Upper Midwest Hazelnut Development Initiative

HAZELNUT RESEARCH BULLETIN

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Upper Midwest Hazelnut Joint Performance Trials - 2021 Results

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Introduction

A concerted effort over the last 25 years by both private and public breeding programs has produced a number of promising new hazelnut varieties for the Eastern USA and Canada (Fischbach and Braun, 2020; Muehlbauer et al, 2021). Since 2017, we have been populating research plantings with these new varieties at six locations in the Upper Midwest (Table 1). These plantings are intended to provide comparative performance data and a chance for growers to see the new varieties in action. These "Joint Performance Trials" include varieties developed by the Upper Midwest Hazelnut Development Initiative (UMHDI), Oregon State University, Rutgers University, and Grimo Nut Nursery (Table 2). The oldest of these plants are now starting to come into production (Photo 1). This bulletin reports on the growth and nut yields at age 5 for the cohort of varieties established in 2017 and 2018.

Photo 1. The first varieties planted in the Joint Performance Trials were from Oregon State University, Cecil Ferris, and Grimo Nut Nursery. The plants have established very well at the Verona location in WI (near Madison), as shown in this photo, but have struggled elsewhere.

Methods

The six sites of the Upper Midwest Joint Performance Trials were established starting in 2017 with the planting of five of the Grimo varieties ('Aldara', 'Andrew', 'Frank', 'Marion', 'Northern Blais'), 'Grand Traverse', and 'The Beast' (OSU 541.147). The Grimo selections were originally selected from plantings near Niagra-on-the-Lake, Ontario, which

State	Nearest City	USDA Hardiness Zone	Soil Type
Wisconsin	Bayfield	5a	705B - Cublake-Croswell-Ashwabay complex (sand)
	Verona	5a	PnC2 - Plano silt loam
Minnesota	Staples	4a	567A - Verndale sandy loam
	St. Paul	4b	411C - Waukegan Silt Loam
Iowa	Marion	5a	8B - Judson silty clay loam
	Fenton	5a	107 - Webster clay loam

Table 1. The UMHDI Joint Performance Trials (JPTs) are located at six locations in the Upper Midwest and will provide valuable comparative performance data on the new hazelnut varieties being released by breeding programs in the coming years.

has a milder winter climate than the Upper Midwest. 'Grand Traverse' is an older variety originally selected by Cecil Ferris in Michigan. Recently, it was grown in both New Jersey and Nebraska and performed well. 'The Beast' was developed by Oregon State University and has also performed well in New Jersey and Nebraska. A full description of these varieties is included in "Choosing Plants for a Hazelnut Orchard in New Jersey" (Muehlbauer et al, 2021). None of these varieties had yet been evaluated in the Upper Midwest, which is why they were included in the Trials. The additional varieties listed in Table 2 have been added since 2017, and will be reported on in future bulletins as they come into production.

The Grimo selections were provided as dormant rooted layers and 'The Beast' and 'Grand Traverse' as potted plants. Plant spacing is 15 feet between rows and 8 feet between plants at all locations except St. Paul, where between-plant spacing is 10 feet. Establishment and management practices vary across locations, but are based on sod-culture with weed free rows and perennial herbaceous vegetation between rows. Experimental design varied across the locations with randomized complete blocks in some locations and complete randomization in others.

There was some mortality in the 2017 planting year, particularly at the Fenton and Marion locations, with replacements added later. Only data from plants established in 2017 or 2018 are included in this bulletin. After five years at the Bayfield location, the plants are barely knee high and have only produced a few nuts. Data from the Bayfield location are not included in this bulletin.

