

### **Evaluation of fungicides to control early blight of potato - Hancock, 2001**

“B” size Goldrush tubers were planted May 1, 2001 at the Hancock Agricultural Research Station in central WI to establish a field trial to compare early blight and late blight control and plant growth for Bravo Zn and Bravo Zn/Quadris treatment combinations. A randomized complete block design with four replications was used for the experiment, with each plot consisting of four 24-foot-long rows spaced 36 inches apart with tubers 15 inches apart in the row. Drive rows for pesticide application equipment were placed adjacent to plots to avoid soil compaction in treatment rows. The soil type was Plainfield loamy sand, pH 5.8. Fertilizer applied was: 0-0-60, 250 lb/A, broadcast April 16, before planting, 6-24-24, 600 lb/A, banded in the row at planting, sidedress applications on May 18 (21-0-0, 350 lb/A) and May 31 (34-0-0, 375 lb/A) and broadcast application May 31 of Cal-Sul, 500 lb/A. Insects were controlled with Admire 2F incorporated in the fertilizer at planting (16 fl oz./500 lb) and foliar application of Pounce 3.2 EC (4.0 fl oz./A) on August 3, Thiodan 3 EC (1.0 qt/A) + Spintor 2 SC (4.0 oz/A) on August 10. Lorox 50 W (1.0 lb/A) was applied May 15 for weed control. Fungicide treatments were applied to all four rows of each plot at weekly intervals from June 20 to August 22, according to treatment protocol, for a total of ten weeks. Treatments were applied at a rate equivalent to 35 gal water/A at 40 psi, using Tee Jet Hollow Disc Cone D3-23 nozzles (15 nozzles at 8-inch spacing) with a plot sprayer consisting of a tractor-mounted boom pressurized with an air compressor. Plots were not inoculated but relied on natural dispersal of both *Phytophthora infestans* and *Alternaria solani* for disease establishment (the *P. infestans* isolate was identified as US-8 in Dr. J. P. Helgeson's lab at the UW). Disease severity was rated weekly from June 19 through September 4 using the Horsfall-Barratt rating scale. Vines were killed with application of Diquat (1.0 qt/A) plus Peptoil (1.0 qt/A) on September 5. The two center rows of each plot (a total of 48 feet of row) were machine harvested and graded September 17-20. Tubers were graded into US#1, undersize, and cull categories and all potatoes in the US#1 category from each treatment plot were sorted using an optical size grader into six categories: < 4 oz., 4-6 oz., 6-10 oz., 10-13 oz., 13-16 oz. and >16 oz. Specific gravity was determined for a tuber sample from each plot and 25-40 pound samples from selected treatments were placed in storage. These will be evaluated for tuber decay, silver scurf and black scurf after several months in storage. Rainfall measured during the growing season (inches) was 7.2 - May; 4.1 - June; 2.73 - July; 4.57 - August and 3.52 - September (through the 16<sup>th</sup>). An additional 12.8 inches of water was applied as overhead sprinkler irrigation in 24 applications (June 14 - Sep 3).

Plots treated with either Bravo Zn or Quadris/Bravo Zn appeared identical in plant growth, height of plants and leaf color throughout the season. Disease pressure was light through July and early August. By August 20, however, 75% of the foliage in plots treated with Bravo Zn exhibited symptoms of early blight. Significantly more early blight was observed on Aug 13 and 20 in plots treated with Bravo Zn than in plots treated with Quadris alternated with Bravo Zn. At the end of the season, the AUDPC for treatment with Quadris/Bravo Zn was significantly lower than the AUDPC for the Bravo Zn program. While total yields in plots treated with Quadris/Bravo Zn were 35 cwt/A higher than in plots treated with Bravo Zn alone, the difference was not significant at the 10% level. Significantly higher yields of 4-6 oz tubers were harvested from plots treated with Bravo Zn and there were significantly more tubers in the 6-13oz range in plots treated with Quadris/Bravo Zn. The net value of yield for fresh market ranged from \$4,420.88 (Bravo Zn alone) to \$4,725.60 (Quadris alternated with Bravo Zn) while the net value for processing ranged from \$1,513.44 (Bravo Zn alone) to \$1,607.67 (Quadris alternated with Bravo Zn). While these calculated values were not significantly different, they do seem to reflect the benefit of incorporating Quadris into the overall spray program. While Quadris was applied in alternate weeks from row close to vine desiccation, there were no observed or quantifiable negative impacts on the crop growth, appearance or productivity. Only positive benefits were observed from Quadris use that included improved disease control and increased yield of larger tubers.

**Table 1. Effect of treatment on early blight severity (percent foliage infection).**

Treatment	Rate/Acre		Application Schedule <sup>1</sup>	Early Blight Severity (%) <sup>2</sup>												
	Product	AI		19 Jun	26 Jun	2 Jul	10 Jul	16 Jul	23 Jul	31 Jul	6 Aug	13 Aug	20 Aug	28 Aug	4 Sep	
65	Bravo Zn 4.17 F	2.13 pt	1.11 lb	weekly	0	0	0	0.7	0.7	1.8	3.9	10.8	48.6	75.4	87.1	92.4
66	Quadris 2.08 F	0.38 pt	0.1 lb	Appl 1												
	Bravo Zn 4.17 F	0.76 pt 2.13 pt	0.2 lb 1.11 lb	Appl 3,5,7,9 Appl 2, 4, 6,8	0	0.1	0.1	0.9	0.6	1.3	3.1	7.0	14.6	36.9	73.2	87.4
Pr > F <sup>3</sup>				---	0.39	0.39	0.64	0.79	0.22	0.41	0.38	<0.01	<0.01	0.15	0.20	
LSD <sup>3</sup>				---	NS	NS	NS	NS	NS	NS	NS	12.4	10.9	NS	NS	

