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

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Evaluation of weather-based spray programs on resistant and susceptible carrot cultivars to control two foliar diseases – Hancock, 2004

A field trial was established at the Hancock Agricultural Research Station to evaluate two weather-based fungicide programs to control Alternaria and Cercospora foliar diseases, on two carrot cultivars differing in disease susceptibility. Two cultivars Fontana (susceptible dicer, planted at 250,000 seeds/A) and Bolero (resistant slicer, planted at 550,000 seeds/A) were planted 11 May using a standard commercial vacuum planter. Each treatment plot consisted of one 72-in.-wide raised bed planted with three 22-ft-long rows spaced 24 in. apart. All treatments were blocked by cultivar and randomized within each of four replicates. A cover crop of oats was planted on 26 Apr to provide early season wind protection. Soil type was Plainfield sand with pH 6.9. Fertilizer (0-0-60, 500 lb/A) was incorporated prior to tillage on 20 Apr and pop-up fertilizer (0-0-61, 250 lb/A) was broadcast during bed shaping on 26 Apr to aid in seedling development. Additional fertilizer was applied on 29 Jun as a sidedress consisting of NH_3SO_4, 100 lb/A + MAP (11-52-0) 50 lb/A + KMag, 150 lb/A + Boron and micronutrients package, 10 lb/A. Foliar nitrogen was applied through overhead irrigation (28% UAN) (10 lb/A, 24 Jun; 15 lb/A, 4 Aug; 20 lb/A, 14 Sep; 30 lb/A, 11 and 25 Aug) to supplement root expansion. Aster leafhoppers were controlled with foliar applications of Asana XL (6 fl oz/A, 8 Jul) and Baythroid (1.5 fl oz/A, 15 Jun). Weeds were suppressed with applications of Credit (pre-emergence only) (32 fl oz/A, 20 May); Lorox DF (0.75 lb/A, 8 Jul; 1.0 lb/A, 29 Jun and 8 Aug); Sencor DF (0.15 lb/A, 29 Jun and 8 Jul; 0.25 lb/A, 6 Aug); and Fusilade DX (12 fl oz/A, 15 Jun). Rainfall (in.) recorded for this field was: May, 1.7; Jun, 7.7; Jul, 0.5; Aug, 3.6; and Sep, 0. Irrigation was applied in 28 applications from May-Oct. adding an additional 13.63 in. of water.

Foliar fungicide applications were triggered independently for each cultivar, when 1% disease severity was first observed within each cultivar. Application 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 TOM-CAST approach utilized leaf wetness and temperature data measured on an in-canopy weather station using a Watchdog Datalogger 450 (Spectrum Tech Inc.). 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 to that treatment. 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). Treatments were applied according to weather-based recommendations following the experimental protocol located in Table 1. Foliar fungicides were sprayed 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 pressurized with CO_2 at 40 psi. Disease severity ratings were conducted on four sections of the center row in each treatment plot, approximately every 7-10 days from 27 Jul to 29 Sep using the Horsfall-Barratt (0-11) rating system. Two (5-ft) sections of the center row were lifted by hand from each plot on 5 Oct and graded into five size classes (based on diameter) and culls. The size classes were then grouped according to processing standards for slicing and dicing carrots. Yield values were calculated for each treatment based on typical processing contracts.

