

CARROT (*Daucus carota* subsp. *sativus*)
Alternaria Leaf Blight; *Alternaria dauci*
Cercospora Leaf Blight; *Cercospora carotae*

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Evaluation of carrot cultivars and breeding selections to identify resistance to foliar blights - Hancock 2006

An experiment was performed at the Hancock Agricultural Research Station, Hancock, WI, to examine 40 carrot cultivars, advanced breeding lines and wild carrot progeny for resistance to *Alternaria* leaf blight and *Cercospora* leaf spot. Seeds of 16 cultivars, 12 advanced breeding lines and 12 wild accessions from seven seed sources were planted 9 May using a cone seeder push planter (slicing, cut-and-peel and wild types, 24 seeds/ft) (dicing type, 12 seeds/ft). Each experimental plot consisted of two adjacent 10 ft test rows spaced 1 ft apart in the center portion of a 6-ft-wide planting bed. The trial was designed as a randomized complete block with three replications. To minimize interplot interference and provide more consistent inoculum across the trial, a guard row of commercial cultivar Heritage (susceptible, slicer type, 550,000 seeds/A) was planted on each side of each experimental plot on 3 May using a standard commercial planter. Sources of natural inoculum for both pathogens were available from nearby commercial carrot fields and no inoculation was necessary. The soil type was Plainfield sand with pH 7.1. Oat seed was sown on 26 Apr as a cover crop prior to planting carrots to provide early season wind protection. Pop-up fertilizer (0-0-62, 250 lb/A) was broadcast during bed shaping on 3 May to aid in early seedling establishment. Sidedress fertilizer consisting of NH_3SO_4 , 100 lb/A, + mono-ammonium phosphate (11-52-0), 50 lb/A, + KMag, 150 lb/A, + Boron and micronutrients package, 10 lb/A, was applied on 23 Jun. Foliar nitrogen was applied through overhead irrigation (28% UAN, 30 lb/A) 4 and 28 Aug to supplement root growth. Insects were controlled with foliar applications of Baythroid (1.6 fl oz/A, 27 Jun; 10 Aug) and Asana XL (4 fl oz/A, 27 Jul). Herbicides applied were Lorox DF (1.0 lb/A, 27 Jun; 0.75 lb/A, 6 Jul); Sencor DF (0.10 lb/A, 6 Jul); Fusilade 2000 (25 fl oz/A, 23 May); and Select (2.0 oz/A, 23 May). Fungicide sprays were not applied to this trial at any time during the season. Foliar disease severity was rated on four sections of the test rows in each plot every 7-10 days, from 28 Jul to 26 Sep using the Horsfall-Barratt (0-11) rating system. On 2 Oct, two 5 ft sections from each experimental plot (10 ft total) of 28 cultivars and advanced breeding lines were hand harvested and roots were graded into five size classes (based on diameter) and culls (misshapen or rotten). Roots from each size class were then grouped according to commercial processing standards for slicing and dicing carrots. The value of each trial entry was calculated from total yield without culls, according to standard processing contracts. No yield information was taken for 12 wild carrot accessions as roots were not consistent with standards for processing carrot type. These roots were harvested separately and will be used for future breeding purposes. Rainfall (in.) recorded for this field was: May, 4.6; Jun, 1.6; Jul, 2.9; Aug, 4.3; and Sep, 3.4. An additional 11.8 in. of water was applied as irrigation in 24 applications Jun-Sep.

Initial symptoms of foliar disease were recognized on 18 Jul in susceptible cultivar Heritage, and test lines Inverness, Big Sur and PX 719265. Foliar disease symptoms were not seen on cultivar Bolero and test line 60052 until the rating on 9 Aug. Several test lines showed 1% disease severity or less on the 28 Jul rating, indicating not all test lines expressed initial foliar disease symptoms at the same point in development. Considerable variation was observed among lines in disease severity resulting in varying affects on foliar health and plant vigor, with several of the most susceptible lines showing >40% severity by 30 Aug. By harvest, these susceptible plants were severely defoliated, with oldest and middle leaves necrotic and brittle. There were significant differences among test lines in disease severity on all rating dates, RAUDPC (relative area under the disease progress curve) and total root yield. RAUDPC values for the susceptible cultivar Heritage (0.355) and the resistant cultivar Bolero (0.046) provided a range for expected values among evaluated test lines. Nine test lines had RAUDPC values that did not differ significantly from Bolero, suggesting comparable reduction in season-long disease progress. Disease severity on 26 Sep and RAUDPC values for 20 test lines were significantly lower when compared to Heritage, highlighting important differences in susceptibility among trial entries. Fourteen test lines yielded 25 ton/A or greater, of which nine had RAUDPC values and a final severity rating significantly less than Heritage. Trial entries including Gold King, Soprano, PX719225, and PX719265 produced yields greater than 25 ton/A, even though plants were

