

# *Idaho Potato Commission*

## *Summary Report*



### White Mold – Early Blight Control in Western Russet Potato 08P-IPC-06 (2008)

Additional Sponsors: AgraQuest, Inc., BASF Corporation, Bayer CropScience, Syngenta Crop Protection

#### **Objectives:**

1. Determine the most economical control white mold.
2. Assess new white mold control products.
3. Evaluate early blight control with white mold products and timing.

#### **Results:**

##### White Mold (Table 2):

1. All Endura rates (even the early blight rate 2.5oz/a) and timings reduce white mold.
2. Omega control was similar to Endura.
3. One of the new Bayer experimental fungicides was better than either Omega or Endura for white mold.
4. The second Bayer experimental fungicide was similar to Omega and Endura for white mold control.
5. Serenade increased white mold symptoms.

##### Early Blight (Table 1):

1. All Endura rates (2.5, 4 and 5.5 oz/a) reduced early blight.
2. All Endura treatments applied twice at white mold timings provided season long control of early blight.
3. A single application of Endura (5.5 oz/a) reduced early blight but was not as effective as two applications at any rate (2.5, 4, or 5.5 oz/a).
4. Serenade increased early blight.
5. Omega did not control early blight (Omega is not labeled for early blight).

##### Control of early blight and white mold:

1. Increased total cwt/acre (Table 3: 30 cwt/a).
2. Decreased tubers less than 4 ounces (Table 5: 3-7%).
3. Increased total US #1 tubers (Table 6: 5-8%).
4. Increased net dollar return/acre (Table 6: \$200 for a processing contract and greater than \$700/a for a fresh pack contract).
5. Early blight and white mold control resulted in higher specific gravities (Table 7).

#### **Conclusions:**

Control of early blight was exceptional even when fungicides were applied at timing prescribed for white mild control. Both Endura and one of Bayer's new experimental fungicides gave excellent control of white mold and early blight with only two applications. As early blight and white mold were decreased, yield, grade and specific gravity were increased. This is impressive considering Western Russet is very susceptible to both diseases. Bayer's new fungicide will be a good weapon in the potato fungicide arsenal.

## Experimental Plot Data

### Protocol ID: 08P-IPC-06

Planting Date: May 2, 2008

Variety: Western Russet

Row Spacing: 34 inches

Plant Spacing: 14 inches

Plot Size: 11.33' (4 rows) × 34'

Irrigation Type: Wheel line sprinkler

Plot Design: Randomized Complete Block

Replications: Four

Irrigation Schedule: 60-70% field capacity

Location: Acequia, ID

Early Blight Evaluations: August 16 & 20

White Mild Evaluation: August 16

Harvest: September 10

Maintenance Pesticides: Tricor (0.7 lb/a), Establish (15 oz/a), Prowl H<sub>2</sub>O (1.5 pt/a) were applied on May 16 for weed control. Leverage (3.8 fl oz/a) was applied on July 3 for Colorado potato beetle and aphid control.

Fertility: 96 lb/acre N, 40 lb/acre P, and 280 lb/acre K broadcast on 14 April and then incorporated by the bedding operation on 15 April. A total of 200 units of N (Uran) was applied through the irrigation water throughout the growing season.

Soil Type: Sandy Loam (Tindahay sandy loam), 76:16:8 (sand:silt:clay), 0.8% O.M., pH 7.1, Bulk density = 1.41, CEC = 12.6

Application Data: Test products applied with Teejet flat fan 11002 nozzles (8 nozzles spaced 18 inches apart; boom positioned 20 inches above the canopy).

A = July 11 (13.3 GPA - sign of first trash on the ground)

B = July 26 (18.7 GPA - two weeks after first application)

### Treatments:

1. Untreated check
2. Endura, 2.5 oz/a + Rivet, 0.5 % v/v (AB)
3. Endura, 4.0 oz/a + Rivet, 0.5 % v/v (AB)
4. Endura, 5.5 oz/a + Rivet, 0.5 % v/v (AB)
5. Endura, 5.5 oz/a + Rivet, 0.5 % v/v (A)
6. Bayer experimental 1 (Bayer1), 11 oz/a (AB)
7. Bayer experimental 2 (Bayer2), 4 oz/a (AB)
8. Bayer experimental 2 (Bayer2), 5.6 oz/a (AB)
9. Omega, 6 oz/a (AB)
10. Serenade ASO, 1 gal/a (AB)

## DETAILED RESULTS AND DISCUSSION

### Early Blight (Table1)

Early blight was evaluated on August 16 and 20. The results of these two evaluations were similar. Disease severity was greater at the later evaluation as expected.

