

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

P. M. Rogers W. R. Stevenson,
R. V. James and R. E. Rand
Department of Plant Pathology
University of Wisconsin-Madison
Madison, WI 53706

Evaluation of weather-based spray programs on tolerant and susceptible carrot cultivars to control *Alternaria* and *Cercospora* leaf blights – Hancock, 2003

A field trial was established at the Hancock Agricultural Research Station to evaluate the efficacy of weather-based fungicide programs to control carrot foliar diseases, on two carrot cultivars varying in susceptibility. Seeds of cultivars Bolero (resistant slicer, planted at 550,000 seeds/A) and Fontana (susceptible dicer, planted at 250,000 seeds/A) were machine planted 6 May using a standard commercial vacuum planter. Treatments were blocked by cultivar and randomized within each of four replicates. Each treatment plot consisted of one 72-in.-wide raised bed with three 22-ft-long rows planted 24 in. apart. A cover crop of oats was planted on 18 Apr to provide early season wind protection. Soil type was Plainfield sand (pH 6.8). Soil test results showed fertility levels of P, K, Mg, S and Mn were adequate for carrot cropping. Potash (0-0-61) fertilizer was broadcast at 250 lb/A during bed shaping on 18 Apr. Additional fertilizer was applied on 20 Jun as a sidedress consisting of NH₃SO₄, 100 lb/A + MAP (11-52-0), 50 lb/A + KMag, 200 lb/A, + Boron and micro nutrient package, 10 lb/A. Nitrogen was applied through irrigation water (28% UAN, 30 lb/A) on 17 Jul, 7 Aug and 21 Aug. Foliar applications of Asana XL (6 fl oz/A, 8 and 28 Jul) were made for insect control. Weeds were controlled with applications of Lorox DF (0.75 lb/A, 13 Jun; 1.0 lb/A, 3 Jul; 1.5 lb/A, 28 Jul), Sencor (0.15 lb/A, 13 Jun; 0.33 lb/A, 3 Jul; 0.5 lb/A, 28 Jul), and Poast (1.5 pt/A, 28 Jul). Rainfall (in.) recorded for this field was: May, 2.26; Jun, 3.3; Jul, 1.89; Aug, 0.95; and Sep, 3.05. An additional 12.79 in. of irrigation was applied in 26 applications Jun-Oct.

Foliar fungicide applications were initiated independently for each cultivar, when 1% disease severity was first detected. Spray intervals were based on a modified Tom-Cast 15 or 20 Disease Severity Value (DSV) schedule or Dacom PLANT-Plus weather-based disease management recommendations. The Dacom system used weather data collected in the field combined with weather forecasts and plant growth data entered on-line and processed by equipment and software supplied by DACOM PLANT-Plus. Recommendations for fungicide product, rate and schedule for this forecasting treatment were provided by DACOM PLANT-Plus online (<http://www.dacom.nl/ppo/ppo.php>). Fungicide treatments were applied according to protocol with a backpack sprayer (3.5 ft boom) equipped with 4 XR11003VS nozzles. Treatments were applied at a rate equivalent to 35 gal water/A at 40 psi. Leaf wetness and temperature data were measured on a weather station using a Watchdog Datalogger 450 (Spectrum Tech Inc.) to collect and store information. Weather data were analyzed using Specware 6.0 disease forecasting software (Spectrum Tech Inc.) and disease severity values (DSV's) were calculated and summed independently for each treatment. When the appropriate threshold (15 or 20 DSV's) was exceeded, that treatment was sprayed and DSV accumulation began again from zero. Each time the threshold DSV level was reached, another spray was applied. Disease severity ratings were conducted on four sections of the center row in each treatment plot, approximately every 7-10 days from 21 Jul to 22 Sep using the Horsfall-Barratt (0-11) rating system. Two 5-ft-long sections of the center row were hand dug from each plot on 29 Sep and graded by hand into five size classes (based on diameter) and culls. The size classes were then grouped appropriately to conform to processing standards for slicing and dicing carrots. Yield values were calculated for each treatment based on typical processing contracts.

