Carrot (*Daucus carota* cv.'Fontana' & 'Bolero') P.V. Oudemans, M.D. Zimmerman,
Leaf blights; *Alternaria dauci* M.L. Fogg, & J.E. Garton, Jr.
Cercospora carotae

EVALUATION OF THE INTEGRATION OF VARIETAL RESISTANCE, FUNGICIDE TREATMENT AND APPLICATION SCHEDULE ON LEAF BLIGHTS OF PROCESSING CARROTS, 2003: The experiment was conducted in a field (Aura sandy loam, pH 6.9) on the Rutgers Agricultural Research & Extension Center, Bridgeton, NJ. On 16 April the field was fumigated with Vapam HL (75 gal/A) for soil borne fungal pathogens and weed control. On 6 May, Treflan 4E (22 oz/A) was applied pre-plant and incorporated for weed control. On 14 May, carrots were seeded into the field with a Planet Jr. seeder with the seeding rate adjusted for each variety according to seed size. Plots consisted of 2, 15 ft. long rows on low beds spaced 5-ft apart with a 6-ft fallow area down each between plots. Varieties were replicated 4 times in a complete randomized block design. On 16 May Dual Magnum (12 oz/A) was applied and incorporated for weed control. On 25 Jun, Lorox (1 lb/A) was applied post emergence for weed control (nutsedge). On 31 Jul and 13 Aug, Guthion (1 gal/A) was applied for the insect control. Fungicide applications were made with a tractor mounted single stage air compressor pump delivering 51 gal/A at 60 psi. A 5-ft tractor mounted boom containing 3 hollow cone nozzles (D4-25, disc core) spaced with a long drop nozzle at each end of the boom and a short drop nozzle in the center. Fungicide applications were made on a 10-day schedule or according to Tom-Cast forecasting system. Applications began on 21 Jul and a total of 7 applications were made on the 10-day schedule (21 Jul; 12, 22 Aug; 2, 11, 24 Sep; 6 Oct). Applications made according to the Tom-Cast system were initiated at 35 DSV on 21 Jul and designed to be repeated after the accumulation of 15 Disease Severity Values (DSVs) from the last fungicide application for a total of 6 applications [21 Jul (35 DSV); 12 Aug (40 DSV); 20 Aug (17 DSV); 2 Sep (20 DSV); 11 Sep (15 DSV); 24 Sep (18 DSV)]. Weather data was collected by a WatchDog data logger (Spectrum Technologies, Inc. Plainfield, IL) positioned in the middle of the field at a 45 degree angle in the row at canopy height. Rainfall was 3.25 in. in May, 6.19 in. in Jun, 4.72 in. in Jul, 4.69 in. in Aug, and 4.73 in. in Sep (rainfall for Oct and Nov not available). Supplemental overhead irrigation was applied as needed. Plots were evaluated visually for the percentage of leaf blights on 24 Jul, 29 Aug, and 18 Sep. On 3 Nov, all of the foliage was removed from all of the plants in each plot leaving no petiole tissue on the carrots. On 4 Nov, the soil in each plot was loosened using a "V-ripper" that had a shank positioned between each row and on the outside of each plot. On 4 Nov, carrots were manually harvested and weighed for yield determinations.

The primary purpose of this experiment was to compare the efficacy of a Bravo only program with a Bravo alternation program applied to carrot varieties of differing leaf blight susceptibilities ('Fontana' – susceptible; 'Bolero' – resistant) according to different application schedules. Cabrio, recently labeled for use on carrots, was evaluated at two rates in alternation with Bravo on a 10-day schedule only on 'Fontana'. The growing season was unusually cool. Long periods of leaf wetness led to the