- 1- There were no significant differences observed between the 2.5, 4.0 and 5.5 oz/a Endura rates when Endura was applied twice.
- 2- A single application of Endura at 5.5 oz/a was less effective in controlling early blight compared to two applications at any rate.
- 3- Both Bayer experimental products controlled early blight similar to the two higher rates of Endura.
- 4- Omega was not effective in controlling early blight. This was expected since early blight control is not on the label.
- 5- Serenade increased the early blight severity even compared to the untreated check. The reason for this is not known.

### White Mold (Tables 1 and 2)

The number of white mold foci/68 row ft is our least accurate method for evaluation (Table 1). Based on this evaluation:

- 1- All treatments except Serenade significantly reduce white mold incidence.
- 2- All of the Endura treatments were equally effective.
- 3- Control with Bayer Exp 2 and Omega control was similar to Endura.
- 4- Bayer Exp 1 was the most effective treatment for white mold control.

The white mold severity index is our most sensitive and labor intense evaluation method. We first determine the percentage of the stems infected, the percentage of the plants with white mold, and the percentage of the plant affected by the disease (disease severity). The disease severity index is calculated by multiplying the percentage of the plants with white mold by the percentage of the plant affected by the disease (Table 2).

- 1- % plant of the plant infected
  - a. Serenade and the untreated check both had 100% of the plants infected.
  - b. Only Bayer Exp 1 and Endura at 5.5 oz/a applied twice significantly reduced the percentage of the plants showing white mold symptoms.
  - c. Bayer Exp1 was the most effective treatment in the study. It provided significantly better control than any other treatment.
- 2- % stem incidence
  - a. The Serenade treatment had significantly more stems infected compared to the untreated check.
  - b. The Bayer Exp 2 at 4 oz/a twice, Endura at 2.5 oz/a twice, and a single application of Endura at 5.5 oz/a treatments were not different than the untreated check.
  - c. Bayer Exp 2 at 5.6 oz/a twice was similar to Omega, Endura at 2.5 and 4 oz/a twice and a single application of Endura 5.5 oz/a
  - d. Endura at 5.5 oz/a and Bayer Exp 1 had the lowest % of infected stems.

- 3- Disease Severity
  - a. Serenade increased the severity of white mold compared to the untreated check.
  - b. All other treatments significantly reduced the severity of white mold.
  - c. Bayer Exp 1 was the most effective product for reducing the severity of the white mold in this study
- 4- White Mold Severity Index
  - a. Serenade increase the disease index compared to the untreated check.
  - b. Endura at 2.5 oz/a was not as effective as the two higher rates of Endura applied twice or Endura at 5.5 oz/a applied only one time..
  - c. Bayer Exp 1 at 11 oz/a provided the best white mold protection. It was even more effective than the standard of Endura 5.5 oz/a applied twice.

### **Yield (Table 3)**

Serenade and the untreated check had significantly lower yields than any of the other treatments. The remaining treatments (2-9) all produced a significant yield increase of 27-46 cwt/a.

### **Grade**

Table 4: There were no differences in individual US # 1 categories due to any treatment.

Table 5:

- a. Serenade was not different from the untreated check treatment.
- b. All other treatments decreased tubers less than 4 ounces (3-7%)

Table 6: Significant differences were observed when all categories of US #1 tuber were combined into a single category.

- a. Serenade and Bayer Exp 2 were the only treatments that were similar to the untreated check treatment.
- b. All Endura treatments, Bayer Exp 1, and Omega increased the total US #1 tubers
- c. All treatments other than Serenade produced a significant increased dollar return/acre.

### **Specific Gravity**

Treatments receiving Endura twice and the Bayer experimental treatments produced specific gravities higher than the untreated control (Table 7). These were the treatments with the most effective early blight control. As early blight severity increased yield and specific gravity decreased. The correlation between early blight severity was negative and significant (Table 8). Similar results were observed for white mold.

Table 1. Effect of fungicide programs (1 or 2 applications) on early blight severity and white mold incidence.

