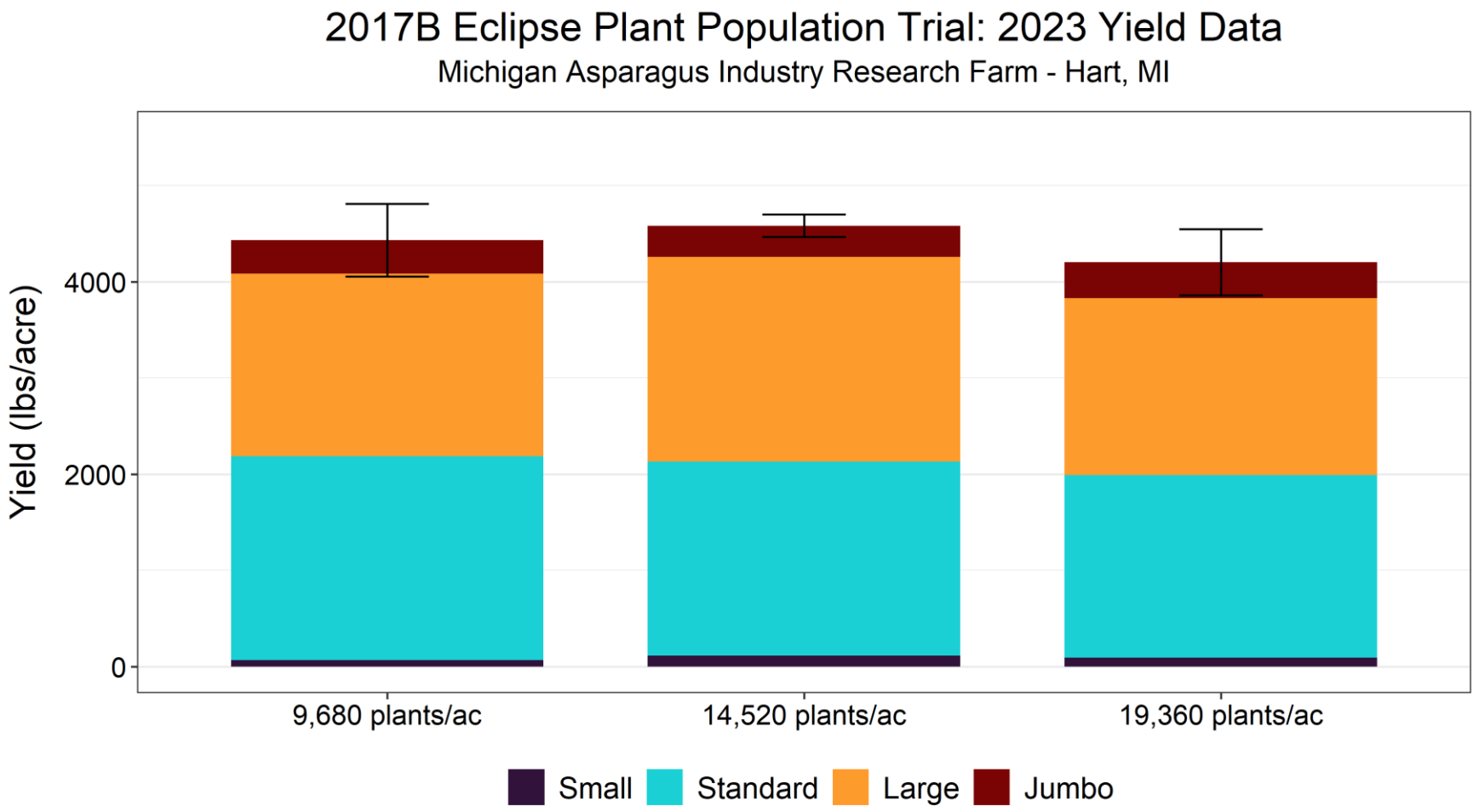
Michigan Asparagus Industry Research Farm - Hart, MI

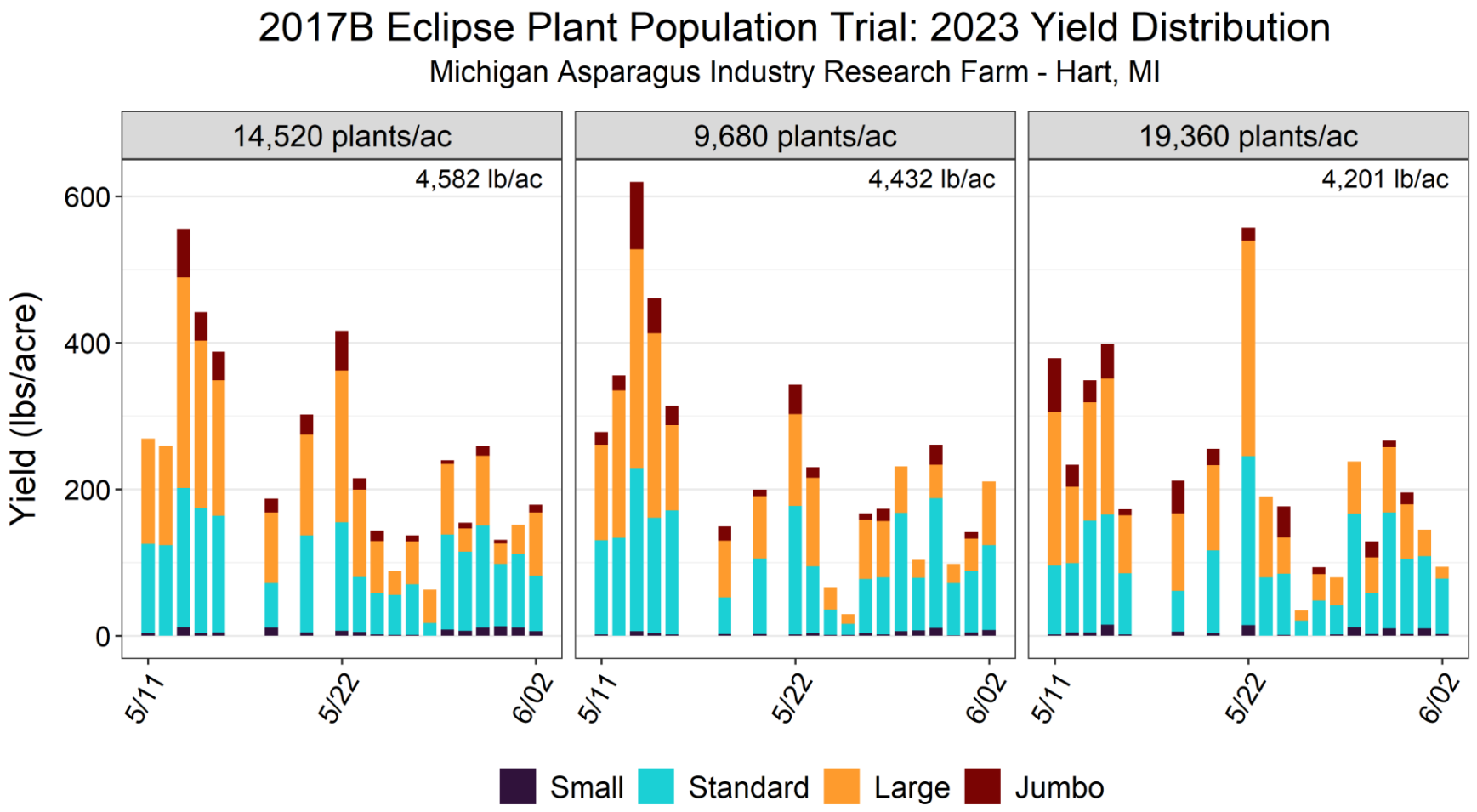
Population	Mean Yields in lbs./acre					Spear Tip Quality	
	Small	**Standard**	**Large**	**Jumbo**	**Total**	**Avg Flowering[1]**	**Invalid[2]**
9,680 plants/ac	67	2117	1900	350	4432	31%	15%
14,520 plants/ac	113	2015	2129	324	4582	29%	13%
19,360 plants/ac	93	1895	1840	373	4201	30%	13%
p Value	0.0674	0.5501	0.4129	0.9357	0.6852	0.2933	0.6429
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: 2023 Yield Data
Michigan Asparagus Industry Research Farm - Hart, MI
Yield (lbs/acre)
4000
2000
0
9,680 plants/ac
14,520 plants/ac
19,360 plants/ac
Small
Standard
Large
Jumbo


2017B Eclipse Plant Population Trial: 2023 Yield Distribution
Michigan Asparagus Industry Research Farm - Hart, MI
14,520 plants/ac
9,680 plants/ac
19,360 plants/ac
4,582 lb/ac
4,432 lb/ac
4,201 lb/ac
Yield (lbs/acre)
600
400
200
0
5/11
5/22
6/02
Small
Standard
Large
Jumbo

