Plant Pathology Research & Demonstration Progress Reports

Compiled by G.D. Franc and W.L. Stump
University of Wyoming Department of Plant Sciences

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2004 Plant Pathology Research and Demonstration Progress Reports

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Additional copies are available by telephone (307-766-2397), or by e-mail to: FrancG@uwyo.edu. This report will also be published during the spring of 2005 as MP101-05 and will be available online from the University of Wyoming Plant Sciences website at: www.uwyo.edu/ces/plantsci.htm.

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Research Project	**Management of Potato Foliar Diseases with Foliar Fungicide Programs, 2004**
Research Team Tel: 307-766-2397 FAX: 766-5549 francg@uwyo.edu	G.D. Franc and W.L. Stump University of Wyoming College of Agriculture- Plant Sciences, Dept 3354 1000 E. University Ave. Laramie, WY 82071
Field Plot Details	Torrington Research & Extension Center located at Torrington, WY 4104 MSL: sandy loam soil; overhead irrigation
Plot Design	Randomized complete block design with four replications; plots were four rows (36-in row centers) X 20 ft with 5 ft in-row buffer. All treatments were made to, and all data were collected from, the center two rows.
Plot Management	**Planting Date:** 11 May, 2004 **Variety:** FL1867 **Fertilizer:** 150 lb N + 50 lb P_2O_5 **Herbicide:** Matrix 75DF (1 oz product/A) + Prowl 3.3EC (1.5 pt product/A) early POST (irrigation incorporated) on 2 June, Sencor 75DF (4 oz product/A) POST on 23 June. **Insecticide:** Provado 1.6F (3.75 fl oz product/A) on 15 July; Asana (8 fl oz product/A) on 3 August for Colorado potato beetle.
Disease Development	On 14 July, a foliar application of *Alternaria solani* spores (2.7×10^3 infectious units/ml) was made to one border row of each plot in a total volume of 1.06 gal/1000 ft of row via a single-nozzle (8002 flat fan) equipped boom. Application of inoculum corresponded to when the first early blight lesions appeared in the general plot area, and culture-based recoveries from early blight lesions (ca. 1 cm diameter) collected 21 July from treatment plots (non-inoculated rows) yielded *A. solani*. Late blight was not detected during the growing season. Plants in the plot area began started to decline by 11 August and most foliage was dead by the end of August.
Treatment Applications	Treatments for foliar disease consisted of spray programs initiated on 14 July (prior to inoculation) and application dates are indicated in the Tables. Note that treatments 2 and 3 were on a 14-day application interval, while all other treatments were made at 7-day application intervals. Fungicide for all treatments was applied with the aid of a portable (CO_2) sprayer in a total volume of 43 gal/A at 30 psi boom pressure (four #8004 flat fan nozzles spaced at 20 inches).
Disease and other Treatment Evaluations	Early blight disease severity was measured by counting lesions on foliage and then calculating the average number of lesions per leaflet for leaves collected on 14, 21, 28 July, 4, 11, and 18 August. Six leaves were randomly selected from each treatment plot (two leaves each from the top, middle, and bottom third of the canopy) and the number of early blight lesions, on up to seven leaflets from each leaf were counted. Disease severity data from 14 July to 18 August were used to calculate an area under the disease progress curve (AUDPC) rating for each treatment program. The AUDPC is a

	measure of season long disease severity for each treatment. Additionally, plots were visually rated using the Horsfall-Barratt scale (0-11) to estimate the percentage of foliar necrosis (combined effects of disease and senescence) on 12, 16, and 25 August. A portion of the data is summarized in the Tables.
Harvest	Two rows by 10 ft were dug with a one-row mechanical digger on 20 September. Tubers were sorted and weighed to determine yield and grade on 21 September. All yield data are summarized in Table 2.
Statistical Analysis	ANOVA with four replications. Mean separations were done using Fisher's protected LSD ($P \leq 0.05$).