Carrot leaf blight symptoms were recognized on 21 Jul in the susceptible cultivar Fontana and throughout Bolero plots on 8 Aug. Disease pressure was moderate and disease symptoms advanced more quickly on Fontana. Disease severity in the untreated Fontana progressed to 65% by 15 Sep and the AUDPC (relative area under the disease progress curve) was 0.28. At harvest, untreated Fontana plots were severely defoliated, which would cause considerable difficulty for lifting carrots with typical commercial harvesting equipment. Applications of Bravo alternated with Quadris provided some level of disease control regardless of spray schedule or cultivar. The two cultivars tested had significantly different reactions to the fungicide programs used in this trial. On Fontana, significant differences were observed between all fungicide treatments and the control. Only weekly and 15 DSV programs provided adequate disease control. The 15 DSV program provided significantly better disease control than the 20 DSV program, however it did not differ statistically from the Dacom treatment. On Bolero, no statistical differences were recognized between fungicide treated programs in disease progress or AUDPC and no further disease control was gained from five fungicide sprays. An obvious difference in disease susceptibility to foliar diseases was noted, as there was significantly less disease in the untreated Bolero than on Fontana with four fungicide applications. There was significantly less disease in the untreated Bolero than on Fontana with four fungicide applications. A susceptible cultivar like Fontana appears to require a weekly or 15 DSV spray program to achieve adequate disease control, while a resistant cultivar like Bolero, may be sprayed on a 20 DSV fungicide schedule resulting in fewer fungicide sprays. Significant differences were noted in total yield between fungicide programs and the untreated control. Minor differences were noted in the size distribution of carrots harvested.

Table 1. Foliar Fungicide Treatments.

Cultivar and application schedule	Rate/Acre		Schedule summary	Application schedule	Total no. of sprays for season	Total active ingredient (ai) used during season (lb/A)
	(Form)	(a.i.)				
Bolero (Vilmorin)						
Untreated Control					0	0
Bravo Ultrex Quadris 2.08 SC	1.4 lb 9.2 fl oz	1.16 lb 0.15 lb	20 DSV schedule, Alternating	Appl 1 Appl 2	2	1.31
Bravo Ultrex Quadris 2.08 SC	1.4 lb 9.2 fl oz	1.16 lb 0.15 lb	15 DSV schedule, Alternating	Appl 1, 3 Appl 2	3	2.62
Bravo Ultrex Quadris 2.08 SC	1.4 lb 9.2 fl oz	1.16 lb 0.15 lb	Weekly, Alternating	Appl 1,3,5,7 Appl 2,4,6	7	5.09
Bravo Ultrex Quadris 2.08 SC	1.4 lb 9.2 fl oz	1.16 lb 0.15 lb	Dacom	Appl 2 Appl 1,3	3	1.46
Fontana (Bejo)						
Untreated Control					0	0
Bravo Ultrex Quadris 2.08 SC	1.4 lb 9.2 fl oz	1.16 lb 0.15 lb	20 DSV schedule, Alternating	Appl 1, 3 Appl 2	3	2.47
Bravo Ultrex Quadris 2.08 SC	1.4 lb 9.2 fl oz	1.16 lb 0.15 lb	15 DSV schedule, Alternating	Appl 1, 3 Appl 2, 4	4	2.62
Bravo Ultrex Quadris 2.08 SC	1.4 lb 9.2 fl oz	1.16 lb 0.15 lb	Weekly, Alternating	Appl 1,3,5,7 Appl 2,4,6,8	8	5.24
Bravo Ultrex Quadris 2.08 SC	1.4 lb 9.2 fl oz	1.16 lb 0.15 lb	Dacom	Appl 2,3,4 Appl 1	4	3.63

Table 2. Effect of foliar fungicide treatment on *Alternaria* and *Cercospora* leaf blight on carrots.