Foliar disease symptoms were observed (1% severity) on 26 Jul on Fontana (susceptible) and on Bolero (resistant) on 8 Aug. Weather conditions were cool and moist in 2004, providing an environment less favorable for these foliar diseases than previous years. Foliar disease pressure was light to moderate in the early part of the season, but symptoms progressed more rapidly from late Aug through harvest. By the final rating date, symptom severity in the untreated Fontana was >45% resulting in partial defoliation, enough to cause considerable difficulty lifting carrots with commercial harvesting equipment. All treatments receiving fungicide at weekly intervals or a schedule dictated by a forecasting program (15 or 20 DSV and Dacom), significantly improved disease control compared to the untreated check, regardless of cultivar. Statistical differences in disease severity were recognized between fungicide treated and untreated plots on Fontana following the 17 Aug rating. Significant differences among fungicide treatments on Fontana were noted on 29 Sep, with the 15 DSV and weekly programs providing better control than Dacom, 20 DSV and the untreated. Analysis of relative AUDPC (relative area under the disease progress curve) demonstrated no differences in disease control within fungicide treatments on Fontana, however all fungicide treated plots were significantly lower than the untreated control. On Bolero, differences between fungicide treatments and the untreated control were recorded from 10 Sep to harvest. Significant differences in disease severity were noted on 24 Sep between fungicide treatments on Bolero, with the 15 DSV and weekly treatments showing reduced severity compared to the 20 DSV and Dacom programs. All chemical treatments on Bolero had significantly lower AUDPC values than the untreated. The 15 DSV program did not differ statistically from the weekly program on either cultivar, suggesting no improvement of disease control with the

application of four additional fungicide sprays. The value of host resistance in Bolero was noted in this trial, as there was no significant difference in AUDPC between the untreated Bolero and Fontana treatment (weekly) receiving eight fungicide sprays

Analysis of total yield on Fontana revealed significant differences between fungicide treatments with the 15 DSV, 20 DSV, and weekly treatments having greater yield than the Dacom program or untreated control. No statistical differences were noted in total yield among treatments on Bolero; however gross value of yield was higher in the weekly program compared to other treatments due to fewer culls and greater percentage of carrots in usable size categories. Fungicide treatments did not significantly change the size distribution of carrots harvested. Applying fungicides according to in-canopy or local weather data substantially reduced chemical inputs (total ai), the number of sprays, and total toxicity of a season-long program, without sacrificing disease control or carrot yield. Data from this experiment, under the weather conditions of 2004, suggest monitoring environmental conditions and managing foliar diseases appropriately, offers a significant benefit to carrot growers by eliminating unnecessary fungicide sprays and disease management costs.

Table 1. Foliar Fungicide Treatments.

Cultivar and application schedule	Rate/Acre (Form)	Rate/Acre (a.i.)	Schedule summary	Application schedule	Total no. of sprays for season	Total active ingredient (ai) used during season (lb/A)
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	Dacom	Appl 2, 3, 4 Appl 1	4	3.63
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
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	2.47
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
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

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

Cultivar and application schedule	Foliar disease severity (%, Alternaria and Cercospora blight - combined) [1]								Relative AUDPC [2]
	27 Jul	10 Aug	17 Aug	24 Aug	3 Sep	10 Sep	22 Sep	29 Sep	
Fontana									
Untreated	1.0	2.6	4.7	8.5	17.4	25.5	44.5	48.4	0.175
20 DSV	1.0	1.8	2.2	3.8	6.1	7.3	11.7	12.3	0.055
15 DSV	0.9	1.8	2.3	3.5	7.6	9.8	7.9	7.6	0.052
Dacom	0.6	1.5	3.1	3.7	4.7	7.0	13.5	14.1	0.054
Weekly	1.2	1.9	2.6	2.5	5.9	5.6	6.3	6.1	0.040
P > F [3]	0.83	0.06	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01
LSD [3]	NS	NS	0.9	3.1	7.7	9.9	8.5	4.9	0.039
Bolero									
Untreated	0	1.8	1.8	2.6	5.7	6.7	9.7	10.0	0.044
20 DSV	0	1.6	1.9	1.9	3.7	4.4	5.3	5.4	0.028
15 DSV	0	1.0	1.6	1.9	3.1	3.9	3.4	4.7	0.023
Dacom	0	1.6	2.0	2.6	3.7	3.9	5.3	5.0	0.028
Weekly	0	1.3	1.6	1.3	2.5	2.9	2.8	2.9	0.018
P > F [3]	--	0.36	0.80	0.08	0.05	<0.01	<0.01	<0.01	<0.01
LSD [3]	NA	0.8	0.9	1.1	2.1	1.5	1.7	2.5	0.008
Analysis including both cultivars and all treatments									
P > F [3]	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
LSD [3]	0.8	0.7	0.9	2.1	5.0	6.3	5.5	3.5	0.025
Analysis of the effect of cultivar and fungicide treatments									
Effect of cultivar									
Fontana	0.9	1.9	3	4.4	8.3	11.0	16.8	17.3	0.075
Bolero	0	1.5	1.8	2.1	3.7	4.4	5.3	5.6	0.028
P > F [3]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
LSD [3]	0.3	0.3	0.4	0.9	2.2	2.8	2.5	1.6	0.011
Effect of fungicide treatment									
Untreated	0.5	2.2	3.2	5.5	11.6	16.1	27.1	30.2	0.110
20 DSV	0.5	1.7	2.1	2.9	4.9	5.9	8.5	8.9	0.042
15 DSV	0.4	1.4	2	2.7	5.3	6.9	5.6	6.1	0.037
Dacom	0.3	1.5	2.6	3.1	4.2	5.5	9.4	8.1	0.041
Weekly	0.6	1.6	2.1	1.9	4.1	4.2	4.5	4.5	0.029
P > F [3]	0.84	0.03	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
LSD [3]	NS	0.5	0.6	1.5	3.5	4.5	3.9	2.5	0.018
Interaction- Cultivar x Fungicide									
P > F [3]	0.83	0.22	0.11	0.01	0.04	0.03	<0.01	<0.01	0.01

