Carrot (*Daucus carota)*
Leaf Blights; *Alternaria dauci*
Cercospora carotae

S.A. Johnston & M.D. Zimmerman
Rutgers Agricultural Research &
Extension Center, Bridgeton, NJ 08302

EVALUATION OF THE INTEGRATION OF VARIETAL RESISTANCE, FUNGICIDE TREATMENT AND SPRAY SCHEDULE ON LEAF BLIGHTS OF PROCESSING CARROTS, 2002: The experiment was conducted in a field (Aura sandy loam, pH-6.6) on the Rutgers Agricultural Research & Extension Center, Bridgeton, NJ. On 23 Apr fertilizer (40 lb/A of N-P-K) was applied and incorporated. On 7 May, Treflan 4E (1 pt/A) was applied preplant incorporated for weed control. On 8 May, carrots were seeded into the field with a Planet Jr. seeder. In order to achieve similar plant populations, 'Fontana' plots were seeded at setting 4; whereas, 'Bolero' plots were seeded at setting 5 on the seeder. Plots consisted of 2, 15-ft-long rows on low beds spaced 5-ft apart with 5-ft fallow breaks down the row. There were 2 buffer rows on each side of the treated rows. Treatments were replicated 4 times in a randomized complete block design. On 12, 20 Jun and 1, 11, 19, 26 Jul, Lorox 50DF (1 lb/A) was applied post emergence for weed control. Fungicide treatments were applied with a tractor-drawn boom sprayer that had a 5-ft wide boom containing 3 hollow cone nozzles (D4-25, disc core) spaced with a drop nozzle at each end of the boom and a nozzle over the center of the bed. The sprayer delivered 48 gal/A at 60 psi. Fungicide applications were made on either a 10-day schedule or according to the TOM-CAST forecasting system. Applications began on 8 Jul and a total of 10 applications (8, 18, 29 Jul, 9, 19, 29, Aug, 9, 19, 30 Sep, and 9 Oct) were made for the 10-day schedule. Applications made according to TOM-CAST were initiated on 8 Jul and designed to be repeated after the accumulation of 15 DSV (disease severity values) from the last fungicide application for a total of 7 applications [8, 19 (17 DSV), 29 (17 DSV) Jul, 19 (18 DSV), 30 (17 DSV) Aug, 14 (16 DSV) Sep, and 7 (24 DSV) Oct]. 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 3.4 in. in Apr, 3.8 in. in May, 6.1 in. in Jun, 2.0 in. in Jul, 2.9 in. in Aug, 2.5 in. in Sep and 5.8 in. in Oct. Supplemental overhead irrigation was applied as needed. On 8 Jul, 7, 25 Sep, and 22 Oct plots were visually evaluated for the percentage of foliage infected with leaf blights. On 7 Nov, all of the foliage was removed from the plants leaving no petiole tissue on the carrots. On 8 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 8 Nov carrots were manually harvested and weighed for yield determination.

The growing season was unusually hot and dry. Leaf blights began to develop in the field in early July; however, an extended dry period ensued until mid-September resulting in low level of spread of leaf blights in the field. Both rates of Cabrio provided excellent control of leaf blights as evidenced by the leaf blight rating at the end of October and the low area under the disease progress curve (AUDPC; Table 2). Cabrio was not registered for use on carrots at the time of the experiment, and is now labeled for use on carrots. The use pattern for Cabrio will be similar to Quadris, and will be alternated with Bravo rather than a straight Cabrio season long program as followed in this experiment. Since Cabrio was not evaluated in a schedule that will be used commercially, it will no longer be discussed in the results of this experiment. The primary purpose of this experiment was to compare the efficacy of a Bravo alone program with a Bravo/Quadris program applied to two carrot varieties of different leaf blight susceptibility

('Fontana' – susceptible; 'Bolero' – resistant) and different application schedules. The use of the TOM-CAST forecast system reduced the number of fungicide applications from 10 to 7 compared to the standard 10-day program (Table 1). With 'Fontana', only the Bravo/Quadris alternation programs provided a significant reduction in the AUDPC compare to the untreated check (Table 2). Whereas, with 'Bolero', all of the fungicide treatments resulted in a significant reduction in the AUDPC compared to the untreated check. While there were no significant differences in the AUDPC for the straight Bravo program or the Bravo/Quadris program between the 10-day schedule versus the TOM-CAST program, at the 22 Oct evaluation, the TOM-CAST program resulted in more severe blight than the 10-day program, except for the TOM-CAST program where Bravo was alternated with Quadris on 'Bolero'. Using the Bravo/Quadris TOM-CAST program compared to the straight Bravo program reduced the season total amount of active ingredient of fungicide by 56% (Table 1). All of the treatments in the experiment resulted in significantly greater total yield than the 'Fontana' untreated check including the 'Bolero' untreated check. None of the 'Bolero' fungicide treatments provided significantly greater total yield than the 'Bolero' untreated check. The numerically highest net value yields in this test were obtained by the Bravo/Quadris TOM-CAST and 10-day treatments with 'Fontana' (Table 3).

