

2018

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Recommended Citation

Brown, Rebecca, "2018 Carrot Variety Trial Report" (2018). *University of Rhode Island Vegetable Production Research Reports*. Paper 26.
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2018 URI Carrot Variety Trial Report



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Objectives and Design

In 2018 we trialed two groups of carrot varieties. The orange carrot trial focused on Nantes-type varieties, as this is the most popular market class for direct retail sales in New England. The specialty carrot trial focused on non-orange carrots with a variety of root shapes. “Colored” carrots are popular for farmers market sales, and several new varieties have been released.

The trial was conducted at the Gardiner Crops Research farm in Kingston, RI on a deep, stone-free Enfield silt loam soil. The field was in turf for many years. In 2017 the field was plowed and planted to cover crops (Japanese millet followed by winter rye); 2018 was the first year of vegetable production. Lime and a pelleted organic fertilizer (Nature’s Turf 8-1-9) were incorporated in May 2018 based on soil test results. Each planting date was set up as a randomized complete block with three replications. Plots were 10 feet long with three rows of carrots spaced 12 inches apart between rows and thinned to 2 inches between plants in the row. Carrots were seeded with a Jang JP-1 using 12-hole rollers.

Summer planting: A cool, wet Spring followed by an unusually warm May resulted in excellent soil moisture and temperatures when carrots were seeded on May 30. For this planting irrigation was provided by drip tape laid between rows of carrots. Side-dress nitrogen and supplemental boron were applied via fertigation. Crab grass and barnyard grass were the primary weeds; the trial was tined weeded prior to carrot emergence and then hand weeded multiple times. Weather conditions were warm and dry in June and July, becoming warm and wet in August and September. No disease or insect problems occurred until late August when wet conditions resulted in development of *Alternaria* leafspot.



Figure 1. Root lesions on Mokum.

However, persistent woodchuck feeding stunted most plots in rep 1 and about half of the plots in rep 2. The remaining plots were harvested September 12. No statistical analysis was done.

Fall planting: The second planting was seeded August 6 into beds which had been solarized for two months. Soil moisture was very low, so overhead irrigation was used during establishment. The weather pattern shifted in mid-August, becoming unusually wet for the remainder of the growing season. Carrots were side-dressed with urea four weeks after seeding. Weed pressure was significantly less than in the first planting; weeds were controlled using a wheel hoe between the rows and hand-pulling within rows. The trial was covered with spin-bonded rowcover October 25 to prevent deer browsing; covers remained in place until harvest November 12. No insect problems occurred but *Alternaria* leafspot was severe. Data were analyzed using ANOVA and Fisher’s least significant difference.

Orange Carrot Results

Eight Nantes-type varieties were included in both plantings (Table 1). In the Summer planting all eight varieties produced large, straight US No. 1-quality carrots, with yields of firsts ranging from 68% of total for ‘Nectar’ down to 40% of total for ‘Mokum’ (Table 2). Dry conditions resulted in excellent root lengths, and the 100+ days between seeding and harvest led to many carrots with root diameter > 1 inch. If roots which are misshapen (bent, forked, or torpedo-shaped) but otherwise sound are included as marketable, summer yields ranged from 94% for ‘Hilmar’ down to 67% for ‘Mokum’. Weight and size data were not collected since woodchuck damage resulted in loss of over half the plots.

All varieties were smaller in the Fall planting. Wet conditions in the fall resulted in shorter roots, and decreasing temperatures and light levels reduced root diameters. The number of marketable carrots (“baby” and larger) in six feet of row ranged from 25.3 for ‘Napoli’ down to 5.0 for ‘Mokum’ (Table 3). Marketable yields as a percentage of total yield ranged from 82% for ‘Bolero’ down to 26% for ‘Hilmar’. Most unmarketable roots were rejected because of size, rather than for shape defects. Root lengths ranged from 4.6 inches for ‘Romance’ down to only 3 inches for ‘Hilmar’ with diameters of 0.7 to 0.9 inches. None of the varieties met the minimum 5-inch average length for USDA No. 1. ‘Nectar’ was the sweetest of the orange carrots at 8.4% Brix; ‘Mokum’ had the least sugar, likely due to severe *Alternaria* and generally poor canopy. Juice color was very similar across all eight orange varieties. ‘Mokum’, ‘Romance’ and ‘Bolero’ had a very traditional carrot smell and a milky, mildly sweet flavor. ‘Yaya’, ‘Napoli’, and ‘Nectar’ had slightly spicy, bitter aftertastes and stronger smells. ‘Jerada’ and ‘Hilmar’ were the strongest, with a pronounced carotene flavor and odor.

