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URI 2019 Carrot Variety Trials – Red and Purple Carrots

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URI 2019 Carrot Variety Trials – Red and Purple Carrots



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Entries

Consumer interest in anthocyanin-rich foods has driven renewed interest in red and purple carrots and development of several new varieties. The 2019 trial included five purple carrot varieties and three red carrot varieties. All were main-season varieties. 'Deep Purple' has purple peel and cortex, with a small white core. 'Purple Haze' has purple peel with orange cortex and core. 'Dragon' has purple peel, orange cortex, and a yellow core. 'Purple Elite' has purple peel and cortex with a large white core while 'Purple Sun' has purple peel and cortex with a large yellow core. 'Malbec' is a uniform pinkish-red and Ruby Prince' is red-orange throughout. 'Red Sun' has red peel and cortex with a large yellow core. Seed of all entries was supplied by Johnny's Selected Seeds except for 'Purple Sun' which was obtained from Osbourne Seed. 'Deep Purple' and 'Purple Elite' were supplied as pelleted seed; all other entries were raw seed.



Trial Conditions

The 2019 carrot trial was seeded May 26 and 27 using a Jang J-1 push seeder set to 1 inch spacing within row. Each 10 foot long plot contained 3 rows spaced 12 inches apart; plots were on 5 foot centers. Trial design was a randomized complete block with three replications. Prior to seeding the field was amended with Nature's Turf 8-1-9 organic fertilizer to provide 50 lbs N/acre and lime at 435 lbs per acre to ensure adequate calcium levels. Treflan herbicide was incorporated into the top 3 inches of soil

for weed control. Overhead irrigation was provided as needed. The herbicide provided only partial

Harvested roots of purple and red carrot varieties in the trial. 'Deep Purple', 'Purple Sun' and 'Purple Elite' have purple pigment in both the peel and the cortex layers, giving them a dark purple color. 'Purple Haze' and 'Dragon' have purple pigment only in the peel and outer cortex, with orange pigment in the cortex.

control of weeds, and weed pressure was considerable, with significant differences between blocks, despite repeated cultivation and hand weeding. Five weeks after seeding carrots were side-dressed with 12-0-12 to provide an additional 50 lbs N/acre. Damage from *Alternaria daucii* was rate on August 22nd; bolting, canopy height and shoulder protrusion were also measured at this time. The center 5 feet of each plot was harvested beginning on August 22nd, 90 days after planting.

After harvest carrots were graded into marketable and cull, with marketable carrots sub-divided into US #1 and US #2 grades based on length and straightness. Counts and weights were recorded for each category. Five carrots randomly selected from those meeting US #1 standards were used to measure root length and width and then juiced to determine sugar content. Data were analyzed using mixed models ANOVA and post-hoc comparison of least squares means.

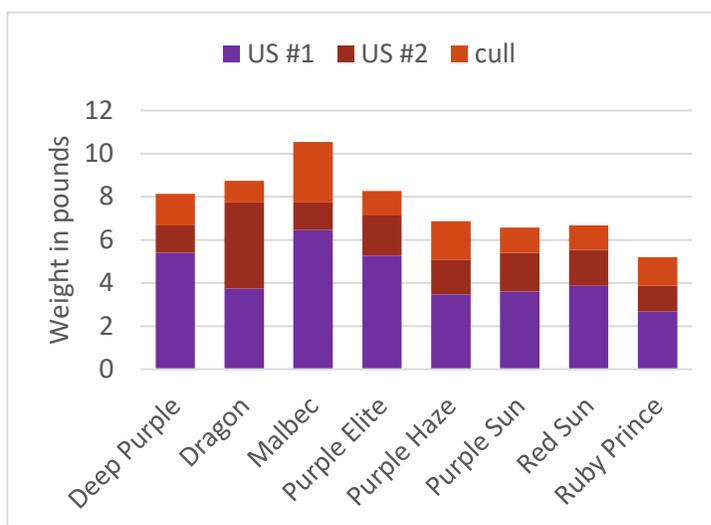
Results

Canopy Characteristics

Entries did not differ significantly in response to infection by *Alternaria daucii*. Disease severity varied significantly across the field, with plots in the eastern third of the field having significantly more disease than plots in the center or western thirds. All purple and red entries had at least one plot with severe leafspot, suggesting that none of the entries have resistance. Canopy heights ranged from 42 cm for 'Purple Sun' to 51 cm for 'Deep Purple'; differences were not significant. Crowns for all entries were at or below the soil surface, and shoulders were covered by soil. Bolting was a problem, with 'Purple Elite', 'Purple Haze' and 'Ruby Prince' having multiple bolted plants in all plots, and 'Red Sun' having bolted plants in two of the three plots. 'Deep Purple', 'Dragon', 'Purple Sun' and 'Malbec' did not bolt under the conditions present in this trial.