Cultivar and application schedule	Foliar disease severity (% <i>Alternaria</i> and <i>Cercospora</i> blight - combined) ¹								Relative AUDPC ²
	21 Jul	28 Jul	04 Aug	14 Aug	26 Aug	02 Sep	15 Sep	22 Sep	
Bolero									
Untreated	0	0	0.4	1.6	4.1	8.3	11.1	18.8	0.051
20 DSV	0	0	1.0	2.1	3.8	4.4	7.6	8.8	0.035
15 DSV	0	0	0.9	1.3	4.2	6.0	8.8	10.5	0.039
Weekly	0	0	0.7	1.8	3.8	3.7	10.3	7.3	0.036
Dacom	0	0	0.3	0.9	3.4	5.7	10.3	10.0	0.037
Pr > F ³	-	-	0.41	0.56	0.90	0.03	0.47	< 0.01	0.01
LSD ³	-	-	NS	NS	NS	3.0	NS	4.6	0.009
Fontana									
Untreated	1.0	2.6	3.4	7.6	27.0	50.4	65.2	66.0	0.281
20 DSV	0.9	2.6	4.1	4.5	6.7	14.9	19.9	25.2	0.096
15 DSV	0.7	2.8	4.0	3.8	6.7	13.2	12.3	14.1	0.074
Weekly	0.7	3.7	4.5	4.7	6.0	8.2	10.0	9.1	0.062
Dacom	0.7	2.9	4.1	4.7	7.6	14.1	17.6	15.8	0.088
Pr > F ³	0.90	0.29	0.31	0.09	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
LSD ³	NS	NS	NS	2.8*	2.7	4.3	5.5	2.5	0.014
Analysis across both cultivars									
Pr > F ³	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
LSD ³	0.5	0.8	1.0	1.9	2.1	3.8	4.6	5.0	0.011
Analysis of the effect of cultivar and fungicide treatments									
Effect of cultivar									
Bolero	0	0	0.7	1.5	3.9	5.6	9.6	11.1	0.040
Fontana	0.8	2.9	4.0	5.1	10.8	20.2	25.0	26.0	0.120
Pr > F ³	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
LSD ³	0.2	0.3	0.4	0.9	0.9	1.7	2.1	2.3	0.005
Effect of fungicide treatment									
Untreated	0.5	1.3	1.9	4.6	15.5	29.4	38.2	42.4	0.166
20 DSV	0.4	1.3	2.6	3.3	5.3	9.7	13.8	17.0	0.065
15 DSV	0.4	1.4	2.4	2.6	5.5	9.6	10.5	12.3	0.056
Weekly	0.4	1.8	2.6	3.2	4.9	5.9	10.1	8.2	0.049
Dacom	0.4	1.5	2.2	2.8	5.5	9.9	13.9	12.9	0.063
Pr > F ³	0.89	0.29	0.20	0.04	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
LSD ³	NS	NS	NS	1.4	1.5	2.7	3.3	3.6	0.008
Interaction- Cultivar x Fungicide									
Pr > F ³	0.89	0.29	0.50	0.07	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01

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* and *Cercospora* blights were not separated. Ratings were converted to percent disease severity.
2. Relative area under the disease progress curve. % disease severity for each date was plotted on a graph and the area under the curve was calculated for each treatment providing a measure of the relative severity of disease over the season. A disease 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. Either decreased disease severity or later disease development will contribute to lower relative areas under the disease progress curve.
3. Analysis of variance was performed on data, and Fisher's protected least significant difference (LSD) was calculated (alpha=0.05). NS = not significant at $P = 0.10$ (* indicates differences between pairs of treatments were significant at $P = 0.10$, but not at $P = 0.05$).

Table 3. Effect of fungicide treatments on yield and size distribution.