defoliated at harvest, indicating an ability to yield in the presence of these pathogens. Significant variation was detected in the size distribution of roots and the gross value of yield for both slicing and dicing carrot types. The results observed in this trial indicate that carrot yield capacity and levels of foliar disease resistance have been enhanced by current breeding efforts and have the potential to benefit commercial carrot production.

Table 1. Seed source and processing type for cultivars and breeding lines used in this trial.

Cultivar or line	Type ¹	Cultivar or line	Type ¹	Cultivar or line	Type ¹
Slicer Standards		Inverness ⁴	CP	60017 ⁷	BP
Bolero ²	S,CP	Komarno ⁴	D	60022 ⁷	BP
Heritage ³	S	Camarillo ⁴	D	60051 ⁷	BP
Enterprise ³	S	Uppercut 25 ⁶	S,CP	60052 ⁷	BP
Dicer Standards		NBC M352 ⁶	S,CP	SIMON-1 ⁷	CP
Carson ⁴	D	NUN 8564 ⁶	S,CP	SIMON-2 ⁷	CP
Gold King ³	D	Big Sur ⁶	D	SIMON-3 ⁷	CP
Test Lines		Soprano ²	S		
Abledo ³	D	Siroco ²	S		
PX 719265 ³	D	Crème de lite ⁶	S		
SVR 717013 ³	D	60027 (60028:60029) ⁷	BP		
PX 719225 ³	D	60005 ⁷	BP		
SVR 711404 ³	S	60001 ⁷	BP		
XCR 2428 ⁵	S,CP	60003 ⁷	BP		
XCR 1357 ⁵	S,CP	60007 ⁷	BP		
Copperhead ⁵	S,CP	60007OC ⁷	BP		
XCR 3617 ⁵	S,CP	60011 ⁷	BP		
Belinda ⁴	S	60013 ⁷	BP		

1. Carrot processing type. D = Dice, S = Slice, CP = Cut and peel, BP=Breeding population
2. Vilmorin
3. Seminis
4. Bejo
5. Sakata
6. Nunhems
7. P. Simon USDA/UW Hort

Table 2. Severity of foliar disease symptoms on carrot cultivars and breeding selections.

Cultivar or breeding selection	% Disease severity (Alternaria and Cercospora blight - combined) ¹						Relative AUDPC ²
	28 Jul	9 Aug	16 Aug	30 Aug	20 Sep	26 Sep	
Slicer Standards							
Bolero	0.0	1.2	1.6	3.3	13.3	14.1	0.046
Heritage	2.1	10.2	16.4	46.9	59.4	70.3	0.355
Enterprise	0.4	5.9	7.2	23.4	56.3	58.3	0.248
Dicer Standards							
Carson	0.2	2.5	3.5	6.6	16.4	36.5	0.089
Gold King	1.8	9.0	14.8	44.5	70.3	79.7	0.378
Test Lines							
Abledo	0.2	4.9	10.2	25.0	26.6	37.0	0.154
PX 719265	2.5	7.2	14.8	50.0	64.6	65.6	0.364
SVR 717013	1.2	5.3	10.5	24.2	43.8	45.8	0.192
PX 719225	1.0	5.7	12.5	37.5	47.9	70.3	0.301
SVR 711404	0.6	3.9	10.5	29.4	65.1	76.6	0.305
XCR 2428	1.2	5.3	6.6	9.0	29.7	42.2	0.126
XCR 1357	0.8	3.3	7.2	17.6	42.7	61.5	0.183
Copperhead	1.4	6.0	5.9	15.0	34.6	55.2	0.152
XCR 3617	1.2	5.9	7.0	17.2	37.0	50.0	0.195
Belinda	0.2	3.7	6.6	14.4	57.3	67.4	0.230
Inverness	2.7	4.9	9.4	32.3	56.3	61.5	0.259
Komarno	0.8	3.9	7.0	20.0	33.9	50.0	0.163
Camarillo	1.6	4.3	5.9	9.8	24.2	35.4	0.110
Uppercut 25	0.6	3.9	5.1	7.8	19.5	42.7	0.104