Variety	Days to Maturity	Crop
Yaya*	56	Early
Napoli*	58	Early
Mokum	54	Early
Nectar*	72	Main
Romance	70	Main
Bolero	75	Storage
Jerada	70	Storage
Hilmar	75	Main

Table 1. Orange Nantes varieties in trial. Jerada’ and ‘Hilmar’ were provided by Osborne Seeds, all others are from Johnny’s Selected Seeds. * variety available as organic seed.

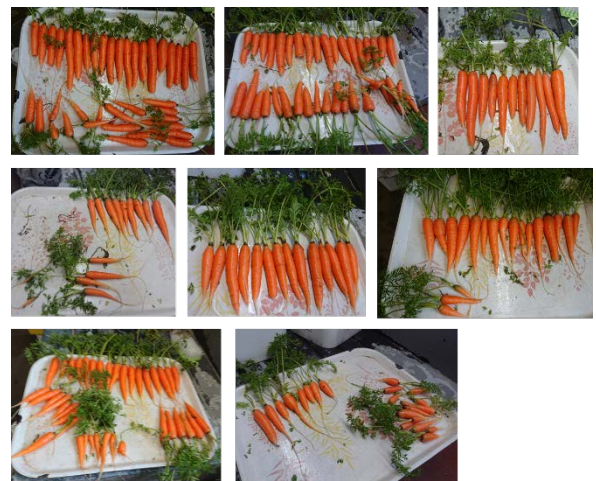


Figure 2. Carrots from the Fall planting. Top row from left: Yaya, Napoli, Mokum. Center row: Romance, Nectar, Bolero. Bottom row: Jerada and Hilmar.

Establishment was good for all varieties except ‘Mokum’ and ‘Bolero’ in the summer planting. ‘Mokum’ also had poor establishment in the fall planting, and ‘Romance’ and ‘Bolero’ were only fair. The shoulders of ‘Nectar’, ‘Bolero’, and ‘Hilmar’ came to just below the soil surface. All other varieties protruded above the soil and required hilling to prevent greening of the shoulders. The soil was dry when the summer planting was harvested, and all varieties pulled easily except for ‘Napoli’, which produced very large roots requiring some effort to pull. All varieties required digging in the fall due to wet soils. Canopy height in the summer planting ranged from 20 cm for ‘Mokum’ to 45 cm for ‘Nectar’ and all varieties except ‘Mokum’ and ‘Yaya’ achieved closed canopies by the end of vegetative growth. ‘Bolero’ was the most resistant to *Alternaria* leafspot in both plantings, with only mild infection in the Fall despite heavy disease pressure. ‘Nectar’ showed good resistance in the Fall but developed moderate leafspot in the summer. ‘Mokum’ had severe leafspot in both plantings, and 33% of the

total roots were infected with a fungus causing small black lesions (Figure 1). ‘Romance’ had 25% of roots infected with similar lesions, but no leafspot. The disease is likely cavity spot caused by Pythium, but the diagnostic lab was unable to isolate the causal agent.

Based on the results of these trials Mokum is not recommended for summer or fall production and Hilmar is not recommended for fall production. Nectar and Bolero are excellent choices for both Summer and Fall, and Napoli is the best of the early varieties. Romance is a good choice for Fall but had problems with root disease in the summer. Jerada shows promise for Summer but has a tendency to split when moisture levels are inconsistent.

Specialty Carrot Results: Yellow and White

The trial included three yellow carrots: ‘Gold Nugget’, ‘Yellowstone’ and ‘Mello Yello’; ‘Mello Yello’ was planted only in the Fall due to delay in obtaining seed. The white carrot ‘White Satin’ and the mixed color ‘Rainbow’ were included with the yellow carrots for analysis. In the Summer planting all varieties produced large, straight US No. 1-quality carrots, with yields of firsts ranging from 77% of total for ‘Gold Nugget’ down to 58% of total for ‘Rainbow’ (Table 5). Dry conditions resulted in excellent root lengths, and the carrots which failed to meet grade standards were skinny rather than short. If roots which are bent or forked but otherwise sound are included as marketable, summer yields ranged from 95% for ‘Yellowstone’ down to 84% for ‘Rainbow’. ‘Rainbow’ had problems with growth cracks which became deformed areas. ‘White Satin’ crowns protruded 3 cm above the soil surface. Combined with an open canopy, this resulted in green shoulders extending as much as 2 inches down the root. ‘White Satin’ also had problems with bolting, Alternaria leafspot, and root lesions. ‘Gold Nugget’ crowns were just above the soil surface, resulting in slight greening of the shoulders. Root lesions and poor stand were other problems. ‘However, ‘Gold Nugget’ had the darkest yellow color, smallest cores, and generally smooth roots (Figure 3). ‘Yellowstone’ was noteworthy for being completely free from root lesions and Alternaria leafspot, with crowns at the soil surface combining with narrow shoulders to prevent greening. However, the roots were rough with enlarged branch roots, swollen lenticels, and multiple crowns. Weight and size data were not collected since woodchuck damage resulted in loss of over half the plots.