development of foliar blight in early July, and disease progressed steadily throughout the summer. At the end of July, no differences were detected between the untreated check and those plots treated with fungicides for either variety. However, 'Bolero' did have significantly less foliar blight than 'Fontana', and this trend continued throughout the season. By late August, Bravo alternated with either Quadris or Cabrio provided better foliar disease control than Bravo alone for 'Fontana'. In addition, there was no advantage to using the higher rate (16 oz./A) of Cabrio. For 'Bolero', all fungicide treatments were effective in controlling foliar diseases. By mid-September, all fungicide treatments on 'Fontana' had significantly less foliar blight than the untreated check. Bravo alternations provided better control than Bravo alone. Alternating Bravo with a higher rate of Cabrio provided only slightly better control than alternating with Quadris; however, this rate is not currently labeled for carrot applications. On 'Bolero', Bravo alternated with Quadris resulted in less foliar blight than Bravo alone applied according to Tom-Cast, which was not significantly different from the untreated check. Upon examination of the area under the disease progress curve (AUDPC) for 'Fontana', Bravo alternations provided significantly better control of foliar blights than Bravo alone which was not significantly better than the untreated check. Conversely, on 'Bolero' no significant differences existed between treatments; but, with the exception of Bravo alone applied according to TOM-CAST, all were more effective in controlling disease than the untreated check. The use of the TOM-CAST forecasting system reduced the number of fungicide applications from 7 to 5 as compared to the standard 10-day program. Use of the Bravo/Quadris TOM-CAST program reduced the total amount of fungicide (a.i.) used by 52% as compared to the standard Bravo 10-day program (Table 1). All 'Fontana' Bravo alternations resulted in higher yield than Bravo alone or the 'Fontana' untreated check. None of the 'Bolero' fungicide treatments provided significantly greater yields than the 'Bolero' untreated check. The numerically highest net value yields in this test were obtained by the Bravo/Cabrio 10-day program and the Bravo/Quadris TOM-CAST program on 'Fontana' (Table 3).

Table 1. Description of treatments for the integration of varietal resistance, fungicide treatment, and application schedule.

Treatment	Rate/A		Total pounds of a.i. used
	Formulated product	Activeingredient (lb)	
'Fontana'			
Untreated Check	-	-	-
Bravo Ultrex 82.5WDG[1] (10d)	1.4 lb	1.16	8.12
Bravo Ultrex 82.5WDG[4] (TC)	1.4 lb	1.16	5.80
Bravo Ultrex 82.5WDG[2]	1.4 lb	1.16	4.64
Quadris 2.1F[3] (10d)	9.2 fl.oz.	0.15	0.45
Bravo Ultrex 82.5WDG[5]	1.4 lb	1.16	3.48
Quadris 2.1F[6] (TC)	9.2 fl.oz.	0.15	0.45

Bravo Ultrex 82.5WDG[2]	1.4 lb	1.16	4.64
Cabrio 20EG[3] (10d)	0.5 lb	0.1	0.30
Bravo Ultrex 82.5WDG[2]	1.4 lb	1.16	4.64
Cabrio 20EG[3] (10d)	1.0 lb	0.2	0.60
'Bolero'			
Untreated Check	-	-	-
Bravo Ultrex 82.5WDG[1] (10d)	1.4 lb	1.16	8.12
Bravo Ultrex 82.5WDG[4] (TC)	1.4 lb	1.16	5.80
Bravo Ultrex 82.5WDG[2]	1.4 lb	1.16	4.64
Quadris 2.1F[3] (10d)	9.2 fl.oz.	0.15	0.45
Bravo Ultrex 82.5WDG[5]	1.4 lb	1.16	3.48
Quadris 2.1F[6] (TC)	9.2 fl.oz.	0.15	0.45

[1]Application dates: 21 Jul; 12, 22 Aug; 2, 11, 24 Sep; 6 Oct
[2]Application dates: 21 Jul; 22 Aug; 11 Sep; 6 Oct
[3]Application dates: 12 Aug; 2, 24 Sep
[4]Application dates: 21 Jul; 12, 20 Aug; 11, 24 Sep
[5]Application dates: 21 Jul; 20 Aug; 11 Sep
[6]Application dates: 12 Aug; 2, 24 Sep

Table 2. Effect of the integration of varietal resistance, fungicide treatment, and spray schedule on Alternaria and Cercospora leaf blights.