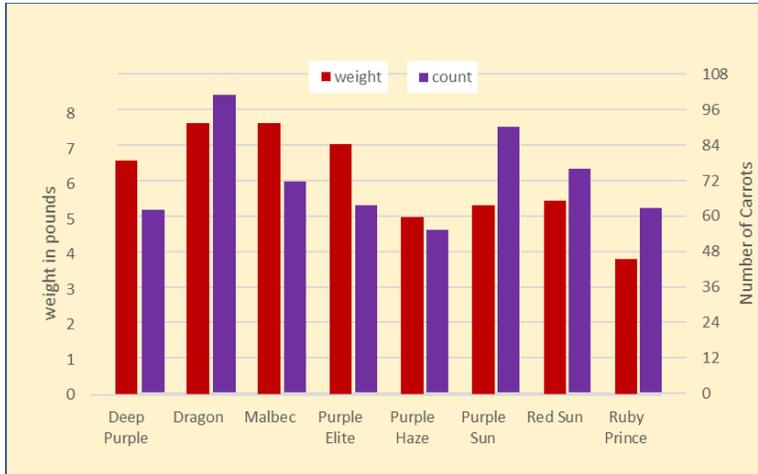
Yields

There were significant differences between replications for most yield components, with the plots at the eastern end of the field yielding the most and yields decreasing moving west.



Yield distribution across grades for red and purple carrot varieties. Differences in total and marketable yields were not statistically significant.

These differences are likely due to increased weed pressure at the west end of the field, and a solar radiation gradient caused by trees to the west of the field which cast lengthening afternoon shadows. Total yields ranged from 5.2 lbs in 15 feet of row for 'Ruby Prince' to 10.5 lbs for 'Malbec'. Total yields did not differ significantly among the purple-rooted entries. 'Malbec' yielded significantly more than either 'Ruby Prince' or 'Red Sun', but the difference was primarily due to increased yield of culled roots.



Marketable yields as weight and counts. Differences were not statistically significant.

Entries did not differ in yields of marketable roots. ‘Dragon’ was the only entry to produce most of the yield in the 3 to 5 inch long US #2 grade, rather than the longer US #1 grade. ‘Dragon’ produced 89% marketable roots, significantly greater than ‘Malbec’, ‘Purple Haze’ or ‘Ruby Prince’. The average number of marketable carrots per plot ranged from 55 for ‘Purple Haze’ to 101 for ‘Dragon’; despite the large range differences were not statistically significant.

Root Characteristics

The red and purple carrot varieties showed significant differences in all root characteristics. At 9 inches from crown to tip ‘Deep Purple’ was the longest entry, closely followed by ‘Malbec’ at 8 inches. ‘Deep Purple’ was also the widest entry, averaging 1.37 inches across the shoulders, but it was not the heaviest. ‘Dragon’ had the shortest roots at 5.5 inches, barely qualifying as US #1 grade; ‘Ruby Prince’ was only slightly longer at 6.3 inches. However, ‘Dragon’ roots were quite thick, with a Kuroda-type shape, whereas ‘Ruby Prince’ tied with ‘Purple Sun’ for the thinnest roots at only 1.08 inches across the shoulders. ‘Malbec’ roots had uneven coloration and a higher incidence of Alternaria canker than other entries, which partially explains the significantly greater cull weight for ‘Malbec’. ‘Red Sun’ also had uneven coloration and roots were rough with large lenticels, but no canker was found. Roots from one plot of ‘Ruby Prince’ and one plot of ‘Deep Purple’ developed Alternaria canker in storage after harvest.

Entry	Length (inches)	Width (inches)	US #1 weight (oz.)	Marketable weight (oz.)	Brix	Flavor
Deep Purple	9.0	1.37	2.06	1.73	9.4	slightly earthy
Dragon	5.5	1.25	2.03	1.17	8.3	earthy
Malbec	8.0	1.15	2.02	1.84	9.3	sour
Purple Elite	7.6	1.21	2.17	1.82	9.5	sweet & nutty
Purple Haze	7.3	1.27	1.49	1.61	9.2	sweet
Purple Sun	6.9	1.08	1.14	0.96	8.7	fruity
Red Sun	6.7	1.16	1.40	1.14	7.3	chemical flavor
Ruby Prince	6.3	1.08	1.30	0.99	8.6	sweet
LSD	1.0	0.17	0.83	0.48	0.9	

Table 1. Root characteristics for red and purple carrot entries. Root length and width values are based on US #1 grade roots. All values are means of three replications. Means which differ by more than the LSD value are significantly different.

