2011 Organic Carrot Variety Trial Results

The following tables present the results of organic carrot variety trials that took place on research stations and cooperating farms in Washington, Oregon, Wisconsin, and Minnesota in 2011. These trials were part of the USDA-OREI funded project Northern Organic Variety Improvement Collaborative. Trials will continue in 2012 and 2013.
Detailed descriptions of the trial methods and rating systems are listed after the results tables.

List of Tables

Table 1: NOVIC 2011 Washington Carrot Data

Variety Name	Top Height (1-5)	Root Shape (1-5)	Tip Fill (1-5)	Root Smoothness (1-5)	Flavor (1-5)	Sweetness (1-5)	Notes
Bolero	3.67 ab	3.00 bcd	3.08 bcd	3.50 a	3.50 abc	4.17 a	Brix 10, 11
Mokum	1.33 c	3.33 bcd	4.00 abc	3.17 a	3.00 bcd	3.67 ab	Brix 10, 10
Nantes Fancy	2.83 bc	2.50 cde	2.17 de	3.00 a	1.50 ef	1.67 c	Brix 9, 9
Napoli	2.67 bc	3.83 abc	4.17 ab	2.33 a	1.33 f	2.17 bc	Brix 9.25, 9.75
Nectar	2.83 bc	2.67 cd	2.33 de	3.00 a	1.83 def	2.67 abc	Brix 9.75, 9.75
Nelson	2.67 bc	4.17 ab	4.42 ab	3.00 a	2.33 cdef	3.83 ab	Brix 9, 9.5
Rumba	3.67 ab	2.00 de	2.33 de	3.67 a	2.67 cde	3.17 abc	Brix 8.5, 9
Scarlet Nantes	3.00 b	2.67 cd	2.67 cd	4.17 a	4.00 ab	3.50 ab	Brix 9, 10.25
Spring Market	5.00 a	1.17 e	1.00 e	2.33 a	4.50 a	2.67 abc	Brix 9.5, 10.25
Yaya	2.17 bc	4.83 a	4.67 a	4.00 a	2.67 cde	4.00 a	Brix 9, 8.5

Letters after the scores represent groups of varieties whose means are not significantly different for that trait. In other words, all the varities which have a score with an ”a” after the number have essentially the same score for that trait. NA indicates that data were not available for that trait for a particular variety. For more information on how traits were measured, please see the protocols at the end of this document.

Table 2: NOVIC 2011 Oregon Carrot Data

Variety Name	Top Height (1-5)	Foliar Disease (1-5)	Tip Fill (1-5)	Root Smoothness (1-5)	Flavor (1-5)	Sweetness (1-5)	Notes
Bolero	4.50 ab	3.00 a	4.00 a	4.33 a	2.50 ab	3.90 a	slight pine cone flavor, hard to pull without tops breaking off,
Mokum	2.00 c	2.00 a	4.50 a	4.00 a	2.80 ab	3.00 ab	hard to pull without tops breaking off, hard to hand pull
Nantes Fancy	4.33 ab	3.67 a	4.17 a	3.83 a	1.30 b	1.20 b	pine cone flavor, pine cone flavor,
Nectar	4.33 ab	4.00 a	4.17 a	4.00 a	2.90 ab	2.70 ab	variety with most rust fly damage; hard to pull without tops breaking off,
Nelson	3.20 bc	4.67 a	4.80 a	2.60 ab	3.00 ab	2.50 ab	slight pine cone flavor, bland flavor, hard to hand pull; a lot of splits and significant gopher damage
Rumba	3.60 abc	3.33 a	4.20 a	3.20 a	4.10 a	3.10 ab	nothing to harvest!
Scarlet Nantes	3.50 abc	2.67 a	4.58 a	4.67 a	2.60 ab	3.60 ab	hard to pull without tops breaking off,
Spring Market	5.00 a	4.00 a	2.33 b	1.00 b	2.60 ab	2.70 ab	pine cone flavor, bit of pinecone flavor,
Yaya	2.17 c	3.67 a	4.67 a	3.50 a	2.60 ab	4.20 a	hard to hand pull; many splits

Letters after the scores represent groups of varieties whose means are not significantly different for that trait. In other words, all the varities which have a score with an ”a” after the number have essentially the same score for that trait. NA indicates that data were not available for that trait for a particular variety. For more information on how traits were measured, please see the protocols at the end of this document.