Description		% EB Severity Aug 16	% EB Severity Aug 20	# White mold hits Aug 16
Rating Date				
Trt Treatment*	Rate			
1 Untreated check		38 a	45 b	41 a
2 Endura (AB)	2.5 oz/a	1 d	9 cd	24 b
Rivet (AB)	0.5 % v/v			
3 Endura (AB)	4 oz/a	1 d	3 d	19 b
Rivet (AB)	0.5 % v/v			
4 Endura (AB)	5.5 oz/a	1 d	2 d	26 b
Rivet (AB)	0.5 % v/v			
5 Endura (A)	5.5 oz/a	7 c	25 c	24 b
Rivet (A)	0.5 % v/v			
6 Bayer Exp 1 (AB)	11 oz/a	1 d	0 d	9 c
7 Bayer Exp 2 (AB)	4 oz/a	1 d	1 d	25 b
8 Bayer Exp 2 (AB)	5.6 oz/a	1 d	1 d	20 b
9 Omega (AB)	6 oz/a	13 b	50 b	24 b
10 Serenade ASO (AB)	1 gal/a	43 a	75 a	45 a
LSD (P=.10)		0.2t	18.0	9.5
Standard Deviation		0.2t	9.8	7.9
CV		25.72	46.68	30.61
Grand Mean		0.73t	21.0	25.68
Treatment Prob(F)		<b>0.0001</b>	<b>0.0002</b>	<b>0.0001</b>

\*Application dates: A = July 11, B = July 26.

Means followed by same letter do not significantly differ (P=0.10, LSD).

t=Mean descriptions are reported in transformed data units ( $\log[x+1]$ ), and are not de-transformed. Back transformed data are listed in the columns.

Mean comparisons performed only when ANOVA Treatment Prob(F) is significant at the pre-determined mean comparison level (<0.10). Significant values are bolded.

Table 2. Effect of fungicide programs (1 or 2 applications) on white mold incidence and severity on August 20, 2008.

Description		% Stem Incidence	Disease Severity	% Plant Incidence	Disease Severity Index	
Trt	Treatment* Rate					
1	Untreated check	87 b	39 b	100 a	39 b	
2	Endura (AB) Rivet (AB)	2.5 oz/a 0.5 % v/v	74 bc	28 c	98 a	27 c
3	Endura (AB) Rivet (AB)	4 oz/a 0.5 % v/v	65 cd	27 c	93 ab	25 cd
4	Endura (AB) Rivet (AB)	5.5 oz/a 0.5 % v/v	56 de	21 c	83 b	17 d
5	Endura (A) Rivet (A)	5.5 oz/a 0.5 % v/v	78 bc	26 c	95 a	26 cd
6	Bayer Exp 1 (AB)	11 oz/a	43 e	10 d	70 c	8 e
7	Bayer Exp 2 (AB)	4 oz/a	78 bc	28 c	93 ab	26 c
8	Bayer Exp 2 (AB)	5.6 oz/a	69 cd	28 c	93 ab	27 c
9	Omega (AB)	6 oz/a	73 c	25 c	98 a	24 cd
10	Serenade ASO (AB)	1 gal/a	96 a	49 a	100 a	49 a
LSD (P=.10)		9.8t	7.9	11.1	8.5	
Standard Deviation		8.1t	6.5	9.2	7.1	
CV		13.79	23.37	10.01	26.51	
Grand Mean		58.92t	27.96	92.0	26.7	
Treatment Prob(F)		<b>0.0001</b>	<b>0.0001</b>	<b>0.0022</b>	<b>0.0001</b>	

\*Application dates: A = July 11, B = July 26.

Means followed by same letter do not significantly differ (P=0.10, LSD).

t=Mean descriptions are reported in transformed data units (arcsine [x/100]), and are not de-transformed. Back transformed data are listed in the columns.

Mean comparisons performed only when ANOVA Treatment Prob(F) is significant at the pre-determined mean comparison level (<0.10). Significant values are bolded.

Table 3. Effect of fungicide programs (1 or 2 applications) on tuber yield.

Description		Yield
Trt	Treatment*	Rate
		(cwt/acre)
1	Untreated check	348 c
2	Endura (AB)	2.5 oz/a
	Rivet (AB)	0.5 % v/v
3	Endura (AB)	4 oz/a
	Rivet (AB)	0.5 % v/v
4	Endura (AB)	5.5 oz/a
	Rivet (AB)	0.5 % v/v
5	Endura (A)	5.5 oz/a
	Rivet (A)	0.5 % v/v
6	Bayer Exp 1 (AB)	11 oz/a
7	Bayer Exp 2 (AB)	4 oz/a
8	Bayer Exp 2 (AB)	5.6 oz/a
9	Omega (AB)	6 oz/a
10	Serenade ASO (AB)	1 gal/a
LSD (P=.10)		24.8
Standard Deviation		20.6
CV		5.46
Grand Mean		376.3
Treatment Prob(F)		<b>0.0536</b>

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Table 4. Effect of fungicide programs on the percentage of US#1 tubers for processing grade categories.