Variety	Days to Maturity	Color
Deep Purple	73	Purple
Purple Haze	73	Purple/orange
Purple Elite	75	Purple/white
Purple Sun	75	Purple/yellow
Malbec	70	Red
White Satin	68	White
Gold Nugget	68	Yellow
Yellowstone	73	Yellow
Rainbow	67	Mixed orange, yellow, white
Mello Yello	80	Yellow

Table 2. Specialty carrot varieties in the trial. Mello Yello and Purple Sun were provided by Osborne Seeds and were planted only in the Fall. All other varieties were provided by Johnny's Selected Seeds and planted in both Summer and Fall. Root color in Rainbow ranges from light orange to white.

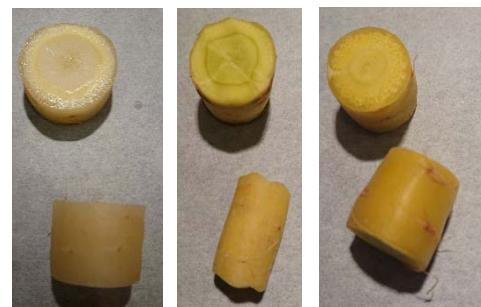


Figure 3. Sections of roots from White Satin, Yellowstone and Gold Nugget from the summer planting.

Roots of all varieties were much shorter in the Fall planting than in the Summer. ‘Yellowstone’ was the longest of the yellow varieties, and the only one with an average root length exceeding the 5 inch minimum for US No. 1 (Table 6). However, average root diameter exceeded $\frac{3}{4}$ inch for all varieties, and roots were large enough to be marketed as ‘baby’ or ‘roasting’ carrots (figure 4) and tops were nice enough for bunching. ‘Gold Nugget’ produced the most marketable carrots, averaging 15.7 per six-foot row section, while ‘Yellowstone’ produced the highest percentage of marketable roots at 85%. The yellow and white varieties fared decently against *Alternaria* leafspot in the Fall, with ‘Rainbow’ and ‘White Satin’ suffering moderate damage and the yellow varieties having only mild symptoms. ‘Gold Nugget’ was the sweetest, with a classic carrot flavor and no aftertaste. ‘White Satin’ and ‘Rainbow’ were similar but milder and less sweet. ‘Yellowstone’ had a strong carrot odor but was very bland, while ‘Mello Yello’ was sweet but had a bitter aftertaste. Based on the results of this trial, all of the varieties tested are well-suited to production in Rhode Island. ‘Gold Nugget’ was my personal favorite among the three yellow varieties, and ‘Rainbow’ has some nice shades not found in the single-color varieties.



Figure 4. Yellow and white varieties in the Fall planting. From the top left: Gold Nugget, Rainbow, Yellowstone, Mello Yello and White Satin.

Specialty Carrot Results: Purple and Red

Varieties are listed in Table 4. Summer performance was similar across the three purple varieties tested, and all were similar to ‘Malbec’, which has red roots. Yields of US No. 1 roots ranged from 63% for ‘Purple Elite’ to 56% for ‘Malbec’ and ‘Purple Haze’ (Table 7). Most roots which did not make grade were bent or forked. ‘Deep Purple’ was the most refined of the purple varieties, with smooth roots and even color. ‘Purple Elite’ and ‘Purple Haze’ were rough, with large lenticels, and ‘Purple Haze’ had very uneven development of the purple color down the length of the root (Figure 5). ‘Malbec’ roots were also smooth and uniformly colored, but had a tendency to crack during growth, leading to surface deformities on 10% of the roots. All varieties had good soil coverage of the shoulders. ‘Purple Elite’ was easy to pull; other varieties needed to be dug and ‘Malbec’ was hard to pull without damage even after digging. ‘Deep Purple’ was the only purple variety which did not bolt in the Summer planting, but it was the most susceptible to *Alternaria* leafspot.