Best Worst

Table 3: NOVIC 2011 Wisconsin Carrot Data

Variety Name	Top Height (1-5)	Foliar Disease (1-5)	Root Shape (1-5)	Tip Fill (1-5)	Root Smoothness (1-5)	Flavor (1-5)	Sweetness (1-5)	Notes
Bolero	5.00 a	4.60 a	2.40 a	3.00 a	3.00 a	3.40 a	4.00 a	short roots, very good, would be perfect if a bit sweeter,
Mokum	1.60 d	4.40 a	2.80 a	3.60 a	3.80 a	3.00 a	2.80 a	soapy, soapy,
Nantes Fancy	3.80 abc	4.60 a	3.40 a	2.60 a	4.00 a	3.20 a	3.00 a	floral, not in a good way, not sweet, mellow,
Napoli	3.00 bcd	4.40 a	4.00 a	4.40 a	3.20 a	3.00 a	3.00 a	very perfumy and flowery,
Nectar	4.20 ab	4.40 a	4.40 a	3.80 a	3.60 a	2.40 a	2.20 a	a little piney,
Nelson	2.60 bcd	4.20 a	3.40 a	4.20 a	3.60 a	2.60 a	2.80 a	good mellow overall carrot flavor, mild-neither bold nor bland, nice texture, pine cone flavored,
Rumba	2.00 cd	4.40 a	3.20 a	3.00 a	3.20 a	2.80 a	3.00 a	soapy, shape is variable, didn't germinate well
Scarlet Nantes	3.80 abc	4.40 a	3.00 a	3.60 a	3.80 a	3.60 a	3.40 a	strong carroty flavor, variable between carrots, tester favorite,
Spring Market	4.40 ab	5.00 a	3.80 a	2.60 a	2.00 a	3.60 a	3.60 a	too perfumy, doesn't taste like a carrot, tester favorite,
Yaya	2.20 cd	4.20 a	3.40 a	4.40 a	3.60 a	3.00 a	3.60 a	watery, juicy, not very carroty,

Letters after the scores represent groups of varieties whose means are not significantly different for that trait. In other words, all the varities which have a score with an "a" after the number have essentially the same score for that trait. NA indicates that data were not available for that trait for a particular variety. For more information on how traits were measured, please see the protocols at the end of this document.

CARROT DESCRIPTORS

Effective carrot evaluation requires both data describing the tops or foliage as well as data describing the roots. This is especially true where we are trying to determine which carrots are best suited to compete with weeds by having tops with increased height and disease resistance. Root evaluation will be practiced using several root characteristics that are universally considered important among farmers for producing high quality market carrots. This includes traits like the shape of the root, shape of the root's tip, the root's smoothness, its flavor, and sweetness. These carrot trials will evaluate Nantes and Nantes X Imperator hybrid types as they are the predominant class used for the local and regional organic fresh market in North America.

Trait Evaluation: Most traits will be scored on their agronomic or market desirability using a 1 to 5 scale for relative merit with the "1" being the least desirable and "5" being the most desirable. In order to get a good statistical spread it is important to assign all 5 numbers in this scale for each trait evaluated. This entails "setting the scale" of each trait for the specific set of accessions that are evaluated in that particular trial on that specific day. Reserving a "5" or a "1" score for an idealized best or worst carrot entry you have seen previously in another time or place is strongly discouraged. In order to use the entire range of scores effectively the evaluators must "walk the trial" before beginning the evaluation process, observing all the entries to get an overview of all of the accessions for each trait. Then they will identify the least desirable variety in the trial for a particular trait and assign it a "1" and then identify the most desirable variety in the trial for the same trait and assign it a "5." Many evaluators then find one or more intermediate varieties between these extremes and establish their "3." From there it is quite easy to assign scores of both "2" and "4" to other accessions.

Please Note Changes for 2011: Based on concern over the need for the incorporation of border rows I have changed my recommendations in the *Planting Specifications* to give everyone several options for the row configurations to include border rows. We will also be planting more seed this year, allowing for some thinning to an appropriate stand.

Top Density/Foliar Density: This trait is very important to the carrot breeding work associated with NOVIC, however we now know that in order to evaluate it properly we will need to use techniques that go beyond the evaluator's "visual impression" of the trait. Therefore, we will not request that you gather this data at the trial sites.