Entry Name	Breeding Program	Established
OSU 541.147 (The Beast)	Oregon State University	2017/2018
Grand Traverse	Cecil Ferris	2017/2018
Aldara	Grimo Nut Nursery	2017/2018
Andrew	Grimo Nut Nursery	2017/2018
Frank	Grimo Nut Nursery	2017/2018
Marion	Grimo Nut Nursery	2017/2018
Northern Blais	Grimo Nut Nursery	2017/2018
Dermis	Grimo Nut Nursery	2018/2019
Arb 4-3	UMHDI	2018-2021
Arb 7-1	UMHDI	
Cuddy 2-28	UMHDI	
Gibs 5-15	UMHDI	
Heas B	UMHDI	
Price W41	UMHDI	
Rose 9-2	UMHDI	
Shep Rosy	UMHDI	
SPC-2D5	UMHDI	
Gibs 2-30	UMHDI	
Gibs 6-23	UMHDI	
Eric 4-21	UMHDI	
Gunth GF	UMHDI	
Stap N7-6	UMHDI	
Raritan	Rutgers University	2021
Monmouth	Rutgers University	2021
Somerset	Rutgers University	2021
Hunterdon	Rutgers University	2021

Table 2. New hazelnut selections developed for the Eastern USA and Canada included in the Joint Performance Trials.

Plant Vigor

In the fall of 2021, plant height was measured from the ground to the highest point on the shrub. Plant width was measured after harvest at the widest point perpendicular to the row. The width measurement was used to calculate canopy coverage on a cross-sectional area basis using the area of a circle.

Yield and Kernel Quality

Once the majority of the nuts had abscised from the husk, all clusters were harvested from the plant and dried in onion bags until the husks were dry. The husks were then removed and the in-shell nuts weighed to determine in-

shell yield. A sub-sample of 20 nuts was selected at random for each plant and shelled. Percent kernel was determined in two ways. "As is" percent kernel is the weight of all kernel in the sub-sample divided by the total weight of the in-shell subsample. This measure includes blanks and defective kernels and is used as a measure of how much kernel the plant produced. "Good" percent kernel is the weight of just the good kernels divided by the shell plus kernel weight of the good kernels. This measure is intended to reflect the genetic potential of the plant and excludes the kind of environmental factors that might cause blank nuts (no kernel) or defective kernels (shriveled, insect damage). The average individual kernel weight was determined by dividing the total weight of the good kernels by the number of good kernels. Yield density is the weight of kernels divided by the canopy coverage of the plant. This measure is used to compare yields between plants of different sizes, as larger plants tend to produce higher yields. Because smaller plants can be planted at closer spacing, yield density can easily be extrapolated to yield per acre.

	# of plants bearing in 2021 / # of plants in trial				
Variety	**Verona**	**Fenton**	**Marion**	**St. Paul**	**Staples**
Aldara	8/9	0/7	0/5	4/5	4/7
Andrew	4/10	0/10	0/10	3/11	2/7
Frank	3/10	0/4		3/5	2/4
Grand Traverse	2/11	0/10	0/10	0/9	0/2
Marion	10/10	0/9	0/10	7/10	4/7
Northern Blais	10/11	0/10	0/8	12/13	4/7
OSU 541.147 (The Beast)	0/11	0/4	0/11	0/7	0/2

Table 3. The number of plants producing nuts in 2021 out of the number of plants that were successfully established for each variety.

Results and Discussion

Plant Vigor

Table 3 shows the number of surviving plants from the 2017/2018 planting, and the number that produced nuts in 2021 at each location for each variety. 'Northern Blais', 'Marion', and 'Aldara' were the first varieties to come into production with most plants of these varieties producing nuts at the Verona, St. Paul, and Staples sites in 2021. Due to slower establishment at the Iowa sites, none of the plants are yet producing. 'The Beast' has yet to produce any nuts at any of the locations.

Figure 1 shows the average height and canopy coverage. All of the varieties have established very well at the Verona location near Madison, WI with the plants being significantly larger than