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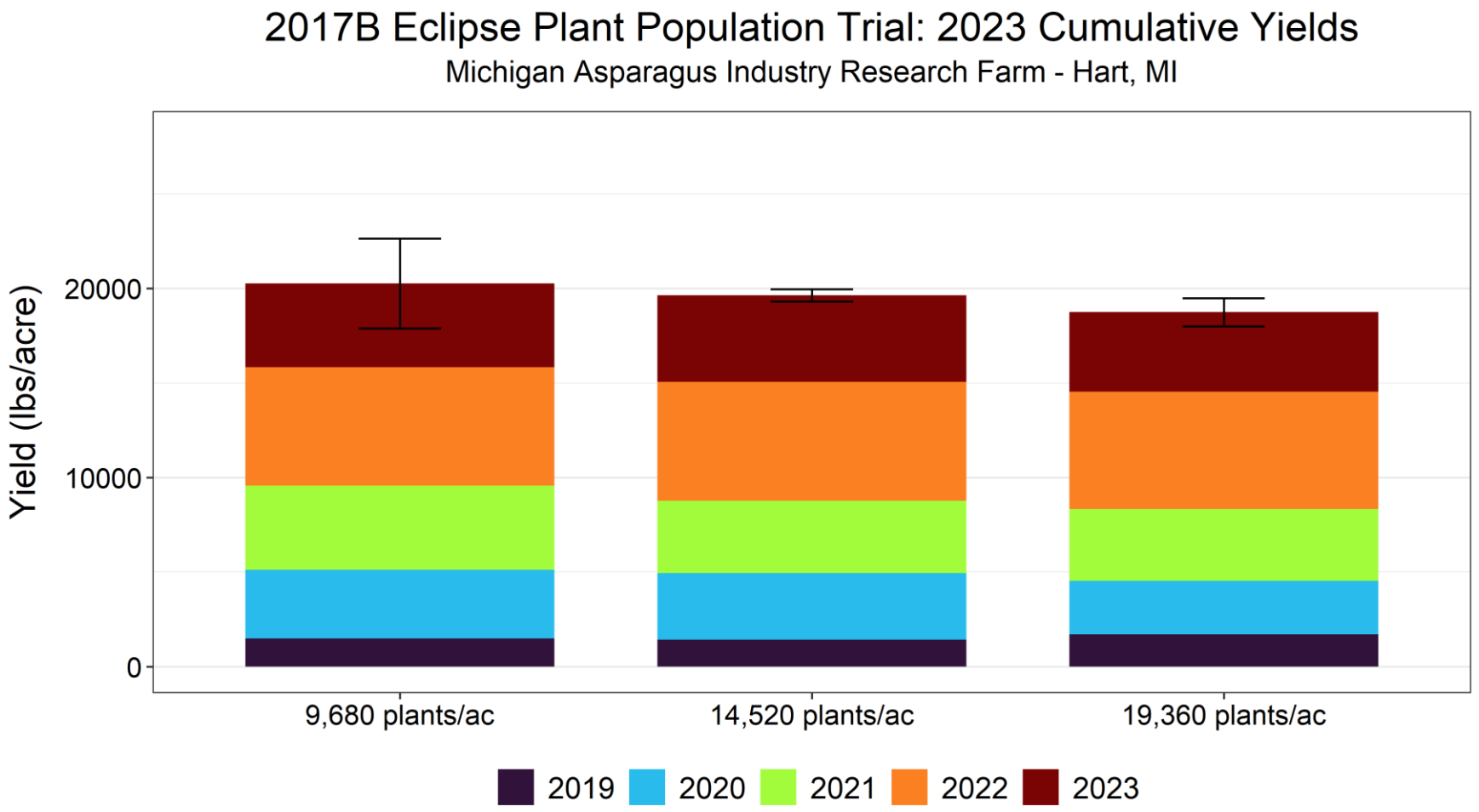
2017B Eclipse Plant Population Trial: 2023 Cumulative Yields

Michigan Asparagus Industry Research Farm - Hart, MI

Population	Mean Yields in lbs./acre					
	2019	**2020**	**2021**	**2022**	**2023**	**Total**
9,680 plants/ac	1486	3638	4445	6261	4432	20262
14,520 plants/ac	1425	3514	3825	6292	4582	19638
19,360 plants/ac	1705	2836	3786	6221	4201	18749
p Value	0.1822	0.3424	0.3265	0.9946	0.6852	0.7695
LSD.05	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.


2017B Eclipse Plant Population Trial: 2023 Cumulative Yields
Michigan Asparagus Industry Research Farm - Hart, MI
Yield (lbs/acre)
20000
10000
0
9,680 plants/ac
14,520 plants/ac
19,360 plants/ac
2019
2020
2021
2022
2023

2023 Weather and Climate Data

Michigan Asparagus Industry Research Farm - Hart, MI

Month	Average Temperature (F)			Total Precipitation (in)		
	2022	2023	30yr Normal	2022	2023	30yr Normal
January	22.6	30.6	22.9	0.09	1.70	2.75
February	23.2	29.0	24.1	0.77	1.66	1.96
March	33.5	33.8	32.4	2.62	3.13	2.37
April	41.9	46.8	43.8	3.37	2.26	3.63
May	58.7	56.3	54.8	2.50	1.22	4.45
June	64.0	64.9	64.8	1.95	1.71	3.72
July	70.2	69.4	68.8	5.13	3.02	3.53
August	68.5	66.7	67.6	6.29	3.16	3.27
September	61.4	63.8	60.8	2.23	0.81	3.23
October	49.2	50.9	49.0	5.36	4.95	3.96
November	40.8	38.5	37.7	2.52	2.03	3.43
December	28.8	37.5	28.4	1.00	1.56	2.60

Daily weather data from ARF Enviroweather Station. NOAA climate normals 1991-2020 from Hart 3 WSW Station.

MSU Enviroweather sensors do not measure frozen precipitation, affecting accuracy of precipitation totals during winter months.

Asparagus Emergence Studies: Phenological Models and Indicator Plants

Dan Brainard, MSU Department of Horticulture & MSU Extension

Research Takeaways

- Growing Degree Day (GDD) models based on Enviro-weather soil temperature data provide reasonable estimates of when asparagus will emerge in the spring and may help growers make more informed marketing and labor management decisions.
- Although useful, predictions of asparagus emergence based on Enviro-weather data are limited by variations between fields in soil type, slope aspect (south vs north facing), crown depth (shallow vs deep), groundcover management (rye cover crop vs bare soil) and asparagus variety.
- Newly funded research will explore whether the timing of emergence or flowering of "Indicator Plants" that are present in or around asparagus fields can provide a low-cost alternative to sensor-based systems for predicting asparagus emergence in specific grower fields.

Asparagus Emergence Studies: Phenological Models and Indicator Plants

Dan Brainard
Michigan State University
Horticulture

1

New MDARD Grant (PI – Hayden)

Title: Decision Support to Improve Asparagus Yield, Quality, and Industry Competitiveness Under Weather Extremes

10/1/23 – 9/1/25 (Two field seasons)

Objective 1. Investigate the interactive effects of soil calcium management and overhead irrigation on asparagus yield and quality (Hayden).

Objective 2. Model the effects of temperature and soil moisture on yield and quality characteristics of asparagus using high resolution sorter data (Hayden).

Objective 3. Improve predictions of spear emergence through refinement of degree day models and identification of phenological indicators of spear emergence (Brainard)

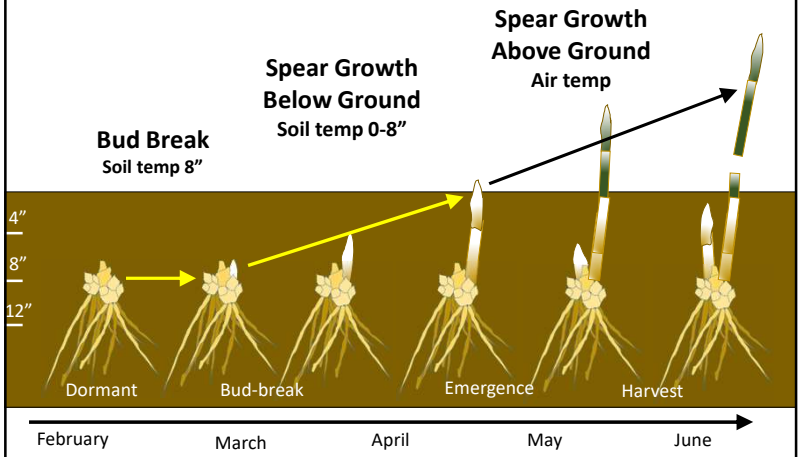
Can "Indicator plants" provide a low-cost alternative to sensor-based models for prediction spear emergence?