Cultivar and application schedule	Total yield (ton/A) ¹	Percentage of yield for carrot diameter (inches)					% culls	# of roots with Aster yellows symptoms
		< ¾	¾ - 1 ¼	1 ¼ - 1 5/8	1 5/8 - 2	> 2		
Bolero								
Untreated	27.6	2.5	28.1	34.5	14.2	0.6	20.1	12.8
20 DSV	29.6	0.8	22.1	31.9	17.6	1.4	26.1	11.3
15 DSV	31.9	6.3	28.3	34.6	12.9	1.2	16.7	12.0
Weekly	34.1	1.4	27.0	35.4	13.5	2.0	20.6	14.3
Dacom	32.2	0.6	27.0	33.0	19.6	9.3	10.5	6.5
Pr > F ²	0.03	0.44	0.96	0.97	0.60	0.59	0.63	0.13
LSD ²	4.0	NS	NS	NS	NS	NS	NS	NS
Fontana								
Untreated	28.4	0.7	4.4	17.6	45.9	22.0	9.5	9.0
20 DSV	39.8	0.1	1.3	6.7	29.1	43.6	19.2	5.5
15 DSV	43.5	0.1	1.3	8.1	34.5	42.4	13.7	3.5
Weekly	42.0	0.1	0.9	9.1	37.6	42.1	10.3	3.5
Dacom	38.7	0.1	2.9	13.1	37.3	31.4	15.1	6.3
Pr > F ²	< 0.01	0.09	0.11	0.03	0.44	0.06	0.75	0.06
LSD ²	5.3	0.13*	NS	2.6	NS	6.2*	NS	4.0*
Analysis across both cultivars								
Pr > F ²	< 0.01	0.28	< 0.01	< 0.01	< 0.01	< 0.01	0.65	< 0.01
LSD ²	5.3	NS	14.0	10.0	14.2	11.4	NS	4.8
Analysis of the effect of cultivar and fungicide treatments								
Effect of cultivar								
Bolero	31.1	2.3	26.5	33.9	15.6	2.9	18.8	11.4
Fontana	38.5	0.2	2.2	10.9	36.9	36.3	13.6	5.6
Pr > F ²	< 0.01	0.06	< 0.01	< 0.01	< 0.01	< 0.01	0.19	< 0.01
LSD ²	2.4	2.2*	6.2	4.5	6.3	5.1	NS	2.1
Effect of fungicide treatment								
Untreated	28.0	1.6	16.2	26.1	30.0	11.3	14.8	10.9
20 DSV	34.7	0.5	11.7	19.3	23.3	22.5	22.7	8.4
15 DSV	37.7	3.2	14.8	21.4	23.7	21.8	15.2	7.8
Weekly	38.1	0.7	14.0	22.3	25.5	22.0	15.5	8.0
Dacom	35.4	0.4	15.0	23.0	28.5	20.3	12.8	6.4
Pr > F ²	< 0.01	0.44	0.91	0.41	0.58	0.04	0.57	0.12
LSD ²	3.8	NS	NS	NS	NS	8.0	NS	NS
Interaction - Cultivar x Fungicide								
Pr > F ²	0.06	0.43	0.97	0.54	0.34	0.02	0.72	0.03

- 1 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. Hand digging is likely to result in a higher apparent yield as fewer carrots are lost than when mechanically dug.
- 2 Analysis of variance was performed on data, and Fisher's protected least significant difference (LSD) was calculated (alpha=0.05). NS = not significant at $P = 0.10$ (* indicates differences between pairs of treatments were significant at $P = 0.10$, but not at $P = 0.05$).