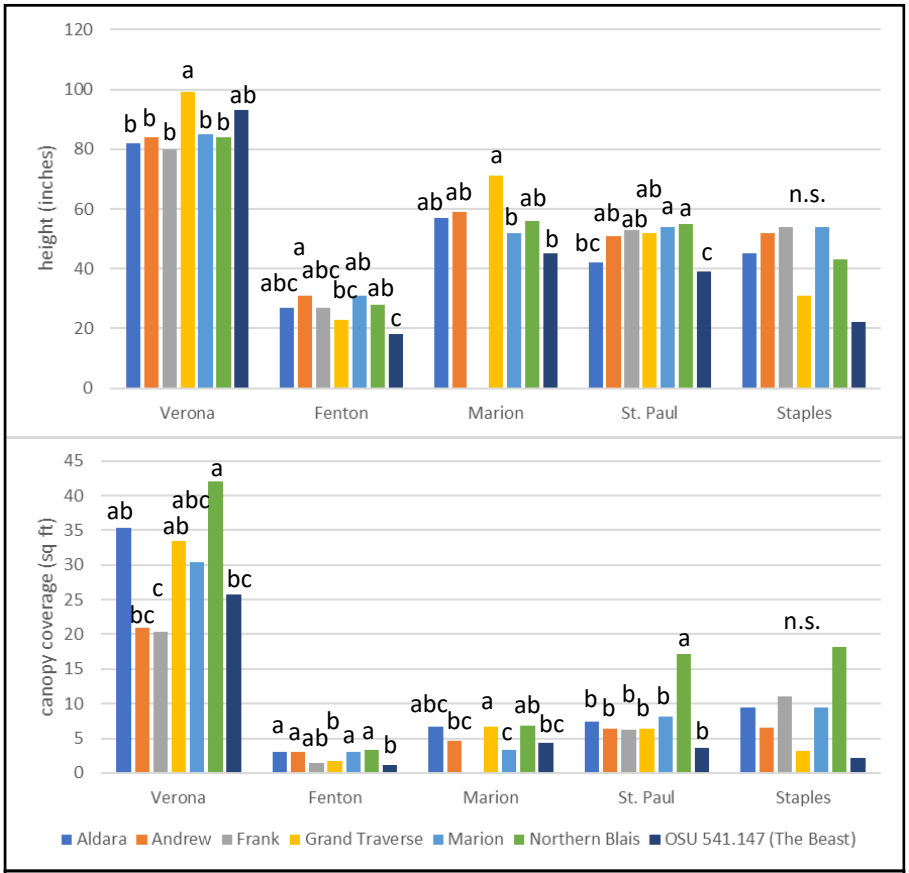

Figure 1. Average height (top) and canopy coverage (bottom) of each of the 2017/2018 cohort of varieties at each location. Means with the same letter are not statistically different.

Table 4. Average in-shell yield, kernel yield, and yield density. Means in a column with the same letter are not statistically different.

	in-shell yield (g)			kernel yield (g)			Yield density (g/sq m)		
Variety	**Verona**	**St. Paul**	**Staples**	**Verona**	**St. Paul**	**Staples**	**Verona**	**St. Paul**	**Staples**
Aldara	532 bb	4 b	18 a	189 bc	1 b	6 a	57 abc	1 bc	3 a
Andrew	95 cd	2 b	2 a	32 cd	1 b	1 a	14 bc	1 bc	0 a
Frank	81 cd	11 ab	2 a	30 cd	4 b	1 a	55 abc	6 abc	1 a
Grand Traverse	18 d	0 b	0 a	8 b	0 b	0 a	2 bc	0 c	0 a
Marion	612 b	35 b	48 a	234 b	8 ab	15 a	86 ab	8 ab	16 a
Northern Blais	1412 a	109 a	100 a	496 a	19 a	34 a	134 a	11 a	18 a
OSU 541.147 (The Beast)	0 d	0 b	0 a	0 d	0 b	0 a	0 c	0 bc	0
P-value	<0.0001	<0.0001	N.S.	<0.0001	<0.0001	N.S.	<0.0001	<0.0001	N.S.

at the other sites. The reason for the smaller plant sizes at the other locations is due to stem dieback resulting from winter injury and likely also due to lower overall fertility.

At the Verona location, 'Grand Traverse' and 'The Beast' tend to be the tallest of the varieties, which is not surprising given their Turkish and European pedigrees, respectively. Of the Grimo varieties, all are roughly the same height, but 'Northern Blais', 'Marion', and 'Aldara' tend to be wider. 'Frank' is a distinctly upright shrub compared to the other Grimo varieties.