Results and Discussion

Early blight disease development was light to moderate in 2004. Disease resulted from both natural and introduced inoculum. The application of introduced inoculum coincided with the appearance of the first natural early blight lesions. The objective of inoculation was to provide increased disease pressure that coincided with the natural initiation of the "epidemic." However, unusually cool and moist weather conditions throughout the High Plains during July and August were not conducive to severe epidemic development. Although variously reported to have occurred in the region, late blight was not detected in the research plots nor was late blight found in any nearby fields. Phytotoxicity was not observed for any of the fungicide treatment programs.

General Fungicide Effects

Data collected on 4 August revealed that all fungicide treatments significantly reduced the average number of lesions per leaflet compared to the nontreated check (Table 1, $P \leq 0.05$). Most fungicide programs resulted in a lower AUDPC value compared to the nontreated check ($P \leq 0.05$). The exception was treatment 13, the two fungicide applications were made too late to effect total disease and thus resulted in an AUDPC value that did not differ from the nontreated check ($P = 0.05$). Addition of Endura to the fungicide program that included Headline and Dithane (treatment 3) significantly improved disease suppression compared to the Headline/Dithane program (treatment 2) that lacked Endura ($P \leq 0.05$). Also, treatment 3 was statistically equivalent to the best fungicide program (Quadris and Bravo Weather Stik in rotation: treatment 11) even though only three applications were made at two week intervals, as opposed to six applications for treatment 11 ($P \leq 0.05$). Chlorothalonil treatment formulations Echo Zn and Echo 825 provided disease suppression equivalent to that provided by Bravo Weather Stik ($P = 0.05$). Weak trends in the data revealed that Echo Zn may be marginally more suppressive than the other chlorothalonil formulations.

Treatment effects on potato yield and quality are shown in Table 2. Total yield and tuber quality was not affected by treatment ($P = 0.05$).

Table 1. Effects of foliar fungicide programs on potato early blight disease severity (G.D. Franc and W.L. Stump, Univ. of WY; 2004)

Treatment and rate (product/A)[1]	Application dates[2]	Early blight lesions per leaflet					AUDPC[3]	% necrosis
		21 Jul	28 Jul	4 Aug	11 Aug	18 Aug		16 Aug
1. Nontreated check	NA	0.00 a[4]	0.03 a	0.95 a	3.02 a	3.42 a	39.97 a	67.0 a
2. Headline 2.08EC (6 fl oz) + NIS (0.25 % v/v)	A	0.00 a	0.08 a	0.27 bcd	0.97 b	0.92 c	12.50 b	65.0 a
2. Dithane NT 75DF (2 lb)	C							
2. Headline 2.08EC (6 fl oz) + NIS (0.25 % v/v)	E							
2. Dithane NT 75DF (2 lb)	NA							
2. Headline 2.08EC (6 fl oz) + NIS (0.25 % v/v)	NA							
3. Endura 70WP (2.5 oz) + MSO (1% v/v)	A	0.00 a	0.00 a	0.01 d	0.17 cd	0.14 d	1.77 de	59.5 a
3. Headline 2.08EC (6 fl oz) + NIS (0.25 % v/v)	C							
3. Dithane NT 75DF (2 lb)	E							
3. Endura 70WP (2.5 oz) + MSO (1% v/v)	NA							
3. Headline 2.08EC (6 fl oz) + NIS (0.25 % v/v)	NA							
4. Tanos 50WG (2 oz) + Manzate 75DF (1.5 lb)	A, C, E	0.00 a	0.04 a	0.10 cd	0.26 cd	0.33 cd	3.92 cde	58.0 a
4. Manzate 75DF (2 lb)	B, D, F							
5. Tanos 50WG (4 oz) + Manzate 75DF (1.5 lb)	A, C, E	0.00 a	0.03 a	0.14 cd	0.16 cd	0.33 cd	3.41 cde	67.0 a
5. Manzate 75DF (2 lb)	B, D, F							
6. Tanos 50WG (6 oz) + Manzate 75DF (1.5 lb)	A, C, E	0.00 a	0.01 a	0.01 d	0.14 cd	0.18 d	1.71 de	48.0 a
6. Manzate 75DF (2 lb)	B, D, F							
7. Tanos 50WG (8 oz) + Manzate 75DF (1.5 lb)	A, C, E	0.00 a	0.05 a	0.07 d	0.33 cd	0.31 cd	4.25 cde	76.5 a
7. Manzate 75DF (2 lb)	B, D, F							
8. JE874 50WG (2 oz) + Manzate 75DF (1.5 lb)	A, C, E	0.01 a	0.01 a	0.09 cd	0.23 cd	0.30 cd	3.45 cde	56.0 a
8. Manzate 75DF (2 lb)	B, D, F							
9. Tanos 50WG (6 oz) + Manzate 75DF (1.5 lb)	A, C	0.00 a	0.02 a	0.08 d	0.25 cd	0.19 d	3.07 cde	50.0 a
9. Manzate 75DF (2 lb)	B, D							
9. Super Tin 80WP (2.5 oz) + Manzate 75DF (1.5 lb)	E, F							
10. Manzate 75DF (2 lb)	A-F	0.00 a	0.01 a	0.13 cd	0.65 bc	0.61 cd	7.58 bcd	56.0 a
11. Quadris 2.08SC (6.2 fl oz)	A, C, E							
11. Bravo Weather Stik 6F (1.5 pt)	B, D, F	0.00 a	0.01 a	0.00 d	0.01 d	0.03 d	0.25 e	56.0 a
12. Bravo Weather Stik 6F (1.5 pt)	A-F	0.01 a	0.01 a	0.07 d	0.46 bcd	0.55 cd	5.75 b-e	69.0 a