Table 4. Processing size distribution of yield, gross value of yield

Cultivar and application schedule	Cost of chemicals/acre ¹	Yield graded as slicers ²							Yield graded as dicers ²						
		Percentage of yield			Price/ton (\$)	Value of yield (\$/A)		Effect of treatment on value (\$/A) ⁴	Percentage of yield			Price/ton (\$)	Value of yield (\$/A)		Effect of treatment on value (\$/A) ⁴
		1 3/4 - 1 5/8"	1 5/8"	Discards		Gross	Net ³		1 1/4 - 2"	> 2"	Discards		Gross	Net ³	
Bolero															
Untreated	0	62.6	14.8	22.6	53.9	1129.3	1129.3	0	48.7	0.6	50.7	34.2	464.8	464.8	0
20 DSV	36.9	54.0	19.0	27.0	53.9	1143.2	1106.4	-23.0	49.6	1.4	49.1	34.2	515.7	478.8	14.0
15 DSV	54.1	62.9	14.1	23.0	53.9	1319.7	1265.6	136.3	47.5	1.2	51.3	34.2	529.6	475.5	10.7
Weekly	91.0	62.4	15.5	22.0	53.9	1426.7	1335.7	206.4	48.9	2.0	49.1	34.2	595.4	504.4	39.6
Dacom	44.3	60.0	28.9	11.1	52.4	1450.0	1405.7	276.3	52.6	9.3	38.1	34.2	687.2	687.2	178.1
Pr> F ⁵	--	0.90	0.07	0.60	--	0.14	0.25	0.25	0.98	<0.01	0.51	--	0.29	0.42	0.42
LSD ⁵	--	NS	11.1*	NS	--	NS	NS	NS	NS	4.6	NS	--	NS	NS	NS
Fontana															
Untreated	0	22.0	67.9	10.1	43.6	1121.1	1121.1	0	63.5	22.0	14.5	34.2	842.5	842.5	0
20 DSV	54.1	8.0	72.7	19.4	43.6	1389.4	1335.3	214.2	35.7	43.6	20.6	34.2	1083.1	1029.0	186.5
15 DSV	63.9	9.4	76.9	13.8	43.6	1625.0	1561.1	440.0	42.6	42.4	15.0	34.2	1268.9	1205.0	362.5
Weekly	108.2	10.1	79.6	10.3	43.6	1643.4	1535.2	414.1	46.7	42.1	11.3	34.2	1288.3	1180.1	337.6
Dacom	46.7	16.0	68.7	15.3	43.6	1419.7	1373.0	251.9	50.4	31.4	18.2	34.2	1077.0	1030.3	187.9
Pr> F ⁵	--	0.01	0.48	0.76	--	0.03	0.09	0.09	0.14	0.06	0.81	--	0.02	0.08	0.08
LSD ⁵	--	7.9	NS	NS	--	336.9	336.9*	336.9*	NS	16.8*	NS	--	272.9	272.9*	272.9*
Analysis across both cultivars															
Pr> F ⁵	--	<0.01	<0.01	0.48	--	0.01	0.04	0.14	0.38	<0.01	<0.01	--	<0.01	<0.01	0.14
LSD ⁵	--	15.4	13.1	NS	--	303.2	303.2	NS	NS	11.4	17.0	--	232.6	232.6	NS
Analysis of the effect of cultivar and fungicide treatments															
Effect of cultivar															
Bolero	--	60.4	18.5	21.1	53.9	1293.8	1248.5	119.2	49.5	2.9	47.6	34.2	558.5	513.3	48.5
Fontana	--	13.1	73.2	13.8	43.6	1439.7	1385.2	264.0	47.8	36.3	15.9	34.2	1111.9	1057.4	214.9
P>F ⁵	--	<0.01	<0.01	0.07	--	0.04	0.05	0.08	0.69	<0.01	<0.01	--	<0.01	<0.01	0.02
LSD ⁵	--	6.9	5.9	8.0*	--	135.6	135.6	164.1*	NS	5.1	7.6	--	104.0	104.0	140.0
Effect of fungicide treatment															
Untreated	0	42.3	41.4	16.4	46.5	1125.2	1125.2	0	56.1	11.3	32.6	34.2	653.7	653.7	0
20 DSV	--	31.0	45.8	23.2	46.5	1266.3	1220.8	95.6	42.6	22.5	34.9	34.2	799.4	753.9	100.2
15 DSV	--	36.1	45.5	18.4	46.5	1472.4	1413.4	288.1	45.1	21.8	33.2	34.2	899.3	840.3	186.6
Weekly	--	36.2	47.6	16.2	46.5	1535.1	1435.5	310.2	47.8	22.0	30.2	34.2	941.8	842.2	188.6
Dacom	--	38.0	48.8	13.2	46.5	1434.8	1389.3	264.1	51.5	20.3	28.1	34.2	882.1	836.6	183.0
P>F ⁵	--	0.35	0.55	0.59	--	<0.01	0.02	0.08	0.30	0.04	0.80	--	0.01	0.11	0.35
LSD ⁵	--	NS	NS	NS	--	214.4	214.4	259.5*	NS	8.0	NS	--	164.5	NS	NS
Interaction - Cultivar x Fungicide															
P>F ⁵	--	0.71	0.08	0.67	--	0.38	0.42	0.61	0.33	0.02	0.52	--	0.10	0.12	0.37