Nut Yields

Table 4 shows the in-shell yield, kernel yield, and kernel yield density of the varieties at the three locations that had nut production in 2021. Clearly, the plants at Verona had much higher yields than the other sites, due mainly to the plants being much larger and healthier. 'Northern Blais' had significantly higher yields compared to the other varieties at the Verona site and tended to be the highest yielding at the other sites, as well.

Kernel Quality

Table 5 shows the kernel quality of the varieties as measured by average kernel weight and percent kernel. 'Grand Traverse' was selected by Cecil Ferris in part because of its larger kernel, and in these trials, 'Grand Traverse' had the largest kernel and the highest kernel percentage. Of the Grimo varieties, the average kernel weights were similar, though 'Aldara' was noticeably smaller (Figure 2). Percent kernel was also

Table 5. Average kernel quality as measured by as-is percent kernel, good percent kernel, and individual kernel weight. Means in each column with the same letter are not statistically different.

	% kernel (as is)			% kernel (good kernels only)			individual kernel weight (g)		
Variety	**Verona**	**St. Paul**	**Staples**	**Verona**	**St. Paul**	**Staples**	**Verona**	**St. Paul**	**Staples**
Aldara	35.8 bc	16.9 b	31.2 a	37.5 bc	20.8 b	40.1 a	0.68 d	0.22 c	0.63 b
Andrew	33.9 c	28.3 ab	37.8 a	35.4 c	34.7 a	37.8 a	0.87 bc	0.58 a	0.86 ab
Frank	36.6 abc	33.8 a	34.8 a	38.7 bc	35.1 a	34.9 a	0.82 bcd	0.58 a	0.95 ab
Grand Traverse	41.8 a			45.4 a			1.26 a		
Marion	38.4 ab	24.6 ab	30.4 a	39.6 b	32.8 a	38.2 a	0.90 b	0.40 ab	0.92 a
Northern Blais	35.4 c	18.1 b	32.1 a	36.2 b	27.0 ab	36.5 a	0.76 cd	0.29 bc	0.83 ab
OSU 541.147 (The Beast)	N/A			N/A			N/A		
P-value	0.0005	0.013	N.S.	<0.0001	0.0225	N.S.	<0.0001	<0.0001	0.0279

similar, though 'Marion' and 'Aldara' tended to have higher percent kernels at the Verona and Staples locations. Overall kernel quality at the St. Paul location was very poor, probably due to drought in 2021.