Cultivar or breeding selection	% Disease severity (<i>Alternaria</i> and <i>Cercospora</i> blight - combined) ¹						Relative AUDPC ²
	28 Jul	9 Aug	16 Aug	30 Aug	20 Sep	26 Sep	
NBC M352	1.0	4.1	6.4	9.4	28.6	45.3	0.127
NUN 8564	0.4	3.5	4.1	8.0	10.2	27.3	0.073
Big Sur	2.7	5.7	10.9	54.2	68.8	71.9	0.386
Soprano	1.2	7.4	12.1	43.7	73.7	78.1	0.380
Siroco	0.4	5.5	5.9	9.4	32.6	46.4	0.130
Crème de lite	2.3	4.3	9.4	25.3	25.8	32.8	0.198
60027OC	0.9	3.5	5.0	14.6	31.4	33.6	0.121
60005	0.6	5.9	6.7	10.5	39.1	50.0	0.145
60001	1.0	4.5	6.2	15.4	8.2	14.8	0.080
60003	1.4	2.7	4.7	9.4	28.6	35.9	0.119
60007	1.0	3.5	6.0	16.8	24.3	25.8	0.117
60007OC	0.2	4.1	6.6	14.8	27.1	26.6	0.129
60011	0.4	2.3	3.1	4.9	9.4	22.7	0.054
60013	1.4	3.3	4.1	8.4	14.1	31.5	0.081
60017	1.0	4.5	6.0	11.7	57.8	57.8	0.186
60022	0.4	4.5	6.4	11.3	18.7	25.5	0.103
60051	0.6	3.1	3.1	4.7	12.5	12.5	0.056
60052	0.0	3.5	7.4	9.8	12.1	19.5	0.080
SIMON-1	0.8	4.5	6.2	11.7	42.7	55.7	0.182
SIMON-2	1.8	6.8	12.9	56.3	63.5	71.4	0.372
SIMON-3	0.2	3.1	5.5	10.9	31.5	34.9	0.127
Pr>F³	0.03	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
LSD³	1.6	2.5	4.4	16.2	15.3	14.8	0.068

- 1 Severity of leaf blight symptoms was rated on a Horsfall-Barratt scale of 0 (no infection) to 11 (all foliage dead). Symptoms of *Alternaria* leaf blight and *Cercospora* leaf spot were not separated. Ratings were converted to % foliar severity.
- 2 Relative area under the disease progress curve (RAUDPC). Disease severity for each date was plotted on a graph and the area under the resulting curve was calculated by for each treatment, providing a measure of the relative disease severity over the season. A severity rating of 100% for the entire season would produce a value of 1.0. All relative AUDPC values are expressed as a proportion of this value.
- 3 An analysis of variance was performed on the data and Fisher's protected least significant difference (LSD) was calculated (alpha=0.05). NS =not significant at $P = 0.05$.

Table 3. Yield, size distribution and gross value for carrot cultivars and breeding selections.