- 2003 Season-long cost of chemicals/Acre (rate, number of applications and retail cost are included in calculation). Retail prices used: Bravo Ultrex = \$7.0/lb; Quadris 2.08 SC = \$1.88/oz. Application costs are not included.
- Values are calculated based on typical 2003 (dicer) or 2002 (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: >90.1% over 2" diameter - \$44.60; 80.1-90% > 2" - \$41.80; 70.1-80% > 2" - \$38.15; 60.1-70% > 2" - \$36.60; 50.1-60% > 2" - \$35.40; <50% > 2" - \$34.20.
 - 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 3/4" diameter - \$54.70; 10-19% > 1 3/4" - \$53.90; 20-29% > 1 3/4" - \$52.40; 30-39% > 1 3/4" - \$49.40; 40-49% > 1 3/4" - \$46.45; >49% > 1 3/4" - \$43.60.
- Gross value minus cost of chemicals applied.
- Net value for the treatment minus net value of the untreated control.
- Analysis of variance was performed on data, and Fisher's protected least significant difference (LSD) was calculated (alpha=0.05). NS = not significant at P = 0.10 (* indicates differences between pairs of treatments were significant at P = 0.10, but not at P = 0.05)

Table 5. Data ranked (within cultivar treatments) according to disease severity and yield measurements.

Sorted by Disease Severity 9/17 (increasing)

Cultivar and treatment	Disease Severity (%) 9/17 ¹	Relative AUDPC ²	Total Yield (t/A) ³	Gross Value of Yield (\$)	
				Slicers ⁴	Dicers ⁴
Bolero					
20 DSV	7.6	0.035	29.6	1143.2	515.7
15 DSV	8.8	0.039	31.9	1319.7	529.6
Weekly	10.3	0.036	34.1	1426.7	595.4
Dacom	10.3	0.037	32.2	1450.0	687.2
Untreated	11.1	0.051	27.6	1129.3	464.8
Fontana					
Weekly	10.0	0.062	42.0	1643.4	1288.3
15 DSV	12.3	0.074	43.5	1625.0	1268.9
Dacom	17.6	0.088	38.7	1419.7	1077.0
20 DSV	19.9	0.096	39.8	1389.4	1083.1
Untreated	65.2	0.281	28.4	1121.1	842.5
P > F ⁵	< 0.01	< 0.01	< 0.01	0.01	0.02
LSD ⁵	4.63	0.011	5.3	303.2	272.9

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

Cultivar and treatment	Disease Severity (%) 9/17 ¹	Relative AUDPC ²	Total Yield (t/A) ³	Gross Value of Yield (\$)	
				Slicers ⁴	Dicers ⁴
Bolero					
Dacom	10.3	0.037	32.2	1450.0	687.2
Weekly	10.3	0.036	34.1	1426.7	595.4
15 DSV	8.8	0.039	31.9	1319.7	529.6
20 DSV	7.6	0.035	29.6	1143.2	515.7
Untreated	11.1	0.051	27.6	1129.3	464.8
Fontana					
Weekly	10.0	0.062	42.0	1643.4	1288.3
15 DSV	12.3	0.074	43.5	1625.0	1268.9
Dacom	17.6	0.088	38.7	1419.7	1077.0
20 DSV	19.9	0.096	39.8	1389.4	1083.1
Untreated	65.2	0.281	28.4	1121.1	842.5
P > F ⁵	< 0.01	< 0.01	< 0.01	0.01	0.02
LSD ⁵	4.63	0.011	5.3	303.2	272.9

Sorted by Relative AUDPC (increasing)