Root Shape and *Root Tip Fill* are the two carrot traits that will be scored with an established specific phenotypic value, whereby a specific numerical value has been established for the overall shape of the storage root and for the shape of the terminus or root tip of the storage root. For each of these traits a sheet with pictures of carrots representing the possible shapes will be supplied by the Organic Seed Alliance. There was some confusion with these traits last year as the tip fill was very similar to the tip of the five shapes represented under *Root Shape*. The scoring of the *Root Shape* is based on the carrot types that we are growing in these trials and will remain the same as used in 2010. Hence, the *Root Shape* sheet is the same as last year. However, I have decided to change the *Root Tip Fill* sheet to better reflect the nature of the particular carrot varieties

in this trial. In the new *Root Tip Fill* sheet the more pointy carrot varieties will receive the lower scores and the rounder, blunter tipped carrots will receive the higher score.

I have also added a new evaluation criterion to augment *Root Flavor*. Last year in an attempt to simplify the *Root Flavor* evaluation for these trials I did not distinguish between *Root Sweetness* and *Root Flavor*. I realize now that by evaluating sweetness and flavor separately that all of us will be able to more accurately assess these sensory traits.

Planting Specifications;
If growing the trial on beds, the most desirable configuration is to plant either 3 rows or 4 rows on the bed. This allows for the outermost two rows to be the border rows. The goal is to plant 12 linear feet of row for each entry per rep. If using 4 rows on the bed then it is advised to plant one variety in rows 1 and 2 and a second variety next to it in rows 3 and 4. These rows would be 6 feet long (6 ft. X double row =12 ft. of each variety). This allows you to evaluate the roots of the first variety from row 2 and the roots of the second variety from row 3, while row 1 and row 4 will serve as border rows. The other preferred way to do this is using 3 rows on the bed, where the same variety is planted in all 3 rows across the bed (4 ft. X triple row = 12 ft. of each variety). In this case the middle row is where you get the carrots for your evaluation with the two outer rows serving as your border rows. In these 2 scenarios you will get plenty of roots from the 4 or 6 feet of inner row for each variety per rep to evaluate. Rows can be planted as closely as 12 to 16 in. apart using the bed system based on the width of the beds.

Alternately, the double row configuration (2 rows/bed) works best when the carrots are grown “on the flat” and the trial is flanked by rows of carrots on both sides at a normal commercial spacing that is hopefully being used by the cooperating farmer. In this case the commercial crop on both sides serves as the border rows. The row length planted (6ft. X double row = 12 ft. of each variety) would be the same as the 4 rows on the bed.

Seed should be planted in 1.5 – 2 inch bands, similar to the width achieved with a Planet Junior planting box with a standard scatter shoe. This allows for a higher density of roots per foot of row than if they are planted in a thin single row. The goal of the revised planting scheme that we are using this year will still be to reach a final density of 16 – 20 roots/foot (avg. 18 roots/foot), however we are increasing the quantity of seed that is being planting to insure an even stand across plots and locations. As the germination percentage of the carrot lots that we have received has been variable we have decided to increase the amount of seed of each variety from ~360 seeds to ~500 seeds per packet. Therefore the sowing rate will be now be ~36 to 42 seeds/foot. Therefore, they will be some instances where thinning the stand will be required to attain a uniform final density of 16 to 20 roots/foot.

We are also changing our recommendations on when to plant the carrot trial. As most of these carrots do require from 110 – 120 days to fully attain market size at this proposed density, we are recommending a mid-June planting date, between June 10 and June 20, based on your field conditions. *A full evaluation of the roots only needs to occur once!* However, *we are advising for evaluators to check market size* by digging and inspecting

a few roots from the end of several rows at 105, 110, and 115 days. BUT ONLY DIG THE TRIAL AND EVALUATE IT ONCE, WHEN THE ROOTS ARE MARKET SIZE!

Evaluation Criteria

1) Top Height / Foliar Height

This trait is based on relative height of the carrot foliage or "tops." While some researchers gather actual measurements on this trait, with experience, an evaluator can easily make the distinction between short (1), medium (3), and tall (5), and then make the finer distinctions of the medium-short (2) and medium-tall (4) entries in the trial. This descriptor is based purely on vertical reach of the tops and should not consider the angle or mass of the foliage.