Cultivar or breeding selection	Total yield (t/A) ¹	Percentage of yield for carrot diameter (in.)					% culls	Yield graded as slicers ²					Yield graded as dicers ²				
		< 3/4	3/4 - 1 1/4	1 1/4 - 1 5/8	1 5/8 - 2	> 2		Percentage of yield			Price/ t (\$)	Gross value of yield (\$)	Percentage of Yield			Price/ t (\$)	Gross value of yield (\$)
								3/4 - 1 5/8"	> 1 5/8"	Dis-cards			1 1/4 - 2"	> 2"	Dis-cards		
Slicer Standards																	
Bolero	34.2	0.9	40.2	42.4	13.4	1.0	2.1	82.6	14.3	3.0	54.7	1798.3	55.8	1.0	43.3	34.3	664.7
Heritage	27.6	8.7	60.4	21.8	6.5	0.0	2.7	82.2	6.5	11.3	54.7	1337.0	28.3	0.0	71.7	34.3	266.1
Enterprise	20.6	14.7	65.0	16.0	2.1	0.0	2.2	81.0	2.1	16.9	54.7	931.9	18.1	0.0	81.9	34.3	111.9
Dicer Standards																	
Carson	31.7	0.2	6.7	25.8	39.1	27.4	0.7	32.5	66.5	1.0	43.6	1368.5	64.9	27.4	7.7	34.3	1002.1
Gold King	37.9	0.3	20.0	40.8	23.4	9.5	6.1	60.8	32.9	6.3	49.4	1751.4	64.2	9.5	26.3	34.3	956.5
Test Line																	
Abledo	31.1	0.9	4.3	20.4	28.0	44.3	2.1	24.7	72.3	3.0	43.6	1315.7	48.4	44.3	7.3	34.3	1000.2
PX 719265	28.8	0.6	15.3	35.6	25.2	18.5	4.8	50.9	43.7	5.4	46.5	1292.8	60.8	18.5	20.7	34.3	778.3
SVR 717013	26.6	1.1	10.2	21.1	29.7	27.2	10.6	31.4	56.9	11.7	43.6	1010.8	50.9	27.2	21.9	34.3	705.4
PX 719225	29.1	0.2	10.1	27.3	36.7	20.8	4.9	37.4	57.5	5.1	43.6	1257.4	64.0	20.8	15.2	34.3	844.6
SVR 711404	20.5	19.8	59.4	15.8	0.0	0.0	5.0	75.2	0.0	24.8	54.7	845.9	15.8	0.0	84.2	34.3	114.4
XCR 2428	25.7	19.3	54.4	18.2	5.5	0.0	2.6	72.7	5.5	21.8	54.7	1094.7	23.7	0.0	76.3	34.3	203.1
XCR 1357	27.0	13.0	64.4	17.0	1.5	1.6	2.4	81.5	3.2	15.4	54.7	1247.0	18.5	1.6	79.8	34.3	188.2
Copperhead	22.3	28.3	62.1	6.3	1.0	0.0	2.3	68.4	1.0	30.6	54.7	849.8	7.3	0.0	92.7	34.3	58.0
XCR 3617	27.6	25.8	59.9	9.8	0.0	1.7	2.6	69.8	1.7	28.5	54.7	1117.2	9.8	1.7	88.4	34.3	111.1
Belinda	28.5	3.5	46.6	39.1	8.7	0.9	1.2	85.7	9.6	4.6	54.4	1479.8	47.9	0.9	51.2	34.3	478.3
Inverness	19.8	16.2	57.2	9.1	13.9	0.0	3.6	66.3	13.9	19.8	53.9	831.6	23.0	0.0	77.0	34.3	156.7
Komarno	26.4	0.4	14.4	32.0	33.6	16.2	3.4	46.4	49.8	3.8	46.5	1171.8	65.7	16.2	18.1	34.3	747.6
Camarillo	28.0	0.0	2.2	7.9	22.1	62.4	5.3	10.1	84.6	5.3	43.6	1154.3	30.0	62.4	7.5	36.6	946.8
Uppercut 25	27.4	13.1	63.5	14.2	4.3	0.0	4.9	77.7	4.3	18.1	54.7	1228.4	18.4	0.0	81.6	34.3	173.2
NBC M352	16.6	47.0	47.3	2.0	1.0	0.0	2.7	49.3	1.0	49.7	54.7	460.7	3.0	0.0	97.0	34.3	17.4
NUN 8564	30.0	12.2	61.6	17.5	3.6	1.0	4.2	79.1	4.6	16.3	54.7	1360.4	21.1	1.0	77.9	34.3	242.0
Big Sur	21.9	4.6	34.3	43.8	14.3	1.7	1.4	78.0	16.0	6.0	53.9	1103.6	58.0	1.7	40.3	34.3	449.2
Soprano	31.7	5.2	70.9	21.4	0.8	0.0	1.8	92.3	0.8	6.9	54.7	1613.6	22.2	0.0	77.8	34.3	238.7
Siroco	26.2	5.4	58.4	30.9	1.1	0.0	4.1	89.3	1.1	9.5	54.7	1295.9	32.0	0.0	68.0	34.3	278.5
Crème de ite	23.5	5.0	47.5	33.6	11.2	0.0	2.7	81.1	11.2	7.8	54.7	1179.8	44.8	0.0	55.2	34.3	364.7
SIMON-1	21.0	6.3	60.9	20.4	7.0	0.9	4.5	81.3	7.9	10.8	54.7	1020.8	27.4	0.9	71.7	34.3	204.7
SIMON-2	19.0	3.6	47.7	36.4	8.0	0.0	4.4	84.0	8.0	8.0	54.7	951.7	44.4	0.0	55.6	34.3	278.5
SIMON-3	12.7	1.1	21.2	28.8	34.7	5.9	8.2	50.0	40.7	9.3	46.5	538.9	63.5	5.9	30.5	34.3	286.0
Pr>F ³	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.756	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
LSD ³	5.4	8.4	16.2	14.2	13.3	7.8	NS	16.0	14.9	10.9	2.6	273.6	18.7	7.8	18.7	--	155.5