	Leaf Blight Rating[1]			
Treatment	**24 Jul**	**29 Aug**	**18 Sep**	**AUDPC[2]**
'Fontana'				
Untreated Check	18.8ab	40.5a	53.8a	1005.3a
Bravo Ultrex 82.5WDG (10d)	21.1a	37.7a	44.9b	942.3a
Bravo Ultrex 82.5WDG (TC)	17.0a-c	39.8a	45.8b	939.1a
Bravo Ultrex 82.5WDG Quadris 2.1F (10d)	17.7ab	28.1b	28.8cd	696.4b
Bravo Ultrex 82.5WDG Quadris 2.1F (TC)	12.7a-d	33.1ab	27.3c-e	714.6b
Bravo Ultrex 82.5WDG Cabrio 20EG[3] (10d)	17.9ab	25.4bc	29.8c	665.2b
Bravo Ultrex 82.5WDG Cabrio 20EG[4] (10d)	17.4ab	28.2b	21.3e-g	657.3b
'Bolero'				
Untreated Check	10.7b-d	26.4bc	32.9c	629.3bc
Bravo Ultrex 82.5WDG (10d)	7.4d	18.2cd	21.7d-g	429.3d
Bravo Ultrex 82.5WDG (TC)	7.5cd	19.5cd	26.4c-f	472.5cd
Bravo Ultrex 82.5WDG Quadris 2.1F (10d)	7.8cd	16.3d	18.1g	390.1d
Bravo Ultrex 82.5WDG	11.8a-d	13.8d	19.2fg	396.0d

Quadris 2.1F (TC)				
LSD (P>0.05)	9.6	8.3	7.3	166.3

[1] Severity of leaf blight symptoms were rated on a scale of 1-100 (none-severe) by visually examining the entire plot. No attempt was made to evaluate symptoms of Alternaria and Cercospora blights separately. Data was arc sine transformed for statistical analyses. Actual disease assessments are reported with statistical separations based on statistical analyses of arc sine transformations.

[2] AUDPC = Area under the disease progress curve. Data for each assessment date were plotted on a graph and the area under the line was calculated for each variety providing a measure of the severity of disease throughout the season.

[3] 8 oz./A rate of Cabrio 20EG

[4] 16 oz./A rate of Cabrio 20EG

Table 3. Effect of the integration of varietal resistance, fungicide treatment, and spray schedule on yield and value.

Treatment	Total Yield (Tons/A)	Gross value of	Fungicide Cost ($) [2]	Net Yield ($) [3]
'Fontana'				
Untreated Check	11.7c	1053	--	1053.00
Bravo Ultrex 82.5WDG	12.2c	1098	59.78	1038.22
(10d)	11.3c	1017	42.70	974.30
Bravo Ultrex 82.5WDG				
(TC)	19.7a-c	1773	90.19	1682.81
Bravo Ultrex 82.5WDG				
Quadris 2.1F (10d)	22.8ab	2052	81.65	1970.35
Bravo Ultrex 82.5WDG				
Quadris 2.1F (TC)	26.0a	2340	70.16	2269.84
Bravo Ultrex 82.5WDG				
Cabrio 20EG (10d)	20.2a-c	1818	106.16	1711.84
Bravo Ultrex 82.5WDG				

Cabrio 20EG (10d)	19.1a-c	1719	--	1719
'Bolero'	23.0ab	2070	59.78	2010.22
Untreated Check	14.8bc	1332	42.70	1289.30
Bravo Ultrex 82.5WDG (10d)	12.1ab	1089	90.19	998.81
Bravo Ultrex 82.5WDG (TC)	24.0ab	2160	81.65	2078.35
Bravo Ultrex 82.5WDG Quadris 2.1F (10d)				
Bravo Ultrex 82.5WDG Quadris 2.1F (TC)				

[1] Price per ton estimated at $90.00

[2] Current market price of fungicide multiplied by the number of applications per season (Bravo Ultrex 82.5WDG - $6.10/lb; Quadris 2.1F - $2.03/fl. oz; Cabrio 20EG – $24.00/lb)

[3] Gross value of yield minus fungicide costs = net yield