2

Degree Day Model Development

3

Two Step Model of Emergence

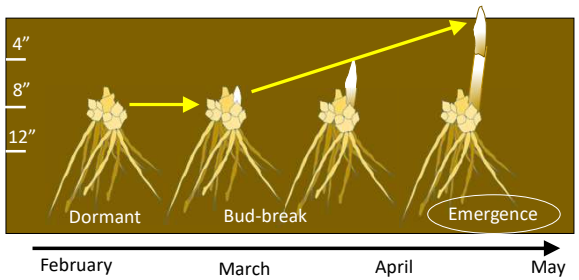


4

Our current best guess
Based on Enviro-weather soil temperature data

Step 1
Bud Break
Soil temp 8”
32 F Base Temp
200 GDD Required

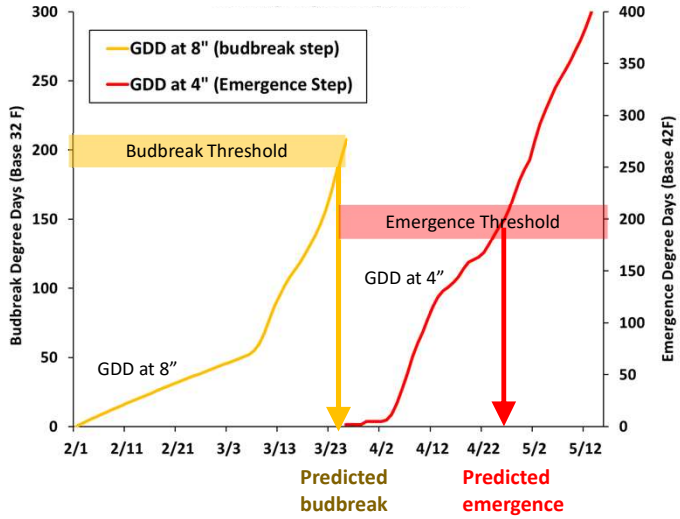
Step 2
Spear Growth
Soil temp 4”
42 F Base Temp
180 GDD Required



25% of crowns with at least one spear > 1”

5

Two Step Model to Predict Emergence

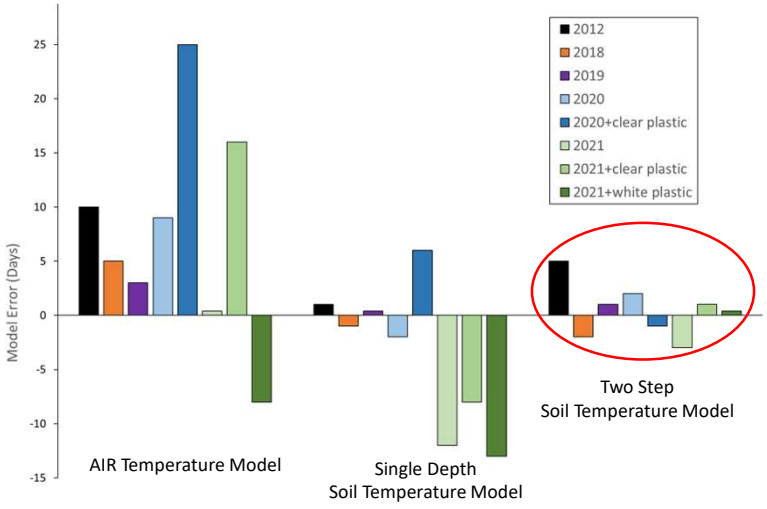


6

Model Development and Testing

7

Comparison of Models



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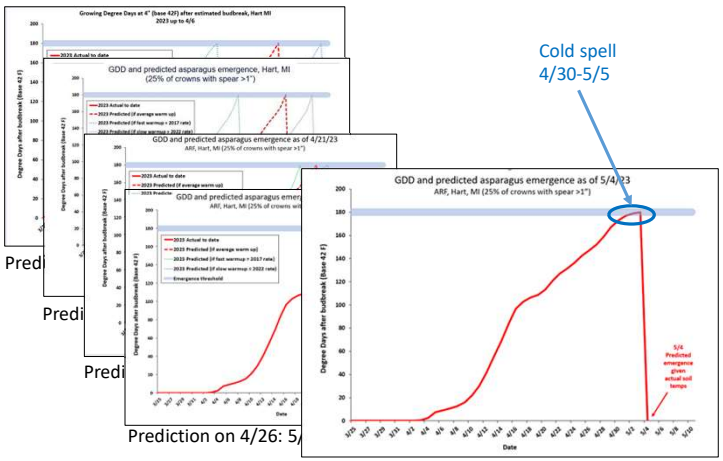
2023 Model Predictions

9

2023 Model Emergence Predictions



Actual 25% Emergence ~ 5/6
Actual First Harvest 5/8

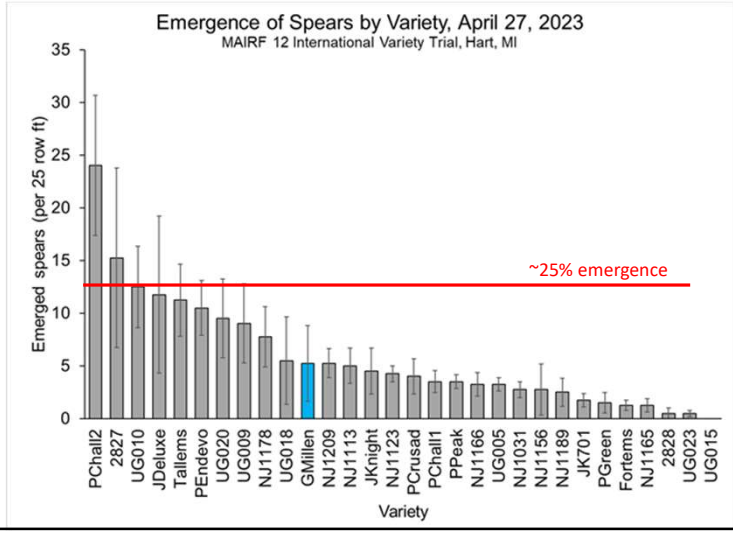
10

Status of spears below ground on 4/27

Farm	~Loc	Variety	Mean bud depth (in)	Mean bud length (in)	bud growth*	Percentage of buds (n=10) with spears <4" from surface	spears <2" from surface	spears emerged
MARF	Hart	Mill.	6.4	1.3	100	20	0	0
Oome	Crystal Vall	Mill.	5.3	1.9	100	70	30	5
MARF	Hart	Sequoia	5.1	2.6	90	90	30	10
Vana	Elbridge	Eclipse	6.2	2.8	100	50	20	5

11

Emergence variation by variety, 2023



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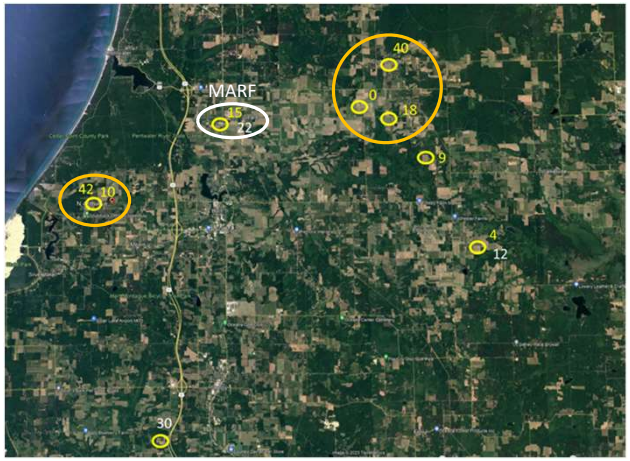
Actual Emergence at MARF = WCMREC 5/4 ~15%

Guelph Millennium Emergence Range: 0 – 42%



Note variation even with ~same weather

13

Why variation in emergence?

- Temperature variation between fields
  - Slope (south vs north facing)
  - Soil type and moisture (light vs heavy)
  - Ground cover (rye or none)
- Depth of crown
- Asparagus variety or age
- Non-temperature effects?
  - Impacts of fall temperatures on dormancy?
  - Drought; disease?

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New MDARD Grant (PI – Hayden)

Title: Decision Support to Improve Asparagus Yield, Quality, and Industry Competitiveness Under Weather Extremes

10/1/23 – 9/1/25 (Two field seasons)

Objective 1. Investigate the interactive effects of soil calcium management and overhead irrigation on asparagus yield and quality (Hayden).

Objective 2. Model the effects of temperature and soil moisture on yield and quality characteristics of asparagus using high resolution sorter data (Hayden).

Objective 3. Improve predictions of spear emergence through refinement of degree day models and identification of phenological indicators of spear emergence (Brainard)

Can "Indicator plants" provide a low-cost alternative to sensor-based models for prediction spear emergence?

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Indicator Plants
Preliminary Plans

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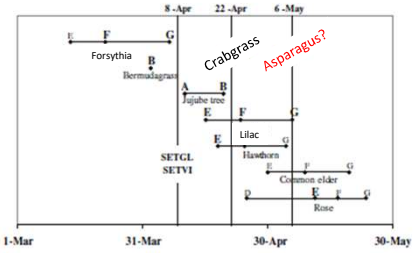
Indicator Plants

Phenological Indicators for Emergence of Large and Smooth Crabgrass
(*Digitaria sanguinalis* and *D. ischaemum*)

John Cardina, Catherine P. Herms, and Daniel A. Herms*

Concept has been used to predict timing of weed emergence (e.g. crabgrass)
Adaptable to asparagus?