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

#	Treatment	Rate/A		Schedule summary (Application dates: 1=7/8, 2=7/18, 3=7/19, 4=7/29,5=7/30, 6=8/9,7=8/19,8= 8/29,9=8/30, 10=9/9, 11=9/14,12= 9/19,13= 9/30,14=10/7, 15=10/9; 10D; alt 10D; TC; alt TC)[1]	Total active ingredient (ai) used during season (lb/A)
		Formulated product	a.i. (lb)		
	cv. 'Fontana'				
1	Untreated check	-	-	-	0
2	Bravo Ultrex 82.5WDG	1.4 lb	1.16	10D: 1,2,4,6,7,8,10,12,13,15	11.6
3	Bravo Ultrex 82.5WDG	1.4 lb	1.16	TC: 1,3,5,7,9,11,14	8.1
4	Bravo Ultrex 82.5WDG	1.4 lb	1.16	alt 10D: 1,4, 7, 10, 13	
	Quadris 2.1F	9.2 fl.oz.	0.15	alt 10D: 2,6,8,12,15	6.6
5	Bravo Ultrex 82.5WDG	1.4 lb	1.16	alt TC: 1,5,9,14	
	Quadris 2.1F	9.2 fl.oz.	0.15	alt TC: 3,7,11	5.1
6	Cabrio 20EG	0.5 lb	0.1	10D: 1,2,4,6,7,8,10,12,13,15	1.0
7	Cabrio 20EG	1.0 lb	0.2	10D: 1,2,4,6,7,8,10,12,13,15	2.0
	cv. 'Bolero'				
8	Untreated check	-	-	-	0
9	Bravo Ultrex 82.5WDG	1.4 lb	1.16	10D: 1,2,4,6,7,8,10,12,13,15	11.6
10	Bravo Ultrex 82.5WDG	1.4 lb	1.16	TC: 1,3,5,7,9,11,14	8.1
11	Bravo Ultrex 82.5WDG	1.4 lb	1.16	alt 10D: 1,4, 7, 10, 13	
	Quadris 2.1F	9.2 fl.oz.	0.15	alt 10D: 2,6,8,12,15	6.6
12	Bravo Ultrex 82.5WDG	1.4 lb	1.16	alt TC: 1,5,9,14	
	Quadris 2.1F	9.2 fl.oz.	0.15	alt TC: 3,7,11	5.1

[1]10D = application on a 10-day schedule; alt 10D = fungicide treatments alternated on a 10-day schedule; TC = applications made according to the TOM-CAST disease forecasting system (scheduled 15 DSVs between applications); alt TC = applications made according to the TOM-CAST disease forecasting system (scheduled 15 DSVs between applications), and fungicide treatments alternated.

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

Treatment number	Leaf blight rating[1]				AUDPC[2]
	7/8	9/7	9/25	10/22	
'Fontana'					
1	4.5a	48.8a	72.5a	40.0cd	1411a
2	2.0b	45.0ab	62.5b	42.5cd	1272ab
3	3.2ab	47.5a	62.5b	53.8ab	1369a
4	3.5ab	37.5bc	52.5bc	41.2cd	1108b
5	3.8ab	35.0c	50.0cd	55.0a	1121b
6	2.5ab	31.2cd	40.0de	21.2e	832c
7	2.2ab	25.0de	32.5c	22.5e	697c
'Bolero'					
8	2.8ab	46.2ab	56.2bc	50.0a-c	1283ab
9	2.5ab	18.8ef	37.5e	37.5d	722c
10	2.5ab	17.5ef	40.0de	56.2a	809c
11	3.2ab	12.5f	40.0de	31.2de	638c
12	3.2ab	15.0f	35.0e	35.0d	650c

[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 Arcsine transformed for statistical analyses. Actual disease assessments are reported with statistical separations based on arcsine transformed data analyses.

[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.

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

Treatment number	Total Yield (T/A)	Price/ton ($)	Gross value of yield ($)	Fungicide Cost[1] ($)	Net Yield[2] ($)
1	4.0f	90.0	360.0	--	360.0
2	10.6c-e	90.0	954.0	86.10	867.90
3	8.2de	90.0	738.0	60.27	677.73
4	13.2bc	90.0	1188.0	138.27	1049.73
5	11.3b-d	90.0	1017.0	91.57	925.43
6	16.7a	90.0	1503.0	--	--
7	14.6ab	90.0	1314.0	--	--
8	8.2de	90.0	738.0	--	738.0
9	8.0bc	90.0	720.0	86.10	633.90
10	7.8e	90.0	702.0	60.27	641.73
11	10.9c-e	90.0	981.0	138.27	842.73
12	10.4c-e	90.0	936.0	91.57	844.43
LSD(P≥0.05)	11.9	--	--	--	--

[1]value of fungicide times number of applications/season (Bravo Ultrex 82.5WDG-$6.15/lb; Quadris 2.1F-$2.07/fl.oz)

[2]Gross value of yield-fungicide cost=Net yield