1 A 5-ft section of row was hand dug from each of the 2 rows in each plot with exception of wild accessions and yield was converted to t/A. Hand digging is likely to result in a higher apparent yield as fewer carrots are lost compared to mechanical digging. Carrots were graded into five size classes and culls (misshapen or rotted). The size classes were then grouped appropriately to conform to standards for dicing or slicing carrots.

2 Values are calculated based on typical 2003(dicer) or 2004 (slicer) processing contracts for uncrowned carrots.

Dicing carrot contract: Minimum size accepted is 1 1/4 inch; discard class includes culls and carrots below the minimum diameter. Dicing base price per ton is: >90% of crop over 2in. diameter - \$44.65; 81-90% > 2in. - \$41.80; 71-80% > 2in. - \$38.15; 61-70% > 2in. - \$36.60; 51-60% > 2in. - \$35.40; < 51% > 2in. - \$34.25.

Slicing carrot contract: Minimum size accepted is 3/4 inch diameter; discard class includes culls and carrots below the minimum diameter. Slicing base price per ton is: < 10% over 1 3/4in. diameter - \$54.70; 10-19% > 1 3/4in. - \$53.90; 20-29% > 1 3/4in. - \$52.40; 30-39% > 1 3/4in. - \$49.40; 40-49% > 1 3/4in. - \$46.45; >49% > 1 3/4in. - \$43.60.

3 An analysis of variance was performed on the data and Fisher's protected least significant difference (LSD) ($\alpha=0.05$) was calculated. NS = not significant at $P=0.05$.

Table 4. Data ranked according to disease and yield measurements. (Footnotes are at the end of section E.)

A. Sorted by Disease severity 9/26 (% , increasing)

Cultivar or breeding selection	% Disease severity 9/26	Relative AUDPC	Total yield (t/A) ¹	Gross value of yield (\$)		Cultivar or breeding selection	% Disease severity 9/26	Relative AUDPC	Total yield (t/A) ¹	Gross value of yield (\$)	
				Slicers ²	Dicers ²					Slicers ²	Dicers ²
60051	12.5	0.056	---	---	---	Siroco	46.4	0.130	26.2	1295.9	278.5
Bolero	14.1	0.046	34.2	1798.3	664.7	XCR 3617	50.0	0.195	27.6	1117.2	111.1
60001	14.8	0.080	---	---	---	Komarino	50.0	0.163	26.4	1171.8	747.6
60052	19.5	0.080	---	---	---	60005	50.0	0.145	---	---	---
60011	22.7	0.054	---	---	---	Copperhead	55.2	0.152	22.3	849.8	58.0
60022	25.5	0.103	---	---	---	SIMON-1	55.7	0.182	21.0	1020.8	204.7
60007	25.8	0.117	---	---	---	60017	57.8	0.186	---	---	---
60007OC	26.6	0.129	---	---	---	Enterprise	58.3	0.248	20.6	931.9	111.9
NUN 8564	27.3	0.073	30.0	1360.4	242.0	XCR 1357	61.5	0.183	27.0	1247.0	188.2
60013	31.5	0.081	---	---	---	Inverness	61.5	0.259	19.8	831.6	156.7
Crème de lite	32.8	0.198	23.5	1179.8	364.7	PX 719265	65.6	0.364	28.8	1292.8	778.3
60027 (60028: 60029)	33.6	0.121	---	---	---	Belinda	67.4	0.230	28.5	1479.8	478.3
SIMON-3	34.9	0.127	12.7	538.9	286.0	Heritage	70.3	0.355	27.6	1337.0	266.1
Camarillo	35.4	0.110	28.0	1154.3	946.8	PX 719225	70.3	0.301	29.1	1257.4	844.6
60003	35.9	0.119	---	---	---	SIMON-2	71.4	0.372	19.0	951.7	278.5
Carson	36.5	0.089	31.7	1368.5	1002.1	Big Sur	71.9	0.386	21.9	1103.6	449.2
Abledo	37.0	0.154	31.1	1315.7	1000.2	SVR 711404	76.6	0.305	20.5	845.9	114.4
XCR 2428	42.2	0.126	25.7	1094.7	203.1	Soprano	78.1	0.380	31.7	1613.6	238.7
Uppercut 25	42.7	0.104	27.4	1228.4	173.2	Gold King	79.7	0.378	37.9	1751.4	956.5
NBC M352	45.3	0.127	16.6	460.7	17.4	Pr>F ³	<.0001	<0.001	<0.01	<0.01	<0.01
SVR 717013	45.8	0.192	26.6	1010.8	705.4	LSD ³	14.8	0.068	5.4	273.6	155.5