Description		% 4-6 oz	% 6-10 oz	% 10-14 oz	% >14 oz	
Trt	Treatment* Rate					
1	Untreated check	17 a	29 a	22 a	11 a	
2	Endura (AB) Rivet (AB)	2.5 oz/a 0.5 % v/v	14 a	40 a	24 a	9 a
3	Endura (AB) Rivet (AB)	4 oz/a 0.5 % v/v	18 a	35 a	21 a	12 a
4	Endura (AB) Rivet (AB)	5.5 oz/a 0.5 % v/v	16 a	35 a	22 a	11 a
5	Endura (A) Rivet (A)	5.5 oz/a 0.5 % v/v	17 a	40 a	18 a	11 a
6	Bayer Exp 1 (AB)	11 oz/a	13 a	35 a	25 a	15 a
7	Bayer Exp 2 (AB)	4 oz/a	15 a	36 a	23 a	8 a
8	Bayer Exp 2 (AB)	5.6 oz/a	15 a	37 a	19 a	10 a
9	Omega (AB)	6 oz/a	19 a	36 a	23 a	9 a
10	Serenade ASO (AB)	1 gal/a	18 a	39 a	18 a	7 a
LSD (P=.10)		3.5	6.2	6.3	4.3	
Standard Deviation		2.9	5.2	5.2	3.6	
CV		17.9	14.2	24.17	35.45	
Grand Mean		16.28	36.28	21.6	10.15	
Treatment Prob(F)		0.1572	0.2073	0.4737	0.1296	

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Table 5. Effect of fungicide programs on the percentage of undersize (< 4 oz), culls, and US#2 tubers.

Description		% < 4 oz	% Culls	% 4-10 oz, US2	% >10 oz, US2
Trt	Treatment* Rate				
1	Untreated check	12 a	5 a	3 a	2 a
2	Endura (AB) Rivet (AB)	2.5 oz/a 0.5 % v/v	5 d 4 a	2 a	2 a
3	Endura (AB) Rivet (AB)	4 oz/a 0.5 % v/v	9 bc 3 a	1 a	1 a
4	Endura (AB) Rivet (AB)	5.5 oz/a 0.5 % v/v	8 bc 4 a	1 a	2 a
5	Endura (A) Rivet (A)	5.5 oz/a 0.5 % v/v	8 bc 4 a	1 a	1 a
6	Bayer Exp 1 (AB)	11 oz/a	7 cd	3 a	2 a
7	Bayer Exp 2 (AB)	4 oz/a	7 cd	5 a	1 a
8	Bayer Exp 2 (AB)	5.6 oz/a	8 bc	5 a	1 a
9	Omega (AB)	6 oz/a	9 bc	3 a	1 a
10	Serenade ASO (AB)	1 gal/a	10 ab	4 a	2 a
LSD (P=.10)		2.5	3.7	1.9	0.3t
Standard Deviation		2.1	3.0	1.6	0.3t
CV		25.77	77.19	99.94	68.88
Grand Mean		8.09	3.95	1.57	0.39t
Treatment Prob(F)		<b>0.0114</b>	0.9813	0.7162	0.2924

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Mean comparisons performed only when ANOVA Treatment Prob(F) is significant at the pre-determined mean comparison level (<0.10). Significant values are bolded.

Table 6. Effect of fungicide programs on the percentage of US#1 tubers, tubers over 10 oz, and gross economic return in dollars per acre for both processing and fresh pack contracts.