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Indicator Plants

Phenological Indicators for Emergence of Large and Smooth Crabgrass
(*Digitaria sanguinalis* and *D. ischaemum*)

John Cardina, Catherine P. Herms, and Daniel A. Herms*

				GDD (50 F)
PJM rhododendron	*Rhododendron* L. 'H-1 P.J.M'	First bloom	April 16	155
Smooth crabgrass	**Bare**	**First emergence**	**April 17**	**178**
Saucer magnolia	*Magnolia* × *soulangiana* Soul.-Bod.	Full bloom	April 18	184
Allegheny serviceberry	*Amelanchier laevis* Medik.	Full bloom	April 18	187
Bradford Callery pear	*Pyrus calleryana* Decne. 'Bradford'	Full bloom	April 19	189
Eastern redbud	*Cercis canadensis*	First bloom	April 20	192
PJM rhododendron	*Rhododendron* L. 'H-1 P.J.M.'	Full bloom	April 20	201
Large crabgrass	**Lawn**	**First emergence**	**April 24**	**211**
Snowdrift crabapple	*Malus* L. 'Snowdrift'	First bloom	April 21	213
Common lilac	*Syringa vulgaris* L.	First bloom	April 24	231
Ohio buckeye	*Aesculus glabra* Willd.	First bloom	April 25	241
Wayfaringtree viburnum	*Viburnum lantana* L.	First bloom	April 28	251
Persian lilac	*Syringa* × *persica* L.	First bloom	April 29	261
Smooth crabgrass	**Lawn**	**25% emergence**	**April 28**	**263**
Common horsechestnut	*Aesculus hippocastanum* L.	First bloom	April 30	264
Snowdrift crabapple	*Malus* L. 'Snowdrift'	Full bloom	May 1	268
Tatarian honeysuckle	*Lonicera tatarica* L.	First bloom	April 29	270
Eastern redbud	*Cercis canadensis* L.	Full bloom	April 30	277
Smooth crabgrass	**Bare**	**25% emergence**	**May 1**	**284**
Flowering dogwood	*Cornus florida* L.	First bloom	May 4	293
Large crabgrass	**Bare**	**First emergence**	**May2-**	**306**
Asparagus ?	*Viburnum lantana* L.	Full bloom	May 6	310
	Syringa vulgaris L.	Full bloom	May 7	331
winter king hawthorn	*Crataegus viridis* L.	First bloom	May 8	344
Smooth crabgrass	**Bare**	**50% emergence**	**May 9**	**347**
Smooth crabgrass	**Lawn**	**50% emergence**	**May 7**	**354**
Vanhoutte spirea	*Spiraea* × *vanhouttei* (Briot) Carr.	First bloom	May 9	367
Black cherry	*Prunus serotina* Ehrh.	First bloom	May 11	372
Ohio buckeye	*Aesculus glabra* Willd.	Full bloom	May 11	384

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Some Potential Indicator Plants

Emergence	Species 1	Species 2	EMonth	EDate	ERange	EGroup	Fmonth	Fdate	Frange	Fgroup	TimeEF
	Quackgrass		Mar.	23	24	1 June		13	16	3	82
	Leafy	spurge	Mar.	24	25	1 May		16	8	2	53
	Dandelion		Mar.	29	6	1 Apr.		29	6	1	31
	Stinging	nettle	Mar.	30	13	1 June		22	1	4	84
40	White	cockle	Mar.	30	12	1 May		25	8	2	56
38	Hoary	alyssum	Apr.	2	3*	2 June		2	2*	3	61
	Yellow	rocket	Apr.	2	12	2 May		8	4	1	36
39	Peony		April	1							
34	Rhubarb		April	6							
	Blackseed	plantain	Apr.	6	5	2 June		30	2	4	85
	Chicory		Apr.	7	2	2 June		26	5	4	80
30	Curly	dock	Apr.	10	24	2 June		9	17	3	60
	Grey	goldenrod	Apr.	10	5	2 Aug.		18	12	6	130
28	Japanese	knotweed	Apr	12	15	3					
	Giant	chickweed	Apr.	12	3*	3 June		12	19	3	61
24	Canada	thistle	Apr.	16	15	3 June		24	4	4	69
23	Comfrey		Apr.	17	6	3 May		22	6	2	35
18	Wirestem	muhly	Apr.	22	11	4 Aug.		10	10	6	110
14	Field	bindweed	Apr.	26	4	4 June		25	21	4	50
14	Swamp	smartweed	Apr.	26	11	4 July		29	13	5	94
12	Field	Horsetail	Apr.	28	7	4 --	--	--	--		
12	Hemp	dogbane	Apr.	28	1	4 June		18	7	3	50
12	Jerusalem	artichoke	Apr.	28	17	4 Sept.		20	16	7	144
10	Perennial	sowthistle	Apr.	30	21	4 July		10	10	4	71
	Purple	loosestrife	May	1	2	5 June		24	10	4	54
	Hedge	bindweed	May	6	12	5 June		22		4	47
4	Milkweed		May	6	5	5 June		26	5	4	52
	Smooth	groundcherry	May	6	4	5 July		1	9	4	56
0	Asparagus	G. Millennium	May	10	12						

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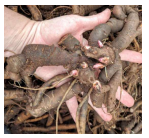
Indicator Initial Plant List

Indicator Species	Relative Emergence Timing
White cockle	40
Peony	39
Rhubarb	34
Curly Dock	30
Japanese knotweed	28
Canada thistle	24
Jerusalem artichoke	12
Perennial sowthistle	10
Milkweed	4
Asparagus	0

Initial choices based on

Similar depth of root/crown buds
Expected emergence 1 – 6 weeks before asparagus
Common in landscape including Ag fields



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Indicator Plants Initial Screening

O21 Asparagus Indicators
Plot Plan

101 1	102 2	103 3	104 4	105 5	106 6	107 7	108 8	109 9	110 10
201 2	202 7	203 8	204 5	205 10	206 9	207 3	208 1	209 4	210 6
301 3	302 10	303 5	304 8	305 1	306 9	307 4	308 7	309 6	310 2

WMREC (Hart)

HTRC (Holt)

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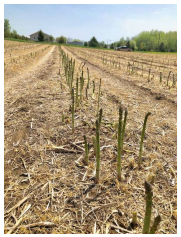
Indicator Plant Evaluation

- Monitor emergence timing relative to asparagus
- Evaluate consistency of relative emergence timing across variable growing environments
- Compare predictive value relative to sensor-based models



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Asparagus Emergence Studies

Take Home Messages

Growing Degree Day (GDD) models based on Enviro-weather soil temperature data provide reasonable estimates of when asparagus will emerge in the spring and may help growers make more informed marketing and labor management decisions.

Although useful, predictions of asparagus emergence based on Enviro-weather data are limited by variations between fields in soil type, slope aspect (south vs north facing), crown depth (shallow vs deep), groundcover management (rye cover crop vs bare soil) and asparagus variety.

Newly funded research will explore whether the timing of emergence or flowering of "Indicator Plants" that are present in or around asparagus fields can provide a low-cost alternative to sensor-based systems for predicting asparagus emergence in specific grower fields.

23

Acknowledgements

- MI Asparagus Research, Inc
- MDARD/USDA

- Greiner Farms
- Oomen Farms
- West MI Produce
- Malburg Farms
- Walsworth Farm
- Van Agtmael Farm
- Van Sickle Farm
- Schwass Farms

- Ben Werling
- Daniel Priddy
- John Bakker
- Hayden lab
- Monique Hemker
- Kristianna Balnik
- Silas Brainard
- Adam Bresson
- Louanges Ndayishimiye
- Emma Rice

24

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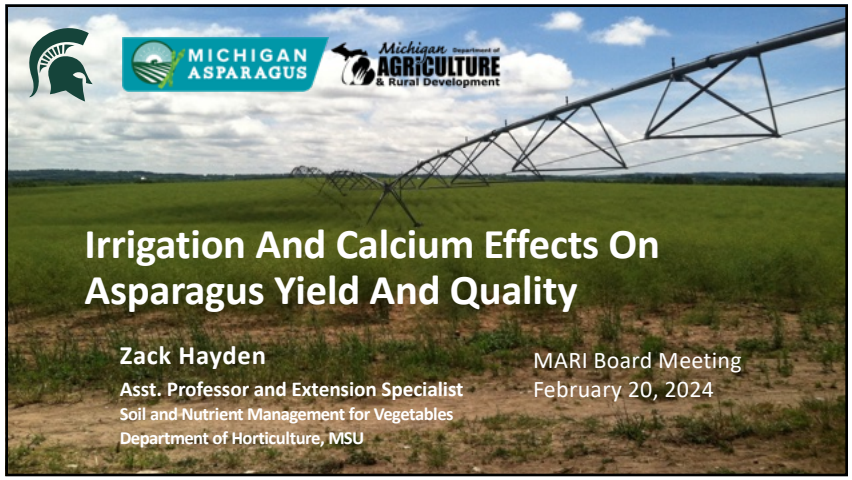
Irrigation and Calcium Effects On Asparagus Yield and Quality

Zack Hayden, MSU Department of Horticulture & MSU Extension

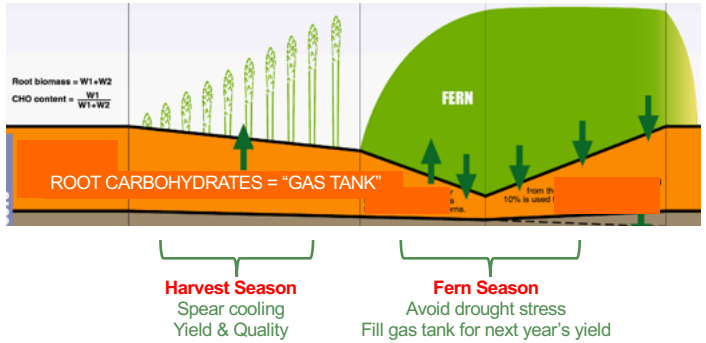
Research Takeaways

- During the hot/dry conditions of 2023, harvest-season irrigation cooled the spear environment, but with limited detection of tip quality improvements.
- Availability of irrigation improved weed control following the dry harvest season.
- Fern-season irrigation increased stem density and resulted in earlier and more consistent stem flushes over the summer.
- Gypsum increased fern concentration of specific nutrients, particularly Sulfur.