B. Sorted By AUPDC (increasing)

Cultivar or breeding selection	% Disease severity 9/26	Relative AUDPC	Total yield (t/A) ¹	Gross value of yield (\$)		Cultivar or breeding selection	% Disease severity 9/26	Relative AUDPC	Total yield (t/A) ¹	Gross value of yield (\$)	
				Slicers ²	Dicers ²					Slicers ²	Dicers ²
Bolero	14.1	0.046	34.2	1798.3	664.7	Abledo	37.0	0.154	31.1	1315.7	1000.2
60011	22.7	0.054	---	---	---	Komarino	50.0	0.163	26.4	1171.8	747.6
60051	12.5	0.056	---	---	---	SIMON-1	55.7	0.182	21.0	1020.8	204.7
NUN 8564	27.3	0.073	30.0	1360.4	242.0	XCR 1357	61.5	0.183	27.0	1247.0	188.2
60001	14.8	0.080	---	---	---	60017	57.8	0.186	---	---	---
60052	19.5	0.080	---	---	---	SVR 717013	45.8	0.192	26.6	1010.8	705.4
60013	31.5	0.081	---	---	---	XCR 3617	50.0	0.195	27.6	1117.2	111.1
Carson	36.5	0.089	31.7	1368.5	1002.1	Crème de lite	32.8	0.198	23.5	1179.8	364.7
60022	25.5	0.103	---	---	---	Belinda	67.4	0.230	28.5	1479.8	478.3
Uppercut 25	42.7	0.104	27.4	1228.4	173.2	Enterprise	58.3	0.248	20.6	931.9	111.9
Camarillo	35.4	0.110	28.0	1154.3	946.8	Inverness	61.5	0.259	19.8	831.6	156.7
60007	25.8	0.117	---	---	---	PX 719225	70.3	0.301	29.1	1257.4	844.6
60003	35.9	0.119	---	---	---	SVR 711404	76.6	0.305	20.5	845.9	114.4
60027	33.6	0.121	---	---	---	Heritage	70.3	0.355	27.6	1337.0	266.1
XCR 2428	42.2	0.126	25.7	1094.7	203.1	PX 719265	65.6	0.364	28.8	1292.8	778.3
NBC M352	45.3	0.127	16.6	460.7	17.4	SIMON-2	71.4	0.372	19.0	951.7	278.5
SIMON-3	34.9	0.127	12.7	538.9	286.0	Gold King	79.7	0.378	37.9	1751.4	956.5
60007OC	26.6	0.129	---	---	---	Soprano	78.1	0.380	31.7	1613.6	238.7
Siroco	46.4	0.130	26.2	1295.9	278.5	Big Sur	71.9	0.386	21.9	1103.6	449.2
60005	50.0	0.145	---	---	---	Pr>F ³	<0.001	<0.001	<0.01	<0.01	<0.01
Copperhead	55.2	0.152	22.3	849.8	58.0	LSD ³	14.8	0.068	5.4	273.6	155.5