1 Severity of foliar disease 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.

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* = 0.05.

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
		< ¾	¾ - 1 ¼	1 ¼ - 1 5/8	1 5/8 - 2	> 2	
Fontana							
Untreated	33.0	0.3	2.7	6.0	25.6	31.8	33.7
20 DSV	39.8	0.1	1.7	6.9	33.5	33.6	24.3
15 DSV	39.1	0.2	0.8	4.7	17.9	39.5	36.9
Dacom	33.6	0.3	1.4	4.5	19.3	35.3	39.2
Weekly	41.1	0.6	1.5	1.7	15.0	37.9	43.2
P > F [2]	0.01	0.14	0.14	0.40	0.38	0.88	0.79
LSD [2]	5.2	0.4	NS	NS	NS	NS	NS
Bolero							
Untreated	33.6	1.5	8.3	20.1	31.2	5.3	33.5
20 DSV	33.7	1.7	12.5	23.4	27.1	10.8	24.5
15 DSV	35.0	1.2	11.2	24.5	25.4	5.0	32.7
Dacom	34.3	1.7	12.3	23.3	31.7	8.3	22.6
Weekly	36.5	1.8	12.9	30.1	32.4	4.0	18.8
P > F [2]	0.73	0.33	0.78	0.66	0.34	0.73	0.45
LSD [2]	NS	NS	NS	NS	NS	NS	NS
Analysis including both cultivars and all treatments							
P > F [2]	<0.01	<0.01	<0.01	<0.01	0.23	<0.01	0.70
LSD [2]	5.1	0.6	5.7	9.9	NS	13.9	NS
Analysis of the effect of cultivar and fungicide treatments							
Effect of cultivar							
Fontana	37.7	0.3	1.6	4.8	22.8	35.5	35.1
Bolero	34.6	1.6	11.4	24.3	29.6	6.7	26.4
P > F [2]	<0.01	<0.01	<0.01	<0.01	0.04	<0.01	0.15
LSD [2]	2.3	0.3	2.5	4.4	6.5	6.3	NS
Effect of fungicide treatment							
Untreated	32.7	0.9	5.6	13.2	27.3	18.9	34.1
20 DSV	36.8	0.9	7.1	15.1	30.3	22.2	24.4
15 DSV	37.9	0.7	6.0	14.5	22.7	22.1	34.0
Dacom	33.9	1.0	6.8	13.9	25.5	21.8	30.9
Weekly	39.5	1.2	7.2	15.9	25.0	20.4	30.3
P > F [2]	<0.01	0.17	0.89	0.94	0.53	0.95	0.83
LSD [2]	3.9	NS	NS	NS	NS	NS	NS
Interaction - Cultivar x Fungicide							
P > F [2]	0.06	0.53	0.56	0.29	0.27	0.76	0.63