1

Irrigation in Asparagus: Why and When?



Adapted from Dan Drost, Utah State

2

Calcium (Ca) Deficiency Symptoms in Asparagus

Essential plant nutrient, involved in cell wall structure and integrity

- Downward curling of tips of young shoots
- Dieback of newly formed shoots
- Shortened storage roots

Carmen Feller & Anja Müller; Leibniz-Institute of Vegetable and Ornamental Crops
Theodor-Echtermeyer-Weg 1, D 14979 Großbeeren, Germany

3

Calcium (Ca) in the Asparagus – Soil System

- Most MI soils contain "adequate" Ca (>300-400 ppm), sandy soils more likely to be low
- Interactions with other nutrients
- Ca is an immobile plant nutrient
- Ca disorders and water uptake are closely linked

4

Calcium x Irrigation Research Questions

1) Are there benefits to supplemental Ca fertilization in asparagus?

2) Are potential benefits mediated by availability of irrigation?

   - Harvest-season irrigation (spear cooling for yield/quality)
   - Fern-season irrigation (fern productivity for future yields)

3) Can we better understand temperature and moisture controls on yield and quality?

5

Methods: Experiment at Asparagus Research Farm

- Guelph Millennium planted 2019 (1-yr old crowns)
- Experiment started spring 2022

Baseline soil test: 0-12" depth

pH	CEC	Organic Matter (%)	Bray-P (ppm)	K (ppm)	Ca (ppm)	Mg (ppm)
6.7	3.5	1.5	175	147	450	98

Loamy sand

6

Methods: Experimental Design

- Split-Plot RCBD, 4 Replications
- Subplots: 2 rows, 25 ft long

	Alley	4 ft	25 ft
1	101 Trt 1		105 Trt 3
2	102 Trt 1		106 Trt 3
3	Guard		
4	103 Trt 2		107 Trt 4
5	104 Trt 2		108 Trt 4
6	Guard		

Gypsum

No Gypsum

Irrigated

Unirrigated

7

Gypsum (Calcium Sulfate – 20% Ca, 16% S)

- 1,000 lb/ac pelletized gypsum pre-harvest annually
  - 210 lb Ca, 160 lb S
- Why gypsum?
  - Common amendment
  - Meaningful soil Ca input without pH change (lime) or excess N ($CaNO_3^-$)
  - Intermediate Ca solubility

8

Methods: Micro-sprinkler Irrigation

- Harvest Season
- Fern Season

Dr. Younsuk Dong, MSU ABSE

9

Methods: Data Collection

Spear Yield and Quality

- Spear number, weight, length, diameter
- Tip quality (flower factor)

Fern Productivity

- Stem production by category
- Light interception
- Fern tissue nutrient analysis

Soil

- Soil nutrient analysis by depth in spring

Environmental

- Soil and air temperature sensors during harvest irrigation
- Soil moisture sensors (4", 8", and 16" depth

10

Results: Weather and Irrigation Summary

	2022	2023
General Weather	Warm/**Wet**	Hot/Dry
Harvest Irrigation Events	4	6
Fern Irrigation Events	2	4

- **No effect of supplemental calcium or irrigation on total or individual harvest yields in 2022 or 2023**
- **Focus:** Quality and fern productivity during Hot AND Dry 2023

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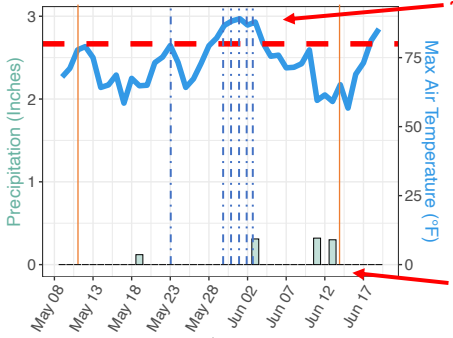
Results: 2023 Harvest Season

6 Irrigation Events During Harvest



~1 week stretch with high temps > 80 F

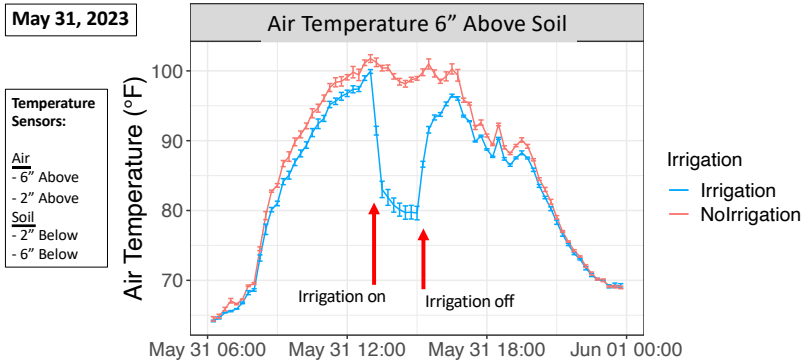
Harvest Season Irrigation
-Irrigate when temperatures are >80 F and surface soil moisture not saturated.

- Run 2 hours (0.25") during heat of the day

Very Dry Soil Surface Conditions

12

Results: Harvest Season Irrigation Cooling



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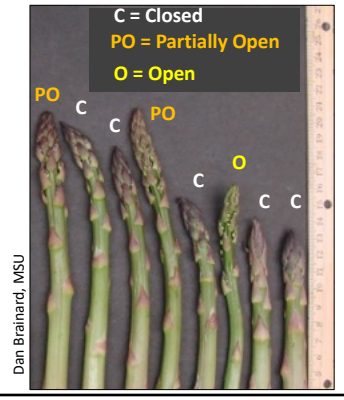
Results: Measuring Spear Tip Quality



"Flower Factor" Tip Quality Measurement

- 0-100% scale developed for white asparagus
- Green asparagus:
  - Best tip quality ~ 40%
  - Poor tip quality ~ 20%

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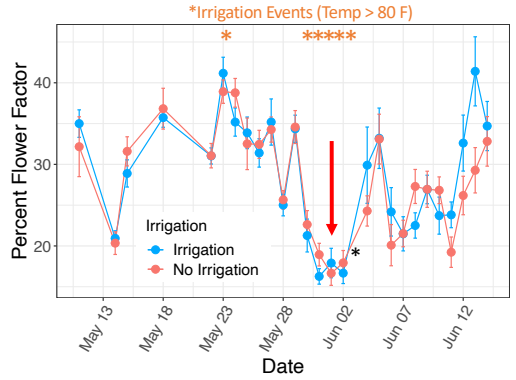
Results: Spear Tip Quality

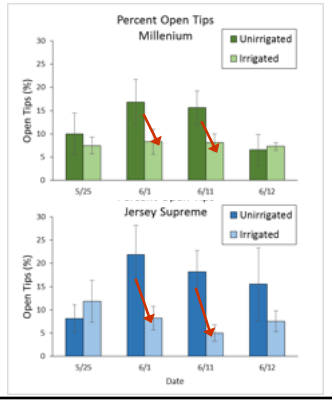


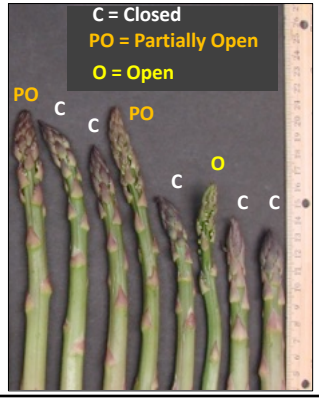
- No tip quality improvement detected for harvests following irrigation*
- Poorest quality overall measured during hottest period (May 30-June 3).

