

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

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Evaluation of fungicides to control carrot foliar blights – Hancock, 2001

A field trial was established at the Hancock Agricultural Research Station, in central Wisconsin to evaluate fungicide efficacy for control of *Alternaria* and *Cercospora* leaf blights. Seeds of cultivar Fontana were planted May 17, at approximately 12 seeds per foot, using standard commercial planting equipment. The experimental design was a randomized complete block with four replications. Each plot consisted of one, 6-foot-wide raised bed planted with three 18-foot-long rows. Soil type was a Plainfield loamy sand with pH 6.5. Soil test results showed fertility levels of P, Ca, Mg, S and Mn were adequate for carrot cropping and 0-0-61 fertilizer was broadcast at 250 lb/A on April 16, prior to planting. Additional nitrogen was applied through irrigation water as 28% UAN (July 25 and August 9, 30 lb/A; August 20, 40 lb/A). Foliar applications of Asana XL, 4 fl oz./A on June 21, and Sevin 50W, 0.5 lb/A on June 26, were made for insect control. Weeds were controlled with applications of Fusilade DX, 0.5 pt/A, June 20, Lorox DF, 0.66 lb/A, June 21; Lorox DF, 1.0 lb/A + Sencor, 0.10 lb/A on June 26; Poast, 1.5 lb/A, July 5; and Lorox DF, 0.25 lb/A + Poast, 1.5 lb/A, August 16. Fungicide treatments were applied with a tractor-mounted boom pressurized with an air compressor. Treatments were applied July 31, August 7, 14, 21, 28, and September 4 and 11 at a rate equivalent to 35 gal water/A at 40 psi, using Tee Jet D3-23 nozzles (8 nozzles at 8-inch spacing). Disease severity was rated on four 3-ft-long sections of the center row in each treatment plot, from August 8 to September 21 using the Horsfall-Barratt system. Two five-foot-long sections of row were hand dug from each plot on September 25 and the yield was graded by hand into five size classes (based on diameter) and culls. The size classes were then grouped appropriately to conform to standards for dicing carrots. Yield values were calculated for each treatment based on a typical processing contract. Rainfall recorded for this field (inches) was: May (7.20), June (4.10), July (2.73), August (4.57), September (4.59). An additional 11.82 inches of irrigation was applied May-September.

Disease development in this trial was limited through most of the growing season. Disease severity in the untreated control plots did not exceed 50% until the final rating on September 21. All chemical treatments controlled foliar disease to some extent. Using the relative AUDPC as a measure of season-long disease progress, Messenger and GibGro did not differ significantly from the untreated control and all programs containing Bravo, Quadris or one of the BAS materials provided significantly better control than Messenger. Programs containing Quadris or one of the BAS materials also provided significantly better control than GibGro. Foliar disease in the final rating was significantly less than the untreated control for all treatments except Messenger. Total yield for Messenger and GibGro, was significantly lower than any of the fungicide treatments or the untreated control. Only minor differences were observed in the size categories of the harvested roots. Use of newer chemistries, alone or alternated with chlorothalonil fungicide, greatly reduced the amount of chemical active ingredients (a.i.) applied in a season-long program, when compared with a standard program using weekly sprays of chlorothalonil alone. Treatment of foliage with BAS 516 and Quadris alternated with Bravo Ultrex, significantly increased the percentage of carrots over 2 inches in diameter. The gross value of yield for carrots treated with GibGro was significantly lower than the untreated control.

Table 1. Description of foliar fungicide treatments.

#	Treatment Chemicals	Rate/Acre		Schedule summary (Application dates: 1= 7/31, 2= 8/7, 3= 8/14, 4= 8/21, 5=8/28, 6= 9/4, 7= 9/11)	Total active ingredient (ai) used during season (lb/A)
		Formulated Product	(a.i.)		
1	Untreated Control				0
2	Bravo Ultrex 82.5 WDG	1.8 lb	1.49 lb	Weekly (Appl. 1-7)	10.4
3	BAS 516 38 WG	0.66 lb	0.25 lb	Appl. 1, 3, 5, 7	1.0
4	BAS 500 20 WG	0.75 lb	0.15 lb	Appl. 1, 3, 5, 7	0.6
5	BAS 510 70 WG	0.243 lb	0.17 lb	Appl. 1, 3, 5, 7	0.7
6	Quadris 2.08 SC	0.7669 pt	0.2 lb	Appl. 1,3,5,7	3.3
	Bravo Ultrex 82.5 WDG	1.0 lb	0.83 lb	Appl. 2,4,6	