1 Harvested roots were graded into five size classes and culls (misshapen or rotted). The size classes were then grouped according to commercial standards for dicing or slicing carrots. Hand digging is likely to result in a higher apparent yield as fewer carrots are lost compared to mechanical harvesting.

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* = 0.05.

Table 4. Effect of treatments on 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 ($/A) [d]	Percentage of yield			Price/ ton ($)	Value of yield ($/A)		Effect of treatment on value ($/A) [4]
		¾ - 1 5/8"	> 1 5/8"	Discards		Gross	Net [3]		1 ¼ - 2"	> 2"	Discards		Gross	Net [3]	
Fontana															
Untreated	0.0	8.7	57.3	34.0	43.6	955.5	955.5	0	31.6	31.8	36.7	34.3	711.5	711.5	0
20 DSV	38.0	8.5	67.1	24.4	43.6	1353.7	1314.8	359.3	40.4	33.6	26.1	34.3	1026.2	987.3	257.8
15 DSV	56.4	5.4	57.4	37.1	43.6	1082.0	1026.1	70.6	22.6	39.5	37.9	34.3	839.2	783.3	71.8
Dacom	47.8	5.9	54.6	39.4	43.6	942.2	892.4	-63.1	23.9	35.3	40.8	34.3	711.5	661.7	-49.8
Weekly	112.8	3.3	53.0	43.8	43.6	1025.6	913.8	-41.7	16.7	37.9	45.3	34.3	772.5	660.7	-50.8
P> F [5]	--	0.36	0.85	0.79	--	0.58	0.51	0.51	0.79	0.88	0.79	--	0.62	0.47	0.47
LSD [5]	--	NS	NS	NS	--	NS	NS	NS	NS	NS	NS	--	NS	NS	NS
Bolero															
Untreated	0.0	28.4	36.5	35.1	49.4	1070.1	1070.1	0	51.3	5.3	43.4	34.3	642.9	642.9	0
20 DSV	28.2	35.9	37.9	26.2	49.4	1219.3	1191.4	121.3	50.5	10.8	38.7	34.3	716.6	688.7	45.8
15 DSV	38.0	35.7	30.4	33.9	49.4	1148.6	1109.7	39.6	49.9	5.0	45.1	34.3	660.7	621.8	-21.1
Dacom	46.6	35.6	40.0	24.3	46.5	1262.1	1217.1	147.0	55.1	8.3	36.6	34.3	746.4	701.4	58.5
Weekly	94.4	43.0	36.4	20.6	49.4	1436.3	1341.5	271.4	62.5	4.0	33.5	34.3	833.2	738.4	95.5
P> F [5]	--	0.42	0.78	0.47	--	0.37	0.11	0.11	0.43	0.73	0.59	--	0.43	0.26	0.26
LSD [5]	--	NS	NS	NS	--	NS	NS	NS	NS	NS	NS	--	NS	NS	NS
Analysis including both cultivars and all treatments															
P> F [5]	--	<0.01	0.03	0.77	--	0.45	0.31	0.73	<0.01	<0.01	0.91	--	0.51	0.63	0.77
LSD [5]	--	14.6	22.7	NS	--	NS	NS	NS	19.1	14.0	NS	--	NS	NS	NS
Analysis of the effect of cultivar and fungicide treatments															
Effect of cultivar															
Fontana		6.4	57.9	35.8	44.8	1071.8	1037.1	81.6	27.0	35.6	37.4	34.3	812.2	773.6	62.1
Bolero		36.6	35.8	27.7	49.4	1259.4	1254.9	184.8	54.4	6.6	39.0	34.3	738.6	710.7	67.8
P> F [5]		<0.01	<0.01	0.17	--	0.20	0.11	0.53	<0.01	<0.01	0.77	--	0.37	0.53	0.96
LSD [5]		6.6	10.2	NS	--	NS	NS	NS	8.5	6.3	NS	--	NS	NS	NS
Effect of fungicide treatment															
Untreated		18.7	46.2	34.5	47.2	1012.8	1012.8	0	41.4	18.5	40.0	34.3	677.2	677.2	0
20 DSV		22.2	52.5	25.3	47.3	1286.5	1068.1	55.3	45.4	22.2	32.4	34.3	871.4	702.7	25.5
15 DSV		20.5	44.9	35.5	46.9	1115.3	1253.4	240.6	36.2	22.2	41.5	34.3	749.9	838.3	161.1
Dacom		20.8	47.3	31.9	47.2	1102.1	1054.9	42.1	39.5	21.8	38.7	34.3	728.9	681.7	4.6
Weekly		25.2	45.5	31.3	46.9	1311.1	1207.5	194.7	41.0	20.8	38.2	34.3	849.5	745.9	68.7
P> F [5]		0.92	0.87	0.83	--	0.34	0.62	0.76	0.74	0.93	0.86	--	0.51	0.76	0.75
LSD [5]		NS	NS	NS	--	NS	NS	NS	NS	NS	NS	--	NS	NS	NS
Interaction - Cultivar x Fungicide															
P> F [5]		0.39	0.89	0.53	--	0.29	0.26	0.45	0.08	0.69	0.56	--	0.42	0.36	0.45

