

## **March 2021 Culinary Breeding Network Squash Tasting**

**About NOVIC:** The Northern Organic Vegetable Improvement Collaboration is now in its third cycle of funding from the US Dept. of Agriculture. The project focuses on vegetable crops that organic farmers in the northern US have identified as needing attention. We trial many different varieties – both new and heirloom – to try and find the best options for organic farmers in our respective regions. Our research considers both agronomic traits, like yield and disease resistance, as well as quality traits like flavor and culinary uses because buyers in local and organic markets have high expectations around these qualities.

Oregon vegetable growers have struggled to store winter squash (*Curcubita maxima*) through the “hunger gap,” with most of it rotting in storage. Researchers at OSU identified a known grass seed pathogen that was unsuspectingly the main culprit behind squash rot, and it turns out variety plays a big role in resistance to the pathogen. The goal of this tasting was to help determine which (if any) of these successfully storing varieties were superior for their sensory attributes.

**Methods:** Nine varieties of *C. maxima* and one interspecific cross (‘Tetsukabuto’ *C. maxima* X *C. moschata*) were planted at the Lewis Brown Farm (Corvallis, OR) in a randomized complete block design with three reps per variety. Plants were grown on certified organic land and maintained according to an Organic Systems Plan. Plants were harvested in September 2020 and stored in controlled conditions until March 2021.

For each variety, one fruit from two different plots were collected, washed, seeds removed and cut into 1”x1.5” cubes with the skin still attached. Varieties were grouped into a ‘Blue-Grey’ and ‘Green-Grey’ set based on their outer skin appearance, and variety names were disguised with three-letter codes to minimize bias. One variety was repeated within each tasting set as an internal check (see Table 1).

<b>Table 1: Squash Tasting Sets and Codes</b>	
<b>Green-Grey Set</b>	<b>Blue-Grey Set</b>
NVM – Tetsukabuto1 (check)	ERP – Silver Bell
PSJ – Marine Grey	KHV – Winter Sweet1 (check)
IDP – JWS 17-4547	OBE – Winter Sweet2 (check)
JXE – Capello del Prete	LPM – Vanity
HKJ – Tetsukabuto2 (check)	FJN – Blue Kuri
ZCL – JWS 14-4069	SNH – Stella Blue

Tasters were recruited from a listserv of culinary professionals and via social media (Instagram). No demographic information was collected, but all tasters lived within the Portland metro area. Tasters chose whether they wanted to taste one or both sets. The ‘Green-Grey’ set was tasted by 25 people, and the ‘Blue-Grey’ was tasted by 24 people. Aluminum foil muffin tins were labeled and filled with uncooked squash before being delivered to tasters. Instructions for cooking and surveys were provided to participants who completed the tasting independently by March 8, 2021.

### **Results (all tasters)**

**Overall Preference:** Correlation analyses showed there were four variables with significant relationships to people’s overall preference. The strongest was flavor intensity ( $r^2=0.92$ ) followed by sweetness ( $r^2=0.88$ ) and texture ( $r^2=0.72$ ), and there was a significant negative correlation between overall preference and bitterness ( $r^2=-0.80$ ).

Analysis of variance (ANOVA) using Satterthwaite’s method ( $F=2.6$ ,  $p<0.01$ ) suggested that there were statistical differences between varieties for people’s overall preference. However, pairwise comparisons failed to show any specific differences (likely due to lack of statistical power). Table 2 shows the mean, upper and lower limits of confidence intervals, and the connecting letters based on pairwise comparisons.

<b>Table 2: Winter Squash - Overall Preference</b>				
<b>Variety/Code</b>	<b>Mean</b>	<b>Lower Limit</b>	<b>Upper Limit</b>	<b>Group</b>
Blue Kuri/FJN	3.7	3.2	4.2	a
JWS 17-4547/IDP	3.6	3.2	4.1	a
Capello del Prete/JXE	3.6	3.1	4.1	a
Vanity/LPM	3.6	3.1	4.0	a
Winter Sweet1/KHV	3.5	3.1	4.0	a
Winter Sweet2/OBE	3.4	3.0	3.9	a
Stella Blue/SNH	3.4	2.9	3.8	a
Marine Grey/PSJ	3.1	2.6	3.6	a
Tetsukabuto 2/HKJ	2.9	2.5	3.4	a
Silver Bell/ERP	2.8	2.4	3.3	a
Tetsukabuto 1/NVM	2.8	2.3	3.2	a
JWS 14-4069/ZCL	2.7	2.3	3.2	a

The results are somewhat of a mixed bag. Officially, we can say there are differences between varieties based on the ANOVA results, but the pairwise comparisons do not tell where the differences are. Even so, altogether it appears as though there are no clear standouts, so growers likely have several options for long storing, tasty winter squash varieties.