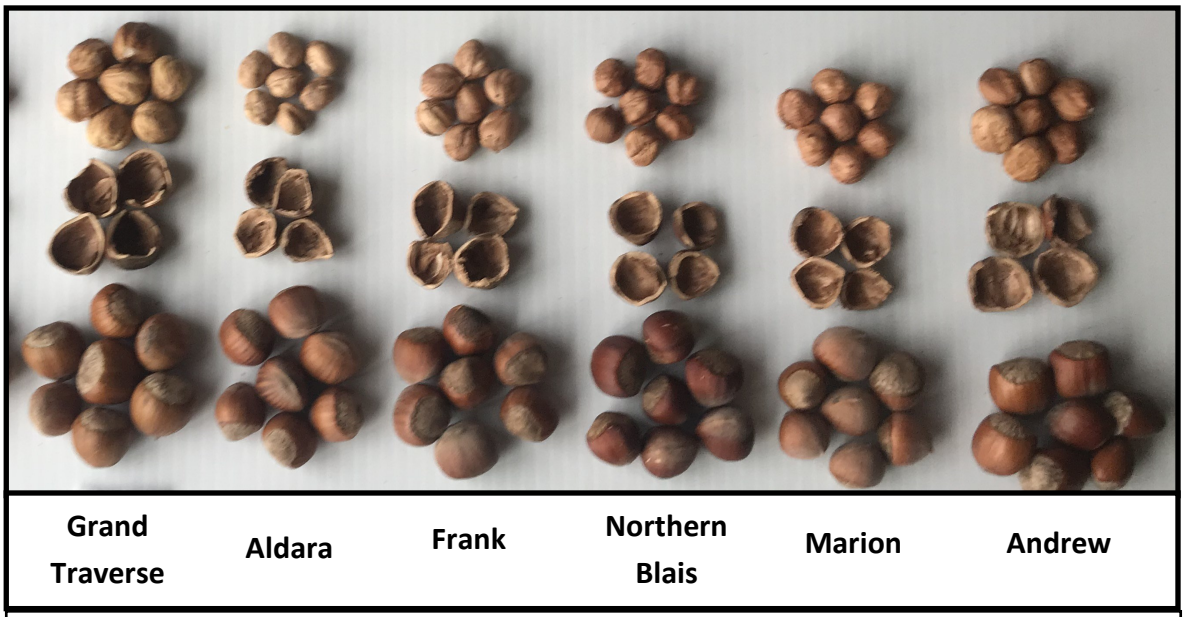

Figure 2. In-shell nuts, shells, and raw whole kernels of the hazelnut varieties reported on in this bulletin.

Conclusion

Location

One purpose of the Joint Performance Trials is to evaluate variety performance across a range of locations. Of the varieties established in 2017/2018, none of them are commercially viable at the northern locations (Bayfield, St. Paul, Staples). Even 'Northern Blais', the highest performing variety in this cohort struggled at the northern locations. The plants have not done particularly well at the Iowa sites either, which is interesting given how well the plants have done at the Verona site, which has similar soils and is at a similar latitude as the Iowa sites. The Verona site is within the urban heat island of Madison and is well protected from winds. Thus, the Verona site may be doing well due to its micro-climate. This suggests that being in a USDA 5a zone alone itself may not be sufficient for growing these 2017/2018 varieties.

Varieties

Though none of the 2017/2018 varieties have proven sufficiently adapted to northern parts of the Upper Midwest, the question still remains as to whether any of the varieties are proving commercially viable at the more southerly Verona site where the plants are growing well. Growing well isn't good enough, they also need to yield well. At age 5, 'The Beast' has not yet flowered. This is not necessarily disqualifying, but cash flow considerations will favor precocious varieties. 'Grand Traverse' has flowered but nut yields have been very low. The Grimo varieties have all flowered but had relatively low yields in 2021, with the exception of 'Northern Blais'.

The performance of Northern Blais at the Verona site is exciting. It averaged 1.1 lbs kernel per plant at age 5. At 363 plants per acre (8' x 15' spacing), that equates to 400 lbs per acre. At the 8' x 15' spacing, the plant is not yet filling its available space at age 5. By using its kernel yield density (0.03 lbs/sq ft), we can project yields at a fully stocked density. Assuming full stocking is when 60% of an acre is covered by the plant canopy, that yield density calculates to 718 lbs of kernel/acre, which is impressive at age 5. 'Northern Blais' also produced nuts in 2020 at the Verona site at age 4 with an average of 0.6 lbs of kernel per plant. 'Northern Blais' needs to be tested at more sites in the southern part of the Upper Midwest before

recommendations for widespread planting can be made, but at this early stage the variety looks promising.

Future Work

Going forward, we anticipate publishing the yield and performance results from these trials on an annual basis. The varieties in the 2017/2018 cohort had never been tested in the Upper Midwest prior to these trials. They were originally developed for the warmer horticultural regions. As such, their relatively poor performance in the colder parts of the Upper Midwest is not surprising. The UMHDI selections included in these trials, on the other hand, have already been through two rounds of evaluation in the Upper Midwest, so we expect performance to be better and more consistent across the six trial locations than the Grimo varieties, 'The Beast', and 'Grand Traverse'.

For More Information About The Varieties

Muehlbauer, M., J. Capik, T. Molnar. 2021. Choosing Plants for a Hazelnut Orchard in New Jersey. New Jersey Agricultural Experiment Station Cooperative Extension Bulletin E368. https://njaes.rutgers.edu/e368/.

Fischbach, J., L. Braun. 2020. Fact Sheet #1—Choosing Hazelnut Plants. Upper Midwest Hazelnut Development Hazelnut Initiative Hazelnuts 101 Fact Sheet Series. http://www.midwesthazelnuts.org/uploads/3/8/3/5/38359971/fact_sheet_series_1_choosing_plants_jan_2020.pdf.

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