1 2004 Season-long cost of chemicals/Acre (rate, number of apps. and retail cost included). Retail prices used: Bravo Ultrex =$7.8/lb; Quadris 2.08 SC = $1.85/oz. Application costs are not included.

2 Values are calculated according to 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 2in. diameter - $44.60; 80.1-90%> 2in. - $41.80; 70.1-80%> 2in. - $38.15; 60.1-70%> 2in. - $36.60; 50.1-60%> 2in. - $35.40; <50% > 2in. - $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 3/4in. 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 Gross value minus cost of chemicals applied.

4 Net value for each treatment minus net value of the untreated control.

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* = 0.05)

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

Sorted by Disease Severity 9/24 (increasing)

Cultivar and treatment	Disease Severity (%) 9/24 [1]	Relative AUDPC [2]	Total Yield (t/A) [3]	Gross Value of Yield ($)	
				Slicers [4]	Dicers [4]
Fontana					
Weekly	6.3	0.040	41.1	1025.6	772.5
15 DSV	7.9	0.052	39.1	1082.0	839.2
20 DSV	11.7	0.055	39.8	1353.7	1026.2
Dacom	13.5	0.054	33.6	942.2	711.5
Untreated	44.5	0.175	33.0	955.5	711.5
Bolero					
Weekly	2.8	0.018	36.5	1436.3	833.2
15 DSV	3.4	0.023	35.0	1148.6	660.7
20 DSV	5.3	0.028	33.7	1219.3	716.6
Dacom	5.3	0.028	34.3	1262.1	746.4
Untreated	9.7	0.044	33.6	1070.1	642.9
$P > F$ [5]	<0.01	<0.01	0.02	0.21	0.53
LSD [5]	5.5	0.025	5.5	482.7	NS

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

Cultivar and treatment	Disease Severity (%) 9/24 [1]	Relative AUDPC [2]	Total Yield (t/A) [3]	Gross Value of Yield ($)	
				Slicers [4]	Dicers [4]
Fontana					
20 DSV	11.7	0.055	39.8	1353.7	1026.2
15 DSV	7.9	0.052	39.1	1082.0	839.2
Weekly	6.3	0.040	41.1	1025.6	772.5
Untreated	44.5	0.175	33.0	955.5	711.5
Dacom	13.5	0.054	33.6	942.2	711.5
Bolero					
Weekly	2.8	0.018	36.5	1436.3	833.2
Dacom	5.3	0.028	34.3	1262.1	746.4
20 DSV	5.3	0.028	33.7	1219.3	716.6
15 DSV	3.4	0.023	35.0	1148.6	660.7
Untreated	9.7	0.044	33.6	1070.1	642.9
$P > F$ [5]	<0.01	<0.01	0.02	0.21	0.53
LSD [5]	5.5	0.025	5.5	482.7	NS