#### *Intensity*

Analysis of variance (ANOVA) using Satterthwaite’s method ( $F=4.0$ ,  $p<0.01$ ) suggested that there were statistical differences between varieties for flavor intensity. Pairwise comparisons showed ‘Capello del Prete’ and ‘JWS 17-4547’ were perceived as more intense than ‘Marine Grey,’ ‘Tetsukabuto1,’ and ‘JWS 14-4069.’ ‘Blue Kuri’ was also significantly more intense than ‘Tetsukabuto1’ and ‘JWS 14-4069.’ Table 3 shows the mean, upper and lower limits of confidence intervals, and the connecting letters based on pairwise comparisons. Varieties that share a letter in the ‘Group’ column are not statistically different from each other.

<b>Table 3: Winter Squash - Intensity</b>				
<b>Variety/Code</b>	<b>Mean</b>	<b>Lower Limit</b>	<b>Upper Limit</b>	<b>Group</b>
Capello del Prete/JXE	3.9	3.5	4.3	a
JWS 17-4547/IDP	3.8	3.5	4.2	a
Blue Kuri/FJN	3.8	3.4	4.2	a b
Winter Sweet1/KHV	3.5	3.1	3.9	a b c
Winter Sweet2/OBE	3.4	3.1	3.8	a b c
Vanity/LPM	3.4	3.0	3.7	a b c
Stella Blue/SNH	3.3	2.9	3.7	a b c
Tetsukabuto2/HKJ	3.1	2.7	3.5	a b c
Silver Bell/ERP	3.1	2.7	3.5	a b c
Marine Grey/PSJ	3.0	2.6	3.4	b c
Tetsukabuto1/NVM	3.0	2.6	3.3	c
JWS 14-4069/ZCL	2.8	2.4	3.1	c

#### *Sweetness*

Analysis of variance (ANOVA) using Satterthwaite's method ( $F=4.0$ ,  $p<0.01$ ) suggested that there were statistical differences between varieties for perceived sweetness. Pairwise comparisons showed 'Blue Kuri' was perceived as sweeter than 'Marine Grey,' 'Tetsukabuto1,' and 'JWS 14-4069.' Similarly, 'Winter Sweet,' 'Capello del Prete,' 'Vanity,' and 'Stella Blue' were also significantly sweeter than 'Tetsukabuto1' and 'Marine Grey.' Table 4 shows the mean, upper and lower limits of confidence intervals, and the connecting letters based on pairwise comparisons. Varieties that share a letter in the 'Group' column are not statistically different from each other.

<b>Table 4: Winter Squash - Sweetness</b>				
<b>Variety/Code</b>	<b>Mean</b>	<b>Lower Limit</b>	<b>Upper Limit</b>	<b>Group</b>
Blue Kuri/FJN	3.9	3.5	4.3	a
Winter Sweet2/OBE	3.9	3.4	4.3	a b
Capello del Prete/JXE	3.7	3.3	4.2	a b
Winter Sweet1/KHV	3.7	3.3	4.1	a b
Vanity/LPM	3.7	3.3	4.1	a b
Stella Blue/SNH	3.7	3.3	4.1	a b
JWS 17-4547/IDP	3.6	3.2	4.0	a b c
Tetsukabuto2/HKJ	3.1	2.7	3.6	a b c d
Silver Bell/ERP	3.1	2.6	3.5	a b c d
JWS 14-4069/ZCL	3.0	2.6	3.4	b c d
Marine Grey/PSJ	2.7	2.3	3.2	c d
Tetsukabuto1/NVM	2.7	2.3	3.1	d

### Appearance

Analysis of variance (ANOVA) using Satterthwaite's method ( $F=3.1$ ,  $p=0.01$ ) suggested that there were statistical differences between varieties for appearance. Pairwise comparisons showed 'Silver Bell,' 'Tetsukabuto1,' and 'Marine Grey' were perceived as more attractive than 'JWS 17-4547' and 'JWS 14-4069.' Table 5 shows the mean, upper and lower limits of confidence intervals, and the connecting letters based on pairwise comparisons. Varieties that share a letter in the 'Group' column are not statistically different from each other.

Variety/Code	Mean	Lower Limit	Upper Limit	Group
Silver Bell/ERP	4.2	3.8	4.6	a
Tetsukabuto1/NVM	4.2	3.8	4.6	a
Marine Grey/PSJ	4.2	3.8	4.6	a
Winter Sweet2/OBE	4.1	3.7	4.5	a b
Tetsukabuto2/HKJ	4.0	3.6	4.4	a b
Stella Blue/SNH	4.0	3.6	4.4	a b
Vanity/LPM	3.9	3.5	4.3	a b
Winter Sweet1/KHV	3.9	3.5	4.3	a b
Blue Kuri/FJN	3.8	3.4	4.2	a b
Capello del Prete/JXE	3.6	3.2	4.0	a b
JWS 17-4547/IDP	3.3	2.9	3.7	b
JWS 14-4069/ZCL	3.3	2.9	3.7	b