*Missing June 3 harvest data

16

Percent Open Tips in Previous Research: 2016





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Harvest Season Irrigation Improved Weed Control

Mid July 2023 Weed Pressure

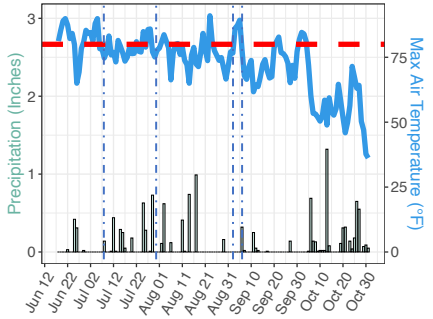
Irrigated

Not Irrigated

18

Results: Fern Season Irrigation in 2023

4 Irrigation Events During Fern Growth



Fern Season Irrigation:

- < 50% Available Water to ~16" depth based on sensors
- Irrigate to field capacity (approx. 1")

2023: Very dry start to fern season

Effects of Irrigation and Gypsum on Fern Productivity?

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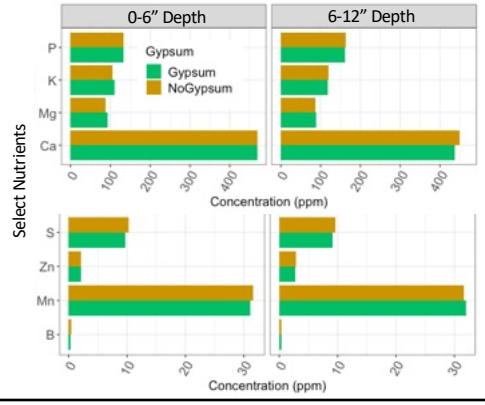
Some Notes on Gypsum

- Gypsum is a source of Calcium and Sulfur
- Gypsum is "intermediately" soluble
- Does not appreciably change soil pH
- Gypsum can act as a soil conditioner to reduce compaction
  - ➢ BUT soil structure benefits much less likely on sandy soils with low clay content
- Risks of high rates on sandy soils
  - ➢ Excessive Ca can interfere with soil retention and plant uptake of other cations (e.g., Potassium, Magnesium, etc.)

20

Results: Are we moving the needle on soil Calcium?

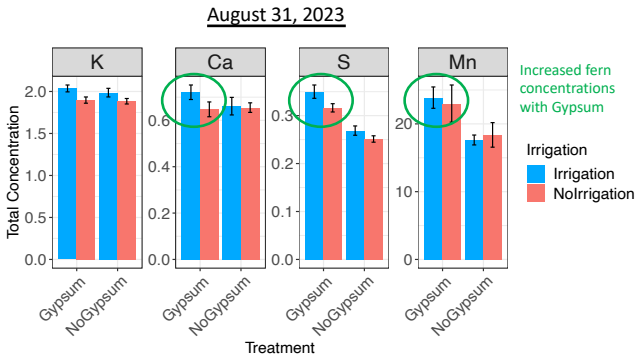


Soil Samples Collected 5/3/23

- No significant differences in Calcium or other soil nutrients detected after first season
- Not surprising, will continue to monitor each year

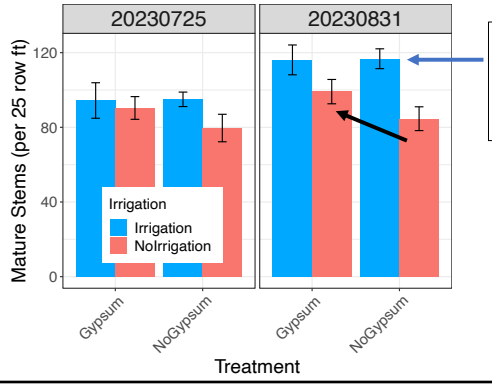
21

Results: 2023 Fern Tissue Samples



22

Results: Mature Stem Counts

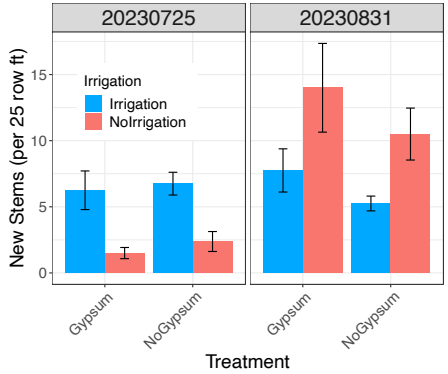


- Irrigation increased stem number
- Gypsum increased stems slightly, only without irrigation

Photos: Ben Werling

23

Results: New Emerging Stems



- Earlier and more consistent stem flushes with irrigation
- More new stems later in season without irrigation

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Summary

Irrigation and Supplemental Calcium Effects during a Hot/Dry 2023:

Harvest-season Effects:

- Irrigation provided cooling, but limited detection of tip quality improvements

Fern-season Effects:

- Irrigation increased stem density and weed control
- Gypsum: Changes to fern nutrient uptake, modest evidence of irrigation-dependent effects on stem density.

Impact on Yields? Stay tuned for 2024 harvest.

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Asparagus Beetle Biology and Management

Zofia Szendrei, MSU Department of Entomology & MSU Extension
Laura Marmolego, M.S. Student, MSU Department of Entomology

Research Takeaways

- Among the currently registered insecticides for asparagus beetle control during harvest, Carbaryl and Assail are the most effective for conventional insecticide options and Pyganic is most effective for organic management. Coragen seemed promising for suppressing egg numbers.
- Insecticide covering only the tip of the spears is as effective as insecticide covering entire spear likely because beetles use the spear tip as an important place to lay their eggs so they contact the insecticide at the spear tip when they lay eggs.
- Asparagus beetles can evaluate spear characteristics and are selective when choosing where to lay their eggs. This behavioral characteristic could be exploited in management and plant breeding in the future.

1

2023 Insecticide trials

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

Photos: J. Roedel

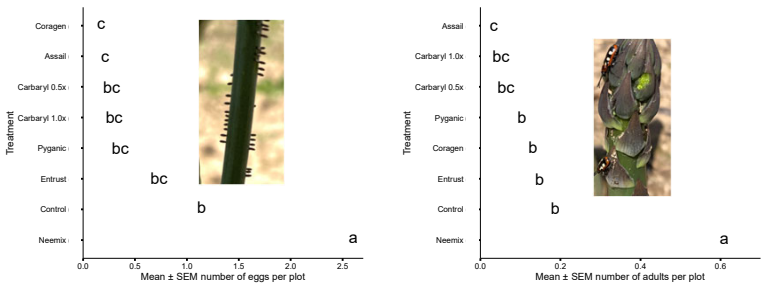
2

Insecticides tested for asparagus beetle management during harvest

Name	Company	Type	Active ingredient	Class	Rate (oz. per acre)
Assail (granular)	Corteva	Synthetic	acetamiprid	neonicotinoid	1.1-**2.3**
Carbaryl (1X)	Loveland	Synthetic	carbaryl	carbamate	**32**
Carbaryl (0.5X)	Loveland	Synthetic	carbaryl	carbamate	**16**
Coragen	FMC	Synthetic	chlorantraniliprole	anthranilic diamide	3.5-**7.5**
Neemix	Certis	Organic	azadirachtin		4-16 (**10**)
Pyganic	MGK	Organic	pyrethrin	pyrethrin	16-**59**
Entrust	Corteva	Organic	spinosad	spinosyn	1.25-**2**
Azera	MGK	Organic	azadirachtin+ pyrethrin		16-**32**

3

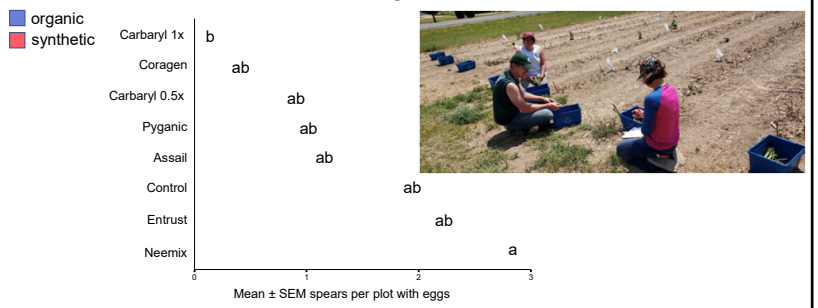
2023 Insecticide trial 24 + 48 hrs



Carbaryl 1x – maximum rate, Carbaryl 0.5x – half of the max. rate

4

2023 Harvested spears with eggs 24 + 48 hrs



5

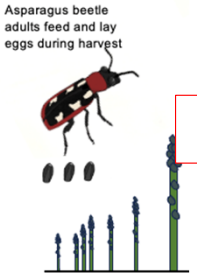
Insecticide no choice assays

Egg laying no choice

Egg laying preference choice test

6

Lab insecticide bioassays

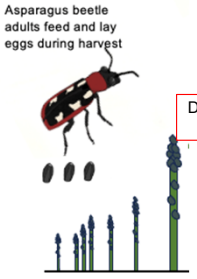


Does spear insecticide coverage matter?

Harvest in spring

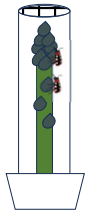
7

Lab insecticide bioassays



Does spear insecticide coverage matter?