Cultivar and treatment	Disease Severity (%) 9/17 ¹	Relative AUDPC ²	Total Yield (t/A) ³	Gross Value of Yield (\$)	
				Slicers ⁴	Dicers ⁴
Bolero					
20 DSV	7.6	0.035	29.6	1143.2	515.7
Weekly	10.3	0.036	34.1	1426.7	595.4
Dacom	10.3	0.037	32.2	1450.0	687.2
15 DSV	8.8	0.039	31.9	1319.7	529.6
Untreated	11.1	0.051	27.6	1129.3	464.8
Fontana					
Weekly	10.0	0.062	42.0	1643.4	1288.3
15 DSV	12.3	0.074	43.5	1625.0	1268.9
Dacom	17.6	0.088	38.7	1419.7	1077.0
20 DSV	19.9	0.096	39.8	1389.4	1083.1
Untreated	65.2	0.281	28.4	1121.1	842.5
P > F ⁵	< 0.01	< 0.01	< 0.01	0.01	0.02
LSD ⁵	4.63	0.011	5.3	303.2	272.9

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

Cultivar and treatment	Disease Severity (%) 9/17 ¹	Relative AUDPC ²	Total Yield (t/A) ³	Gross Value of Yield (\$)	
				Slicers ⁴	Dicers ⁴
Bolero					
Dacom	10.3	0.037	32.2	1450.0	687.2
Weekly	10.3	0.036	34.1	1426.7	595.4
15 DSV	8.8	0.039	31.9	1319.7	529.6
20 DSV	7.6	0.035	29.6	1143.2	515.7
Untreated	11.1	0.051	27.6	1129.3	464.8
Fontana					
Weekly	10.0	0.062	42.0	1643.4	1288.3
15 DSV	12.3	0.074	43.5	1625.0	1268.9
20 DSV	19.9	0.096	39.8	1389.4	1083.1
Dacom	17.6	0.088	38.7	1419.7	1077.0
Untreated	65.2	0.281	28.4	1121.1	842.5
P > F ⁵	< 0.01	< 0.01	< 0.01	0.01	0.02
LSD ⁵	4.63	0.011	5.3	303.2	272.9

Sorted by Total Yield (ton/A, decreasing)

Cultivar and treatment	Disease Severity (%) 9/17 ¹	Relative AUDPC ²	Total Yield (t/A) ³	Gross Value of Yield (\$)	
				Slicers ⁴	Dicers ⁴
Bolero					
Weekly	10.3	0.036	34.1	1426.7	595.4
Dacom	10.3	0.037	32.2	1450.0	687.2
15 DSV	8.8	0.039	31.9	1319.7	529.6
20 DSV	7.6	0.035	29.6	1143.2	515.7
Untreated	11.1	0.051	27.6	1129.3	464.8
Fontana					
15 DSV	12.3	0.074	43.5	1625.0	1268.9
Weekly	10.0	0.062	42.0	1643.4	1288.3
20 DSV	19.9	0.096	39.8	1389.4	1083.1
Dacom	17.6	0.088	38.7	1419.7	1077.0
Untreated	65.2	0.281	28.4	1121.1	842.5
P > F ⁵	< 0.01	< 0.01	< 0.01	0.01	0.02
LSD ⁵	4.63	0.011	5.3	303.2	272.9

1. Severity of leaf blight symptoms (Alternaria and Cercospora combined) rated on a Horsfall-Barratt scale of 0 (no infection) to 11 (all foliage dead).
2. Relative area under the disease progress curve. % disease severity for each date was plotted and area under the curve calculated for each treatment providing a measure of the relative severity of disease 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. Either decreased severity or later disease development will lower AUDPC.
3. 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. Yields may not reflect actual yield as hand harvesting results in fewer roots left in field.
4. Values are calculated based on typical 2003(dicer) or 2002 (slicer) processing contracts for uncrowned carrots (see details in footnote p. 71).
5. Analysis of variance was performed on data, and Fisher's protected least significant difference (LSD) was calculated (alpha=0.05). NS = not significant at P = 0.10 (* indicates differences between pairs of treatments were significant at P = 0.10, but not at P = 0.05).