### Texture

Analysis of variance (ANOVA) using Satterthwaite's method ( $F=3.2$ ,  $p<0.01$ ) suggested that there were statistical differences between varieties for appearance. Pairwise comparisons showed 'Blue Kuri' has significantly smoother mouthfeel than 'Marine Grey,' 'Tetsukabuto,' 'Stella Blue,' 'Winter Sweet2,' and 'JWS 14-4069.' Additionally, 'Vanity' has smoother mouthfeel than 'JWS 14-4069.' Table 6 shows the mean, upper and lower limits of confidence intervals, and the connecting letters based on pairwise comparisons. Varieties that share a letter in the 'Group' column are not statistically different from each other.

<b>Table 6: Winter Squash - Texture</b>				
<b>Variety/Code</b>	<b>Mean</b>	<b>Lower Limit</b>	<b>Upper Limit</b>	<b>Group</b>
Blue Kuri/FJN	4.4	4.0	4.8	a
Vanity/LPM	4.3	3.9	4.7	a b
Capello del Prete/JXE	4.0	3.6	4.4	a b c
JWS 17-4547/IDP	3.9	3.5	4.3	a b c
Winter Sweet1/KHV	3.8	3.4	4.2	a b c
Silver Bell/ERP	3.8	3.3	4.2	a b c
Tetsukabuto2/HKJ	3.6	3.2	3.9	b c
Winter Sweet2/OBE	3.5	3.1	3.9	b c
Stella Blue/SNH	3.5	3.1	3.9	b c
Tetsukabuto1/NVM	3.5	3.1	3.9	b c
Marine Grey/PSJ	3.5	3.1	3.9	b c
JWS 14-4069/ZCL	3.4	3.0	3.8	c

### *Acidity*

Analysis of variance (ANOVA) using Satterthwaite's method ( $F=2.0$ ,  $p=0.03$ ) suggested that there were statistical differences between varieties for perceived acidity. Pairwise comparisons showed 'Tetsukabuto1' was perceived as more acidic than 'Blue Kuri.' Table 7 shows the mean, upper and lower limits of confidence intervals, and the connecting letters based on pairwise comparisons. Varieties that share a letter in the 'Group' column are not statistically different from each other.

<b>Table 7: Winter Squash - Acidity</b>				
<b>Variety/Code</b>	<b>Mean</b>	<b>Lower Limit</b>	<b>Upper Limit</b>	<b>Group</b>
Tetsukabuto1/NVM	2.3	1.9	2.7	a
Capello del Prete/JXE	2.2	1.8	2.6	a b
Winter Sweet1/KHV	2.0	1.6	2.4	a b
Tetsukabuto2/HKJ	2.0	1.6	2.4	a b
Blue Kuri/FJN	2.0	1.6	2.4	a b
Marine Grey/PSJ	1.9	1.6	2.3	a b
Winter Sweet2/OBE	1.8	1.4	2.2	a b
JWS 17-4547/IDP	1.8	1.4	2.2	a b
JWS 14-4069/ZCL	1.8	1.4	2.1	a b
Silver Bell/ERP	1.7	1.3	2.1	a b
Vanity/LPM	1.7	1.3	2.0	a b
Stella Blue/SNH	1.6	1.2	2.0	b

### *Bitterness*

Analysis of variance (ANOVA) using Satterthwaite's method ( $F=2.2$ ,  $p=0.01$ ) suggested that there were statistical differences between varieties for perceived bitterness. But pairwise comparisons failed to show specific varieties (likely due to lack of statistical power). Table 8 shows the mean, upper and lower limits of

confidence intervals, and the connecting letters based on pairwise comparisons. Varieties that share a letter in the 'Group' column are not statistically different from each other.

<b>Table 8: Winter Squash - Bitterness</b>				
<b>Variety/Code</b>	<b>Mean</b>	<b>Lower Limit</b>	<b>Upper Limit</b>	<b>Group</b>
Tetsukabuto1/NVM	2.1	1.7	2.5	a
JWS 14-4069/ZCL	2.0	1.7	2.4	a
Marine Grey/PSJ	2.0	1.7	2.4	a
Silver Bell/ERP	2.0	1.6	2.4	a
Tetsukabuto2/HKJ	1.9	1.6	2.3	a
Winter Sweet1/KHV	1.7	1.4	2.1	a
Blue Kuri/FJN	1.7	1.4	2.1	a
JWS 17-4547/IDP	1.6	1.3	2.0	a
Capello del Prete/JXE	1.5	1.1	1.9	a
Vanity/LPM	1.5	1.1	1.8	a
Stella Blue/SNH	1.5	1.1	1.8	a
Winter Sweet2/OBE	1.4	1.0	1.8	a