C. Sorted by Total Yield (t/A, decreasing)

Cultivar or breeding selection	% Disease severity 9/26	Relative AUDPC	Total yield (t/A) ¹	Gross value of yield (\$)		Cultivar or breeding selection	% Disease severity 9/26	Relative AUDPC	Total yield (t/A) ¹	Gross value of yield (\$)	
				Slicers ²	Dicers ²					Slicers ²	Dicers ²
Gold King	79.7	0.378	37.9	1751.4	956.5	NUN 8564	27.3	0.073	30.0	1360.4	242.0
Bolero	14.1	0.046	34.2	1798.3	664.7	PX 719225	70.3	0.301	29.1	1257.4	844.6
Carson	36.5	0.089	31.7	1368.5	1002.1	PX 719265	65.6	0.364	28.8	1292.8	778.3
Soprano	78.1	0.380	31.7	1613.6	238.7	Belinda	67.4	0.230	28.5	1479.8	478.3
Abledo	37.0	0.154	31.1	1315.7	1000.2	Camarillo	35.4	0.110	28.0	1154.3	946.8

Cultivar or breeding selection	% Disease severity 9/26	Relative AUDPC	Total yield (t/A) ¹	Gross value of yield (\$)	
				Slicers ²	Dicers ²
Heritage	70.3	0.355	27.6	1337.0	266.1
XCR 3617	50.0	0.195	27.6	1117.2	111.1
Uppercut 25	42.7	0.104	27.4	1228.4	173.2
XCR 1357	61.5	0.183	27.0	1247.0	188.2
SVR 717013	45.8	0.192	26.6	1010.8	705.4
Komarno	50.0	0.163	26.4	1171.8	747.6
Siroco	46.4	0.130	26.2	1295.9	278.5
XCR 2428	42.2	0.126	25.7	1094.7	203.1
Crème de lite	32.8	0.198	23.5	1179.8	364.7
Copperhead	55.2	0.152	22.3	849.8	58.0

Cultivar or breeding selection	% Disease severity 9/26	Relative AUDPC	Total yield (t/A) ¹	Gross value of yield (\$)	
				Slicers ²	Dicers ²
Big Sur	71.9	0.386	21.9	1103.6	449.2
SIMON-1	55.7	0.182	21.0	1020.8	204.7
Enterprise	58.3	0.248	20.6	931.9	111.9
SVR 711404	76.6	0.305	20.5	845.9	114.4
Inverness	61.5	0.259	19.8	831.6	156.7
SIMON-2	71.4	0.372	19.0	951.7	278.5
NBC M352	45.3	0.127	16.6	460.7	17.4
SIMON-3	34.9	0.127	12.7	538.9	286.0
Pr>F ³	<0.001	<0.001	<0.01	<0.01	<0.01
LSD ³	14.8	0.068	5.4	273.6	155.5

D. Sorted by Gross Value of Yield Graded as Slicers (decreasing)

Cultivar or breeding selection	% Disease severity 9/26	Relative AUDPC	Total yield (t/A) ¹	Gross value of yield (\$)	
				Slicers ²	Dicers ²
Bolero	14.1	0.046	34.2	1798.3	664.7
Gold King	79.7	0.378	37.9	1751.4	956.5
Soprano	78.1	0.380	31.7	1613.6	238.7
Belinda	67.4	0.230	28.5	1479.8	478.3
Carson	36.5	0.089	31.7	1368.5	1002.1
NUN 8564	27.3	0.073	30.0	1360.4	242.0
Heritage	70.3	0.355	27.6	1337.0	266.1
Abledo	37.0	0.154	31.1	1315.7	1000.2
Siroco	46.4	0.130	26.2	1295.9	278.5
PX 719265	65.6	0.364	28.8	1292.8	778.3
PX 719225	70.3	0.301	29.1	1257.4	844.6
XCR 1357	61.5	0.183	27.0	1247.0	188.2
Uppercut 25	42.7	0.104	27.4	1228.4	173.2
Crème de lite	32.8	0.198	23.5	1179.8	364.7
Komarno	50.0	0.163	26.4	1171.8	747.6

Cultivar or breeding selection	% Disease severity 9/26	Relative AUDPC	Total yield (t/A) ¹	Gross value of yield (\$)	
				Slicers ²	Dicers ²
Camarillo	35.4	0.110	28.0	1154.3	946.8
XCR 3617	50.0	0.195	27.6	1117.2	111.1
Big Sur	71.9	0.386	21.9	1103.6	449.2
XCR 2428	42.2	0.126	25.7	1094.7	203.1
SIMON-1	55.7	0.182	21.0	1020.8	204.7
SVR 717013	45.8	0.192	26.6	1010.8	705.4
SIMON-2	71.4	0.372	19.0	951.7	278.5
Enterprise	58.3	0.248	20.6	931.9	111.9
Copperhead	55.2	0.152	22.3	849.8	58.0
SVR 711404	76.6	0.305	20.5	845.9	114.4
Inverness	61.5	0.259	19.8	831.6	156.7
SIMON-3	34.9	0.127	12.7	538.9	286.0
NBC M352	45.3	0.127	16.6	460.7	17.4
Pr>F ³	<.0001	<0.001	<0.01	<0.01	<0.01
LSD ³	14.8	0.068	5.4	273.6	155.5