Description		% US #1 Tubers	% > 10 oz Tubers	Processing Return	Fresh Return
Trt Treatment*	Rate				
1 Untreated check		79.0 e	35 a	1784 c	4038 e
2 Endura (AB)	2.5 oz/a	87.2 ab	35 a	2136 ab	5656 ab
Rivet (AB)	0.5 % v/v				
3 Endura (AB)	4 oz/a	85.7 a-d	34 a	2060 ab	4780 cd
Rivet (AB)	0.5 % v/v				
4 Endura (AB)	5.5 oz/a	84.3 a-d	36 a	2112 ab	5172 bc
Rivet (AB)	0.5 % v/v				
5 Endura (A)	5.5 oz/a	85.7 a-d	30 a	2036 ab	5147 bc
Rivet (A)	0.5 % v/v				
6 Bayer Exp 1 (AB)	11 oz/a	88.2 a	41 a	2192 a	5786 a
7 Bayer Exp 2 (AB)	4 oz/a	82.4 b-e	35 a	2130 ab	5315 abc
8 Bayer Exp 2 (AB)	5.6 oz/a	81.6 de	33 a	2019 ab	5149 bc
9 Omega (AB)	6 oz/a	86.9 abc	32 a	2008 b	4948 c
10 Serenade ASO (AB)	1 gal/a	82.0 cde	26 a	1811 c	4352 de
LSD (P=.10)		5.08	7.5	175.6	595.8
Standard Deviation		4.22	6.2	145.8	494.8
CV		5.0	18.46	7.19	9.83
Grand Mean		84.28	33.85	2028.53	5034.37
Treatment Prob(F)		<b>0.0850</b>	0.1598	<b>0.0062</b>	<b>0.0008</b>

\*Application dates: A = July 11, B = July 26.

Means followed by same letter do not significantly differ (P=0.10, LSD).

Mean comparisons performed only when ANOVA Treatment Prob(F) is significant at the pre-determined mean comparison level (<0.10). Significant values are bolded.

Table 7. Effect of fungicide programs on tuber specific gravity.

Description		Specific Gravity	
Trt	Treatment* Rate		
1	Untreated check	1.085 c	
2	Endura (AB) Rivet (AB)	2.5 oz/a 0.5 % v/v	1.091 a
3	Endura (AB) Rivet (AB)	4 oz/a 0.5 % v/v	1.091 a
4	Endura (AB) Rivet (AB)	5.5 oz/a 0.5 % v/v	1.091 a
5	Endura (A) Rivet (A)	5.5 oz/a 0.5 % v/v	1.088 bc
6	Bayer Exp 1 (AB)	11 oz/a	1.090 ab
7	Bayer Exp 2 (AB)	4 oz/a	1.090 ab
8	Bayer Exp 2 (AB)	5.6 oz/a	1.089 ab
9	Omega (AB)	6 oz/a	1.086 c
10	Serenade ASO (AB)	1 gal/a	1.085 c
LSD (P=.10)		0.0026	
Standard Deviation		0.0022	
CV		0.2	
Grand Mean		1.09	
Treatment Prob(F)		<b>0.0008</b>	

\*Application dates: A = July 11, B = July 26.

Means followed by same letter do not significantly differ (P=0.10, LSD).

Mean comparisons performed only when ANOVA Treatment Prob(F) is significant at the pre-determined mean comparison level (<0.10). Significant values are bolded.

Table 8. Correlation between disease severity values, tuber yield, and specific gravity.

Description	% EB Severity	WM Severity	WM Index	Yield (cwt/acre)	% US #1 Tubers
r <sup>2</sup> Specific gravity	0.3375	0.2910	0.3245	0.2000	0.0290
r	-0.5810	-0.5394	-0.5697	0.4472	0.1702
Prob(r)	<b>0.0001</b>	<b>0.0003</b>	<b>0.0001</b>	<b>0.0038</b>	0.2937
r <sup>2</sup> % US#1 Tubers	0.1698	0.0683	0.0598	0.0554	
r	-0.4121	-0.2614	-0.2444	0.2355	
Prob(r)	<b>0.0082</b>	0.1033	0.1285	0.1436	
r <sup>2</sup> Yield	0.3601	0.1519	0.1362		
r	-0.6001	-0.3897	-0.3690		
Prob(r)	<b>0.0001</b>	<b>0.0129</b>	<b>0.0191</b>		
r <sup>2</sup> White mold index	0.3620	0.9883			
r	0.6017	0.9941			
Prob(r)	<b>0.0001</b>	<b>0.0001</b>			
r <sup>2</sup> WM Severity	0.3721				
r	0.6100				
Prob(r)	<b>0.0001</b>				

The r<sup>2</sup> value indicates the proportion of variability accounted for in the correlation. The closer the value is to 1, the more accurate the correlation. The r value indicates the nature of the correlation. Values close to 1 indicate positive correlation (as one value increases, so does the other) and values close to -1 indicate negative correlation (as one value increases, the other value decreases). The Prob(r) value indicates if the correlation is statistically significant. Values less than 0.10 are considered significant and are bolded.