Figure 5. Cross sections of purple and red carrots from the summer planting. From top left: Purple Elite, Malbec, Purple Haze and Deep Purple.

‘Malbec’ had the highest marketable yield, highest percent marketable yield, and largest roots of all the red and purple varieties in the Fall planting (Table 8). ‘Purple Elite’ was the only purple variety with acceptable performance in the Fall planting. It was similar to ‘Malbec’ for number of marketable roots, but yielded significantly less by weight. Roots were significantly shorter and lighter but still large enough to qualify as US No. 1. The other purple varieties had severe *Alternaria* leafspot and crown rot, and most roots were too small to market even as baby carrots (Figure 6). In contrast, ‘Malbec’ and ‘Purple Elite’ had only mild leafspot damage.

‘Deep Purple’ was the sweetest carrot in the entire trial, with a Brix of 9. The juice was an attractive deep purple color and had a fruity odor. Taste was sweet with a slight hint of bitterness and a carrot finish. ‘Purple Haze’ was also very sweet with a Brix of 8.8, but the roots had little purple color and the juice was ginger colored (Figure 7). The bouquet was reminiscent of chai but the flavor was mostly sweet. ‘Purple Elite’ smelled like carrots and the juice was sweet with no after-taste, but the yellow cores gave the juice a muddy brown color. ‘Purple Sun’ was reminiscent of beets in both bouquet and flavor, and had deep purple juice. ‘Malbec’ juice was a beautiful intense scarlet color, but the flavor of both the juice and the raw carrots was disappointingly sour and soapy.

Based on the results of these trials, ‘Purple Elite’ is the most productive of the purple carrots, and the best for Fall production. However, it is not a good choice for juicing or use as a coloring agent. ‘Malbec’ is an excellent choice agronomically, but the strong flavor limits its use as a raw vegetable or in juice.



Figure 6. Purple and red varieties in the Fall planting. From left: Malbec, Purple Elite, Purple Sun, Deep Purple and Purple Haze.

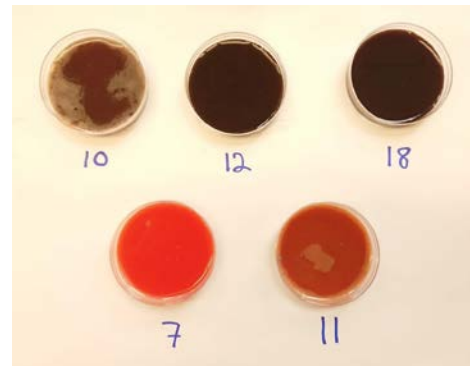


Figure 7. Juice samples from the red and purple carrots in the fall trial. From top left Purple Elite, Deep Purple, Purple Sun, Malbec and Purple Haze.

Data Tables – Orange Nantes Trial

Table 3. Results from Summer planting. Yields are expressed as percentage of total harvest for each variety. Weight and count data were not collected due to woodchuck damage to some plots. Shape defects included curved, forked, and stubby roots. Shoulder protrusion is distance above soil surface.

Variety	Marketable		Unmarketable				
	US No. 1	Shape Defects	Diseased	Split	Shoulder Protrusion	Canopy Height	Alternaria leafspot
Yaya	60%	33%	7%	1%	4 cm	12 in.	moderate
Napoli	53%	41%	6%	0%	1 cm	12 in.	moderate
Mokum	40%	26%	33%	0%	1 cm	8 in.	severe
Nectar	68%	29%	0%	3%	0 cm	18 in.	moderate
Romance	57%	12%	25%	6%	3 cm	16 in.	almost none
Bolero	58%	27%	14%	1%	0 cm	12 in.	none
Jerada	63%	19%	4%	14%	1 cm	14 in.	moderate
Hilmar	57%	37%	3%	4%	0 cm	16 in.	mild

Table 4. Results from the Fall planting. Means separated by more than the LSD value are significantly different at $\alpha = 0.05$. Yield data are based on 10 row feet. Root measurements are averaged across all marketable roots. Alternaria was rated on a ten-point scale with 0 indicating no disease and 9 indicating near-total loss of foliage. Brix was measured on bulked samples and was not analyzed statistically.