- 1 Application dates: 1=Jun 20, 2=Jun 27, 3=Jul 3, 4= Jul 11, 5=Jul 18, 6= Jul 25, 7=Aug 1, 8=Aug 8, 9=Aug 15, 10=Aug 22
- 2 Severity rated on a Horsfall-Barratt scale of 0 (no infection) to 11 (all foliage and stems dead). Ratings were converted to percentages. No symptoms of late blight were observed in this trial.
- 3 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 2. Effect of fungicide treatment on relative area under the disease progress curve, yield, proportion of US#1, undersize and cull potatoes and specific gravity of US#1 potatoes (Treatment numbers as listed in Table 1).**

Trt no.	Relative AUDPC Early Blight <sup>1</sup>	Yield								Specific Gravity
		TOTAL cwt/A	US#1		Undersize <sup>2</sup>		Culls			
			cwt/A	%	cwt/A	%	cwt/A	%		
65	0.196	496.4	340.9	68.7	62.7	12.6	92.8	18.7	1.059	
66	0.109	531.6	361.5	68.1	61.1	11.3	109.0	20.6	1.064	
Pr > F <sup>3</sup>		< 0.01	0.20	0.41	0.88	0.90	0.45	0.37	0.58	0.16
LSD <sup>3</sup>		0.022	NS	NS	NS	NS	NS	NS	NS	NS

1. Relative area under the disease progress curve. Data for each observation date were 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% foliage infection 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 AUDPC. Early blight AUDPC was calculated from Jun 19 - Aug 28.
2. Undersize indicates potatoes < 1 7/8" in diameter.
3. 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 fungicide treatment on size grades of US#1 potatoes (Treatment numbers as listed in Table 1).**

Trt no.	No. of Rotted tubers <sup>1</sup>	Size Grades of US # 1 Potatoes - %							
		< 4 oz.	4-6 oz.	6-10 oz.	10-13 oz.	6-13 oz.	13-16 oz.	> 16 oz.	
65	1.8	10.2	28.9	41.6	9.3	50.8	6.0	4.1	
66	1.3	9.9	23.9	40.6	13.3	53.9	10.7	1.6	
Pr > F <sup>2</sup>		0.50	0.88	0.05	0.65	0.12	0.10	0.11	0.19
LSD <sup>2</sup>		NS	NS	4.8	NS	NS	4.1*	NS	NS

1. The average number of tubers per treatment with any kind of rot observed during grading.
2. Analysis of variance was performed on data, and Fisher's protected least significant difference (LSD) was calculated. 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. Effect of experimental treatment on value per acre of Russet Burbank tubers. (Trt # as listed in Table 1)**

Trt Number	Cost of Chemicals /Acre <sup>1</sup>	Gross Value of Yield (\$/A)		Net Value of Yield (\$/A) <sup>4</sup>		
		Fresh Market <sup>2</sup>	Processing <sup>3</sup>	Fresh Market <sup>2</sup>	Processing <sup>3</sup>	
65	80.33	4501.20	1593.76	4420.88	1513.44	
66	149.19	4874.79	1756.86	4725.60	1607.67	
Pr > F <sup>5</sup>		---	0.18	0.25	0.26	0.47
LSD <sup>5</sup>		---	NS	NS	NS	NS

- 1 2001 Season-long cost of chemicals/Acre (rate, number of applications and retail cost are included in calculation). Retail prices used: Bravo Zn 4.17F - \$ 30.25/gal; Quadris 2.08 F - \$ 255/gal
- 2 Typical 2001 fresh market pricing: 4-6 oz. \$11.50/cwt, 6-10 oz. \$14/cwt, 10-13 oz. \$15.5, >13 oz. \$15, < 4 oz. and culls \$2/cwt.
- 3 Typical 2001 processing contract pricing: Base price is \$4.77/cwt for 69% US#1 (4 oz. minimum) with specific gravity of 1.078. A premium is paid for > 18% 10 oz. or greater. For each 1% > 18% (max.= 32%) > 10 oz. the price increases \$0.03/cwt. The price decreases \$0.03/cwt for each 1% below 19% to 10%. A decrease of \$0.05 for each 1% of potatoes below 10% 10 oz. There is an increase or decrease in price per hundred weight depending on specific gravity: >1.085 + \$.17; 1.084 + \$.14; 1.083 + \$.11; 1.082 + \$.08; 1.081 + \$.06; 1.080 + \$.04; 1.079 + \$.02; 1.078 .00; 1.077 -\$0.02; 1.076 -\$0.04; 1.075 -\$0.06; 1.074 -.08; 1.073 -\$0.10; 1.072 -\$0.12; ≤ 1.071 -.50. There is a payment of \$2.00/cwt for processing culls (up to a maximum of 15% of the total by weight).
- 4 Gross value minus cost of chemicals applied. This trial was intended to compare treatment with Quadris/Bravo vs. Bravo alone. There was no untreated control hence data comparing value of the treatment vs. untreated are not included.
- 5 Analysis of variance was performed on data, and Fisher's protected least significant difference (LSD) was calculated. NS = not significant at  $P = 0.10$ . \* = differences between pairs of treatments were significant at  $P = 0.10$  (but not at  $P = 0.05$ ).