Harvest in spring



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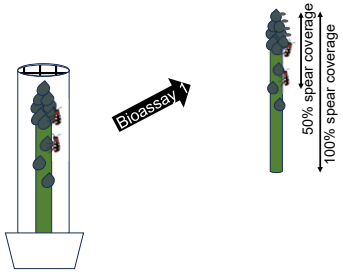
Does spear insecticide coverage matter?



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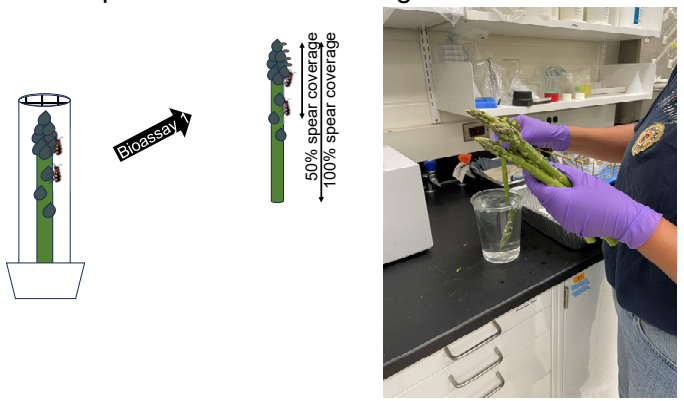
Does spear insecticide coverage matter?



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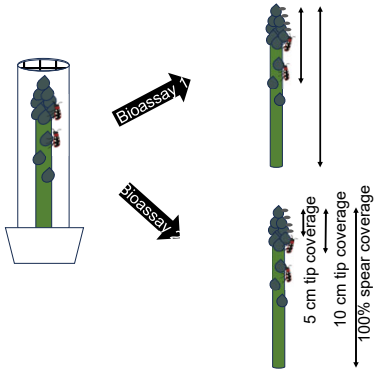
Does spear insecticide coverage matter?



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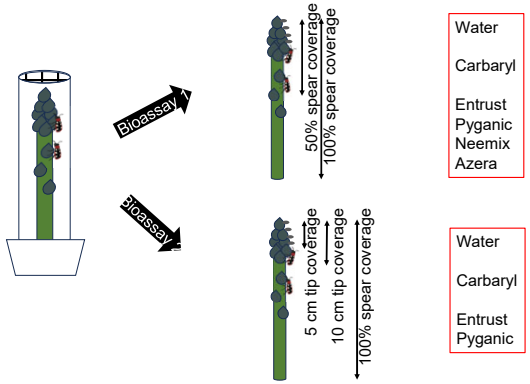
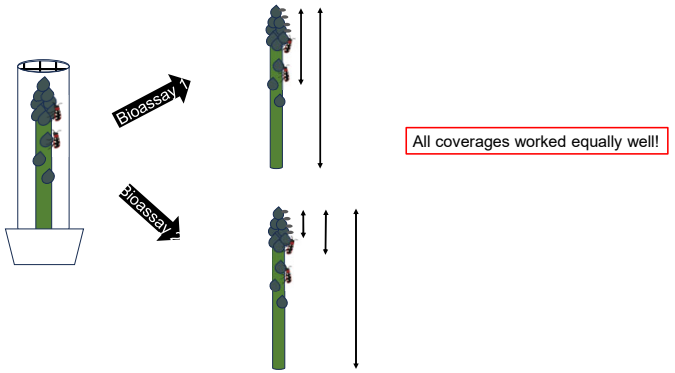
Does spear insecticide coverage matter?



12

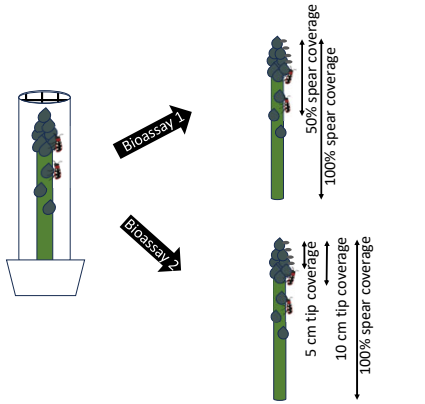
Does spear insecticide coverage matter?



All coverages worked equally well!

13

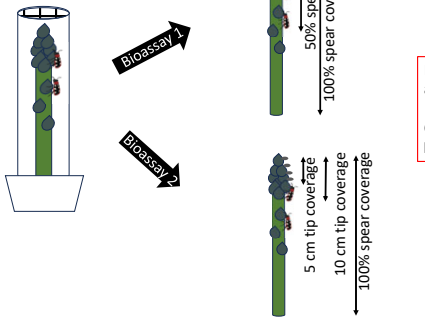
Lab insecticide bioassays



24, 48 hrs adult & egg count

14

Lab insecticide bioassays



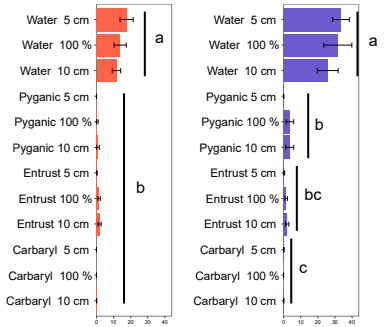
24, 48 hrs adult & egg count

PYGANIC – controlled eggs but not adults

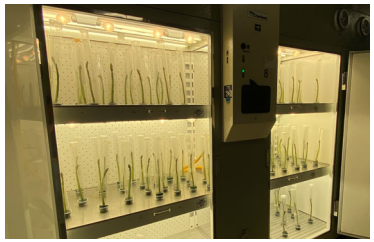
CARBARYL, ENTRUST – controlled both adults and eggs