Sorted by Relative AUDPC (increasing)

Cultivar and treatment	Disease Severity (%) 9/24 [1]	Relative AUDPC [2]	Total Yield (t/A) [3]	Gross Value of Yield ($)	
				Slicers [4]	Dicers [4]
Fontana					
Weekly	6.3	0.040	41.1	1025.6	772.5
15 DSV	7.9	0.052	39.1	1082.0	839.2
Dacom	13.5	0.054	33.6	942.2	711.5
20 DSV	11.7	0.055	39.8	1353.7	1026.2
Untreated	44.5	0.175	33.0	955.5	711.5
Bolero					
Weekly	2.8	0.018	36.5	1436.3	833.2
15 DSV	3.4	0.023	35.0	1148.6	660.7
20 DSV	5.3	0.028	33.7	1219.3	716.6
Dacom	5.3	0.028	34.3	1262.1	746.4
Untreated	9.7	0.044	33.6	1070.1	642.9
$P > F$ [5]	<0.01	<0.01	0.02	0.21	0.53
LSD [5]	5.5	0.025	5.5	482.7	NS

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

Cultivar and treatment	Disease Severity (%) 9/24 [1]	Relative AUDPC [2]	Total Yield (t/A) [3]	Gross Value of Yield ($)	
				Slicers [4]	Dicers [4]
Fontana					
20 DSV	11.7	0.055	39.8	1353.7	1026.2
15 DSV	7.9	0.052	39.1	1082.0	839.2
Weekly	6.3	0.040	41.1	1025.6	772.5
Untreated	44.5	0.175	33.0	955.5	711.5
Dacom	13.5	0.054	33.6	942.2	711.5
Bolero					
Weekly	2.8	0.018	36.5	1436.3	833.2
Dacom	5.3	0.028	34.3	1262.1	746.4
20 DSV	5.3	0.028	33.7	1219.3	716.6
15 DSV	3.4	0.023	35.0	1148.6	660.7
Untreated	9.7	0.044	33.6	1070.1	642.9
$P > F$ [5]	<0.01	<0.01	0.02	0.21	0.53
LSD [5]	5.5	0.025	5.5	482.7	NS

Sorted by Total Yield (ton/A, decreasing)

Cultivar and treatment	Disease Severity (%) 9/24 [1]	Relative AUDPC [2]	Total Yield (t/A) [3]	Gross Value of Yield ($)	
				Slicers [4]	Dicers [4]
Fontana					
Weekly	6.3	0.040	41.1	1025.6	772.5
20 DSV	11.7	0.055	39.8	1353.7	1026.2
15 DSV	7.9	0.052	39.1	1082.0	839.2
Dacom	13.5	0.054	33.6	942.2	711.5
Untreated	44.5	0.175	33.0	955.5	711.5
Bolero					
Weekly	2.8	0.018	36.5	1436.3	833.2
15 DSV	3.4	0.023	35.0	1148.6	660.7
Dacom	5.3	0.028	34.3	1262.1	746.4
20 DSV	5.3	0.028	33.7	1219.3	716.6
Untreated	9.7	0.044	33.6	1070.1	642.9
$P > F$ [5]	<0.01	<0.01	0.02	0.21	0.53
LSD [5]	5.5	0.025	5.5	482.7	NS

1 Severity of foliar disease symptoms (Alternaria and Cercospora combined) rated on a Horsfall-Barratt scale of 0 to 11.

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) commercial processing contracts for uncrowned carrots (see details in footnote for Table 4).

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 $P = 0.05$.