#	Treatment Chemicals	Rate/Acre		Schedule summary (Application dates: 1= 7/31, 2= 8/7, 3= 8/14, 4= 8/21, 5=8/28, 6= 9/4, 7= 9/11)	Total active ingredient (ai) used during season (lb/A)
		Formulated Product	(a.i.)		
7	GibGro Gibberellic Acid (20%)	0.06 lb/A	0.012 lb	Appl. 1, 3, 5, 7	0.05
8	Messenger 3 WDG	9 oz	0.017 lb	Appl. 1, 3, 5, 7	0.07

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

Treatment number	Foliar disease severity (%; <i>Alternaria</i> and <i>Cercospora</i> leaf blight - combined) ¹					Relative AUDPC ²
	8/8	8/20	8/31	9/13	9/21	
1	1.5	4.0	12.3	31.2	62.5	0.178
2	1.2	3.4	7.3	9.1	20.5	0.071
3	1.6	3.5	6.1	7.0	16.4	0.060
4	1.2	3.2	6.1	6.4	15.2	0.056
5	0.9	2.9	4.5	7.9	14.6	0.054
6	0.4	2.8	5.0	7.6	18.2	0.056
7	1.8	4.8	12.1	21.7	33.2	0.131
8	1.0	3.1	13.7	23.6	43.7	0.144
Pr > F ³	<0.01	0.38	0.14	<0.01	<0.01	<0.01
LSD ³	0.6	NS	NS	11.7	22.1	0.062

- Severity of leaf blight symptoms was rated on a Horsfall-Barratt scale of 0 (no infection) to 11 (all foliage dead). No attempt was made to separate symptoms of *Alternaria* and *Cercospora* leaf blights. Ratings were converted to percentages.
- Relative area under the disease progress curve. % disease severity for each date was plotted on a graph and the area under the line was calculated for each treatment providing a measure of the relative severity of disease throughout the season. A disease rating of 100% for the entire season would produce a value of 1.0. All relative AUDPC values are expressed as the proportion of this value. Either decreased disease severity or later disease development will contribute to lower relative areas under the disease progress curve.
- Analysis of variance was performed on data, and Fisher's protected least significant difference (LSD) was calculated. NS = not significant at $P = 0.10$.

Table 3. Effect of foliar fungicide treatment on carrot yield and value.

Treatment number	Total yield (ton/A) ¹	Percentage of yield for carrot diameter (inches)						% culls	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/ton (\$)	Gross value of yield (\$)		
							1 1/4 - 2"		> 2"			Dis-cards	
1	29.3	0.4	5.5	30.5	37.2	23.8	2.6	67.8	23.8	8.5	17.1	460.1	
2	30.5	0.9	4.4	29.9	32.2	31.8	0.9	62.1	31.8	6.2	17.3	495.4	
3	29.7	0.3	4.4	19.9	35.1	38.0	2.4	54.9	38.0	7.1	17.1	471.8	
4	29.9	0.4	6.7	24.4	33.5	33.6	1.4	57.9	33.6	8.5	17.1	470.6	
5	30.3	0.1	4.4	23.1	41.7	25.4	5.3	64.8	25.4	9.8	17.1	468.0	
6	29.0	0.5	4.2	23.0	32.1	39.2	1.0	55.0	39.2	5.8	17.1	468.5	
7	23.4	0.9	12.1	37.9	28.7	18.7	1.9	66.5	18.7	14.9	17.1	341.4	
8	24.9	0.3	6.1	27.9	39.6	24.6	1.5	67.4	24.5	8.0	17.1	394.8	
Pr > F ³	0.02	0.34	<0.01	0.03	0.11	0.02	0.73	0.16	0.02	0.11	0.46	0.01	
LSD ³	4.53	NS	3.0	9.6	NS	12.2	NS	NS	12.2	NS	NS	81.16	

- A 10-foot section of row was hand dug in each plot and yield was converted to tons/A. Hand digging is likely to result in a higher apparent yield as fewer carrots are lost than when mechanically dug. 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 carrots. Yield samples were intended only to permit evaluation of quality and relative size distribution of carrots.
- Values are calculated based on a typical 2001 processing contract for **uncrowned carrots**. Minimum size accepted for dicing contract is 1-1/4 inch diameter; discard class includes culls and carrots below the minimum diameter. Dicing base price per ton is: >90.1% over 2" diameter - \$22.33; 80.1-90% > 2" - \$20.90; 70.1-80% > 2" - \$19.01; 60.1-70% > 2" - \$18.30; 50.1-60% > 2" - \$17.70; <50% > 2" - \$17.13. Price was calculated for each replicate plot. Values shown are means of four replicates.
- Analysis of variance was performed on data, and Fisher's protected least significant difference (LSD) was calculated. NS = not significant at $P = 0.10$.