E. Sorted by Gross Value of Yield Graded as Dicers (decreasing)

Cultivar or breeding selection	% Disease severity 9/26	Relative AUDPC	Total yield (t/A) ¹	Gross value of yield (\$)	
				Slicers ²	Dicers ²
Carson	36.5	0.089	31.7	1368.5	1002.1
Abledo	37.0	0.154	31.1	1315.7	1000.2
Gold King	79.7	0.378	37.9	1751.4	956.5
Camarillo	35.4	0.110	28.0	1154.3	946.8
PX 719225	70.3	0.301	29.1	1257.4	844.6
PX 719265	65.6	0.364	28.8	1292.8	778.3
Komarno	50.0	0.163	26.4	1171.8	747.6
SVR 717013	45.8	0.192	26.6	1010.8	705.4
Bolero	14.1	0.046	34.2	1798.3	664.7
Belinda	67.4	0.230	28.5	1479.8	478.3
Big Sur	71.9	0.386	21.9	1103.6	449.2
Crème de lite	32.8	0.198	23.5	1179.8	364.7
SIMON-3	34.9	0.127	12.7	538.9	286.0
Siroco	46.4	0.130	26.2	1295.9	278.5
SIMON-2	71.4	0.372	19.0	951.7	278.5

Cultivar or breeding selection	% Disease severity 9/26	Relative AUDPC	Total yield (t/A) ¹	Gross value of yield (\$)	
				Slicers ²	Dicers ²
Heritage	70.3	0.355	27.6	1337.0	266.1
NUN 8564	27.3	0.073	30.0	1360.4	242.0
Soprano	78.1	0.380	31.7	1613.6	238.7
SIMON-1	55.7	0.182	21.0	1020.8	204.7
XCR 2428	42.2	0.126	25.7	1094.7	203.1
XCR 1357	61.5	0.183	27.0	1247.0	188.2
Uppercut 25	42.7	0.104	27.4	1228.4	173.2
Inverness	61.5	0.259	19.8	831.6	156.7
SVR 711404	76.6	0.305	20.5	845.9	114.4
Enterprise	58.3	0.248	20.6	931.9	111.9
XCR 3617	50.0	0.195	27.6	1117.2	111.1
Copperhead	55.2	0.152	22.3	849.8	58.0
NBC M352	45.3	0.127	16.6	460.7	17.4
Pr>F ³	<0.01	<0.001	<0.01	<0.01	<0.01
LSD ³	14.8	0.068	5.4	273.6	155.5

- 1 A 5-ft section of row was hand dug from each of the 2 rows in each plot with exception of wild accessions and yield was converted to t/A. Carrots were graded into five size classes and culls (misshapen or rotted). The size classes were then grouped appropriately to conform to standards for dicing or slicing carrots.
- 2 Values are calculated based on typical 2003(dicer) or 2004 (slicer) processing contracts for uncrowned carrots.
Dicing carrot contract: Minimum size accepted is 1 1/4 inch; discard class includes culls and carrots below the minimum diameter.
Dicing base price per ton is: >90% of crop over 2in. diameter - \$44.65; 81-90% > 2in. - \$41.80; 71-80% > 2in. - \$38.15; 61-70% > 2in. - \$36.60; 51-60% > 2in. - \$35.40; < 51% > 2in. - \$34.25.
Slicing carrot contract: Minimum size accepted is 3/4 inch diameter; discard class includes culls and carrots below the minimum diameter.
Slicing base price per ton is: < 10% over 1 3/4in. diameter - \$54.70; 10-19% > 1 3/4in. - \$53.90; 20-29% > 1 3/4in. - \$52.40; 30-39% > 1 3/4in. - \$49.40; 40-49% > 1 3/4in. - \$46.45; >49% > 1 3/4in. - \$43.60.
- 3 An analysis of variance was performed on the data and Fisher's protected least significant difference (LSD) ($\alpha = 0.05$) was calculated. NS = not significant at $P = 0.05$.