15

Insecticide No-choice test

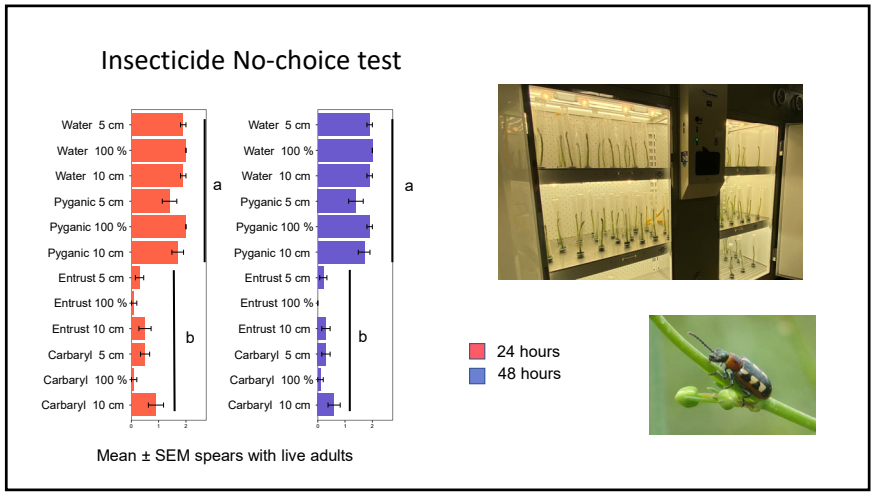


Mean ± SEM spears with eggs

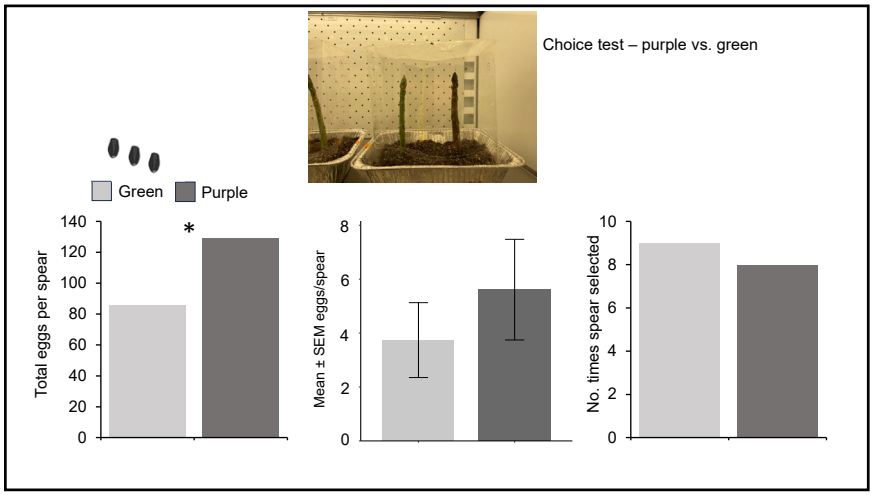


24 hours
48 hours

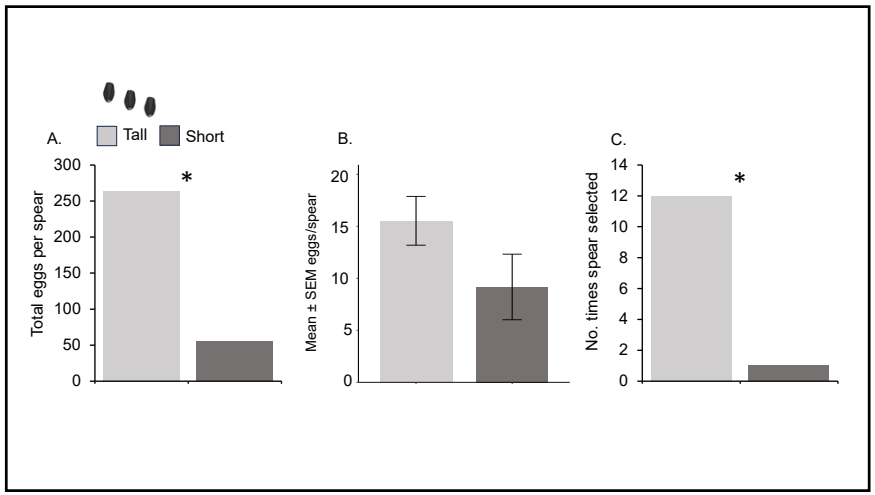
16


Insecticide No-choice test
Water 5 cm
Water 100 %
Water 10 cm
Pyganic 5 cm
Pyganic 100 %
Pyganic 10 cm
Entrust 5 cm
Entrust 100 %
Entrust 10 cm
Carbaryl 5 cm
Carbaryl 100 %
Carbaryl 10 cm
a
b
24 hours
48 hours
Mean ± SEM spears with live adults

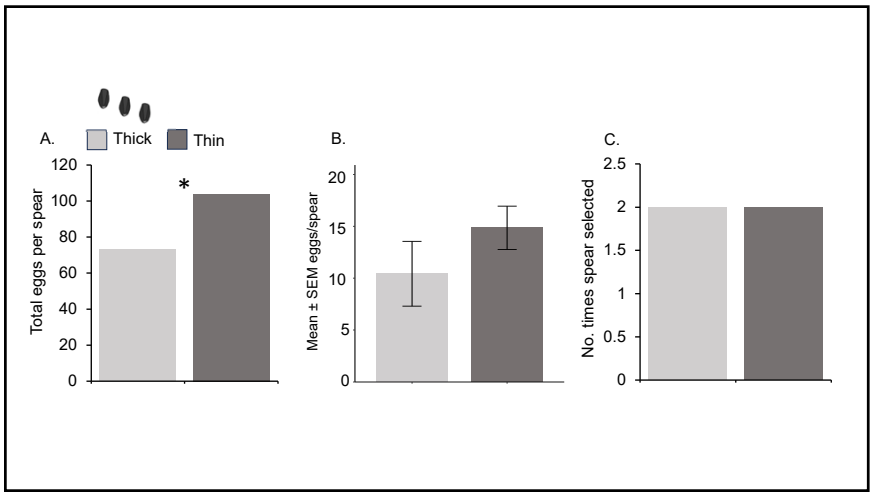
17


Choice test – purple vs. green
Green
Purple
Total eggs per spear
Mean ± SEM eggs/spear
No. times spear selected

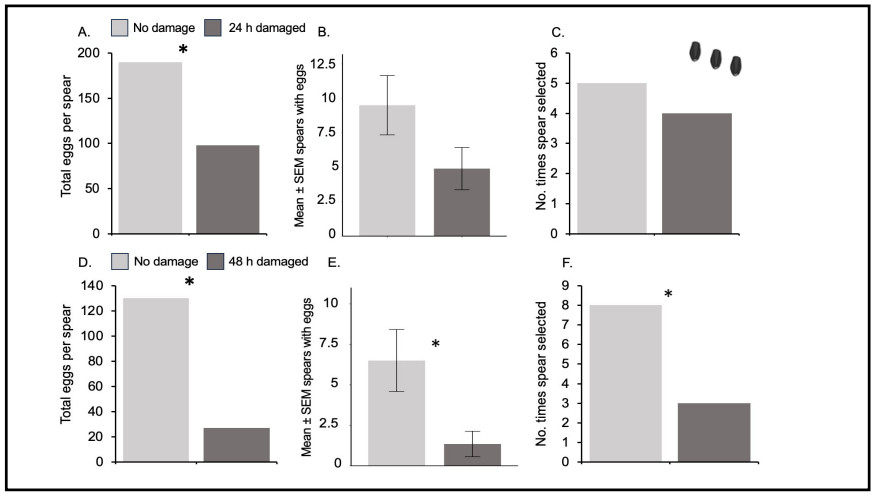
18


A.
Tall
Short
Total eggs per spear
B.
Mean ± SEM eggs/spear
C.
No. times spear selected

19


A.
Thick
Thin
Total eggs per spear
B.
Mean ± SEM eggs/spear
C.
No. times spear selected

20



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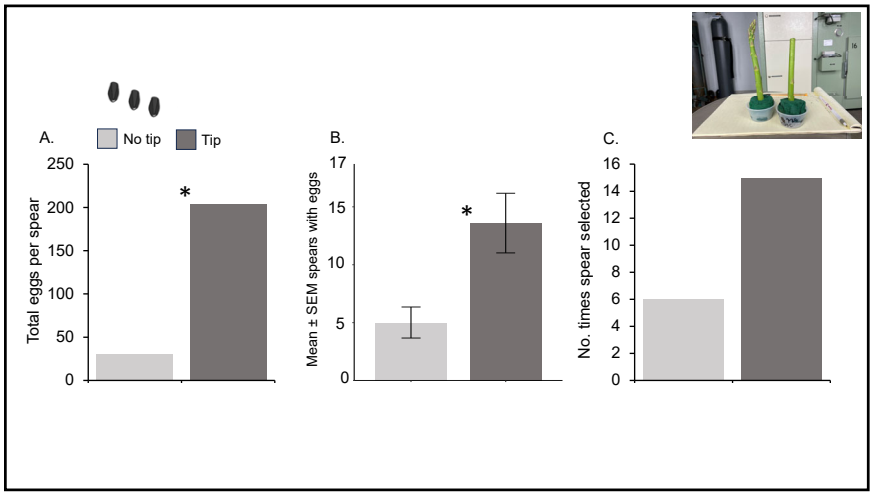

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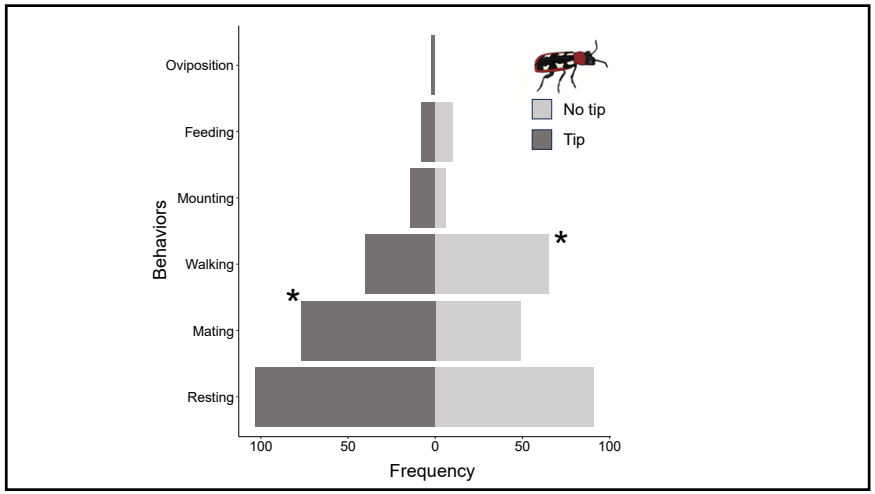

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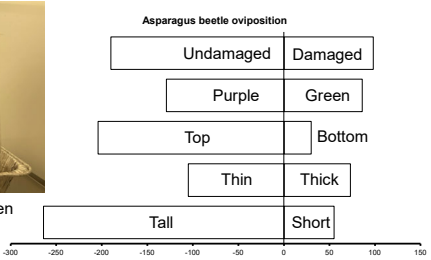
Asparagus beetle oviposition on spears

Choice test – purple vs. green



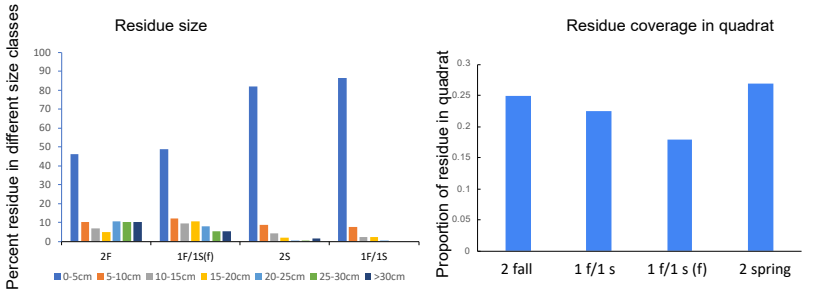
No choice

24

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

Creating residue to test in controlled experiments

25



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Project GREEEN

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MICHIGAN STATE UNIVERSITY
Department of Entomology

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