Color and Flavor Traits

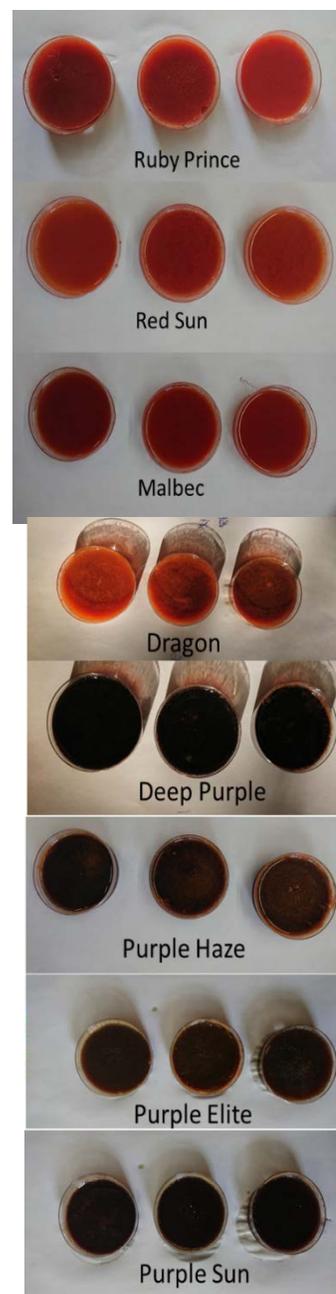
Sugar levels in the red and purple varieties were comparable to those in the orange main season varieties, with the exception of 'Red Sun'. The roots of 'Red Sun' were attractive when cut to expose the yellow centers, but sugar levels only measured 7.3% on the brix scale and the flavor was unpleasant with harsh chemical tones. 'Malbec' had high sugar levels, averaging 9.3% brix, but the flavor was unpleasantly sour. 'Ruby Prince' had highly variable sugar levels, ranging from 9.4% brix in rep 1 down to only 7.8% brix in rep 3 but the flavor was sweet with no unpleasant notes, making this the best of the red-rooted entries. Most of the purple entries had fruity, earthy or spicy flavor notes. 'Purple Elite' and 'Deep Purple' had the highest sugar levels, measuring 9.5% and 9.4% respectively. In 'Purple Elite' the high sugar levels combined with the anthocyanin flavors to give a sweet and nutty flavor, while 'Deep Purple' was earthy and reminiscent of red beets. 'Dragon' had a similar flavor although less sweet. 'Purple Sun' was fruity, and 'Purple Haze' was mostly sweet with a slight carrot flavor.

Conclusions

All of the red and purple varieties were vigorous, with large tops and the capacity to respond to reduced plant density by increasing root size. 'Malbec' has the highest yields of the red varieties, but the sour flavor notes make it a poor choice for fresh eating, and susceptibility to *Alternaria* canker limits storage life. 'Ruby Prince' had the best flavor, but both yields and sugar levels are very sensitive to stress so attention to optimizing growing conditions will be important for success with this variety. 'Red Sun' was not an attractive variety, yielding less than 'Malbec' and having similar problems with poor flavor, as well as rough roots with large lenticels. Among the purple varieties 'Deep Purple' and 'Purple Elite' had the best combination of yields, flavor, and root quality. They both produce a true purple juice, with no brown tints. The long imperator-type roots are well suited to wholesale packaging. However, 'Purple Elite' is susceptible to bolting under long days. 'Dragon' is not suitable for juicing or wholesale as topped carrots, but should be evaluated further as a fresh market variety for local and specialty markets where the short, fat roots are not a disadvantage. 'Dragon' is an extremely attractive carrot, particularly when roasted with the peel intact. Yields were strong, with few culls, and variation in yields and sugar levels across the field was low, suggesting low sensitivity to stress.

Acknowledgements

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Juice samples for the trial entries, showing color. 'Purple Haze' and 'Dragon' are not recommended for juicing as the mixture of purple and orange pigments results in brown juice.