Variety	Marketable Yields			Root Measurements				
	Count	Weight (lbs)	Percent of Total	Length (in.)	Diameter (in.)	Weight (g)	Alternaria Score	Brix
Yaya	31.7	1.47	72%	3.0	0.67	17.5	7.3	7.8
Napoli	43.1	2.19	78%	3.4	0.81	22.2	5.7	7.2
Mokum	8.5	0.42	38%	4.3	0.72	22.1	7.0	6.6
Nectar	25.5	1.05	55%	3.6	0.66	18.9	3.0	8.4
Romance	23.2	1.52	80%	4.6	0.84	29.1	5.0	8
Bolero	26.1	1.74	82%	4.5	0.94	30.3	2.7	8
Jerada	30.0	1.19	48%	3.7	0.71	16.1	6.3	7.6
Hilmar	10.8	0.28	26%	2.7	0.72	11.2	7.0	7
LSD	21.8	1.35	35%	0.9	NS	8.7	1.4	

Data Tables – Specialty Carrot Trial

Table 5. Results from Summer planting for yellow and white varieties. Yields are expressed as percentage of total harvest for each variety. Weight and count data were not collected due to woodchuck damage to some plots. Shape defects included curved, forked, and stubby roots, and roots with multiple crowns. Small roots had diameter $<1/2''$.

Variety	Marketable		Unmarketable			Canopy Height	Alternaria Leafspot	Physiological Problems
	US No. 1	Shape Defects	Diseased	Split	Small			
Rainbow	58%	26%	4%	8%	5%	14 in.	mild	tops snap
White Satin	63%	22%	10%	0%	6%	14 in.	very severe	bolting
Gold Nugget	77%	13%	10%	0%	0%	11 in.	moderate	poor stand
Yellowstone	65%	30%	0%	0%	5%	16 in.	none	

Table 6. Results from the Fall planting for yellow and white varieties. Yield data are based on 10 row feet. Root measurements are averaged across all marketable roots. Alternaria was rated on a ten-point scale with 0 indicating no disease and 9 indicating near-total loss of foliage. There were no statistically significant differences between varieties. Brix was measured on bulked samples and was not analyzed statistically.

Variety	Marketable Yields			Root Measurements				
	Count	Weight (lbs.)	Percent of Total	Length (in.)	Diameter (in.)	Weight (g)	Alternaria Score	Brix
Gold Nugget	26.6	1.59	73%	4.2	0.9	24.9	2.7	8.6
Yellowstone	24.4	1.35	85%	5.1	0.8	28.3	2.3	8.2
White Satin	13.0	0.68	71%	3.9	0.8	22.8	5.7	7.4
Rainbow	13.6	0.89	79%	4.9	0.8	29.6	5.0	8
Mello Yello	17.0	1.05	65%	4.9	0.9	28.0	2.0	7

Table 7. Purple and red carrots in the Summer planting. Yields are expressed as percentage of total harvest for each variety. Shape defects included curved, forked, and stubby roots, and roots with multiple crowns. Small roots had diameter <1/2".

Variety	Marketable		Unmarketable					Physiological Problems
	US No. 1	Shape Defects	Diseased	Split	Small	Canopy Height	Alternaria Leafspot	
Purple Elite	63%	24%	0%	0%	13%	20 in.	significant	bolting
Purple Haze	56%	28%	9%	0%	7%	12 in.	moderate	bolting, poor stand
Deep Purple	58%	31%	5%	0%	6%	20 in.	severe	
Malbec	56%	20%	2%	14%	8%	19 in.	moderate	cracking

Table 8. Fall planting results for red and purple varieties. Yield data are based on 10 row feet. Root measurements are averaged across all marketable roots. Means separated by more than the LSD value are significantly different at $\alpha = 0.05$. Alternaria was rated on a ten-point scale with 0 indicating no disease and 9 indicating near-total loss of foliage. Brix was measured on bulked samples and was not analyzed statistically.

Variety	Marketable Yields			Root Measurements				
	Count	Weight (lbs.)	Percent of Total	Length (in.)	Diameter (in.)	Weight (g)	Alternaria Score	Brix
Malbec	25.5	1.92	73%	7	0.8	34.8	3.7	8
Purple Elite	18.7	0.96	68%	5.3	0.8	22.4	3.3	7
Purple Haze	6.8	0.24	16%	3.9	0.7	14.7	8.3	8.8
Deep Purple	5.7	0.12	19%	4.5	0.6	9.6	7	9
Purple Sun	4.0	0.10	19%	3.9	0.7	11.3	8.3	8
LSD	10.5	0.62	36%	1.2	0.1	7.8	3.3	