2) Foliar Disease

This relative rating is only used when foliar disease symptoms are present. The rating is based on a visual impression of the relative degree of disease symptoms in the tops. The predominant carrot foliar disease in North America is Alternaria leaf blight, which is caused the fungal pathogen *Alternaria dauci* and can occur at all of the NOVIC testing locations. In carrot growing regions of the Northeast and Upper Midwest another foliar blight, Cercospera leaf blight (*Cercospra carotae*), can occur alone or form a complex with Alternaria. The leaf spotting that is a symptom can be scored with carrot varieties with the most extensive leaf spotting getting a "1" and the least infected getting a "5."

3) Root Shape

Root shape is a trait that requires a small chart with specific pictures of the 5 possible root shapes. This rating will be fairly simple as organic fresh market carrots fall into essentially 2 market classes, Nantes and Imperator, and intermediate types. The 5 shapes depicted in the photographs will be definitive possibilities for the entries. The data will reveal specific shape classes for each entry as opposed to indicating which carrot is the best or worst for shape.

4) Root Tip Fill

The terminus of the storage root portion of the carrot root will usually fill out, often called "blunting" by growers. This tip fill occurs near the end of the growth cycle as the carrot attains its market-size. This trait will also require a small picture chart with 5 pictures of the definitive possibilities of the type of tip fill possible with these carrots.

5) Root Smoothness

The "smoothness" of a carrot is largely judged on the number, size, and depth of lateral root scars that are present on the carrot storage root. This trait is judged relative to the other entries in a particular trial. The roughest carrot variety will score a 1, while the smoothest will be a 5.

6) Root Flavor

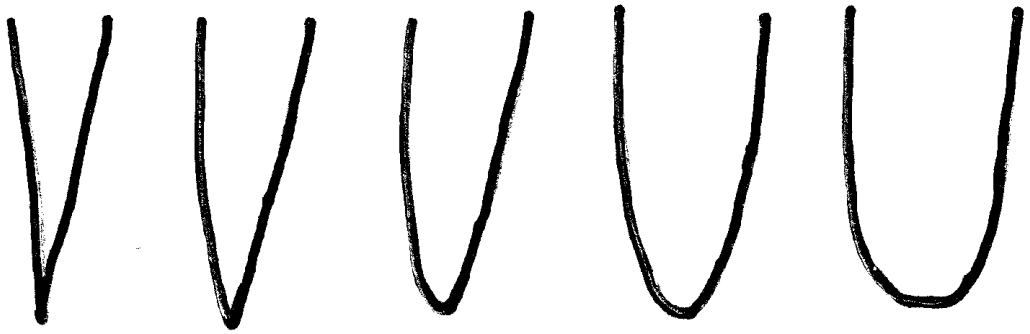
Carrots have one of the most complex flavor profiles of all vegetables. It is hard for people to distinguish between the actual flavor profile of a particular variety and its sweetness. The flavor of a carrot is largely determined by the terpenoids, which are a

large class of volatile flavor compounds. Terpenoids can be light, fragrant and perfume-like ("perfumy") or they can be harsh, bitter, and taste like a pinecone! Somewhere in the middle, between these extremes you will get a nice blend that is pleasant and tastes like a carrot. The sweetness enhances a nice, mellow blend of terpenoids and can make the carrot taste great. If you have a carrot with very low levels of terpenoids but with high sugars it will taste flat or bland, you may get an initial sweetness upon biting into the root but it will fade after one or two chews and the root won't taste like a carrot. The complicating factor is that some people like a light perfumy carrot and some like a richer, stronger carrot flavor, but no one likes a harsh pinecone! So when you evaluate flavor try to score it based on what you like, perfumy or "carroty" flavor and try to do it independent of the sweetness. Evaluators will have to first taste all of accessions before setting a relative standard for the worst tasting carrot (1) and best tasting carrot (5) in the trial. Then at the end of the test try to describe what you consider good carrot flavor so we know what kind of carrots you prefer.

7) Root Sweetness

This trait is hard to judge independently from flavor, but try to ignore the perfume flavor or even the harshness of some of the carrots you taste and ask yourself whether a variety is really sweet or do you just like the flavor. The 5 is the sweetest and the 1 will have an obvious lack of sweetness once you learn to separate the sweetness from the flavor.

Root Tip Fill



1 2 3 4 5

ROOT SHAPE