Treatment and rate (product/A)[1]	Application dates[2]	Early blight lesions per leaflet					AUDPC[3]	% necrosis
		21 Jul	28 Jul	4 Aug	11 Aug	18 Aug		16 Aug
13. Quadris 2.08SC (6.2 fl oz)	E							
13. Bravo Weather Stik 6F (1.5 pt)	F	0.01 a[4]	0.07 a	0.39 bc	3.04 a	2.70 b	33.98 a	59.5 a
14. Echo 825 82.5WG (1.36 lb)	A-F	0.00 a	0.01 a	0.16 bcd	0.45 bcd	0.48 cd	5.99 b-e	67.0 a
15. Echo ZN 4.17F (2.125 pt)	A-F	0.00 a	0.00 a	0.01 d	0.35 cd	0.43 cd	4.06 cde	65.0 a
16. Penncozeb 75DF (2 lb)	A-F	0.01 a	0.02 a	0.47 b	0.51 bcd	0.68 cd	9.40 bc	59.5 a

[1] The NIS (nonionic surfactant) used was X77 and the MSO (methylated seed oil) used was Destiny.

[2] The planting date was 11 May, 2004 with variety FL1867, and harvest was on 20 September. Fungicide application dates were: A= 14 Jul, B= 21 Jul, C= 28 Jul, D= 4 Aug, E= 11 Aug, F= 18 Aug, NA= not-applicable.

[3] Area under the disease progress curve for data collected from 14 Jul through 18 August.

[4] Treatment means followed by different letters differ significantly (Fisher's protected LSD, $P \leq 0.05$).

Table 2 Effects of foliar fungicide programs on potato yield and quality (G.D. Franc and W.L. Stump, Univ. of WY; 2004)

Treatment and rate (product/A)[1]	Application dates[2]	Potato yield (cwt/A)			
		US#1 (<10 oz)	Grade B	Culls	Total
1. Nontreated check	NA	183.1 a[3]	34.5 a	18.0 a	227.6 a
2. Headline 2.08EC (6 fl oz) + NIS (0.25 % v/v)	A	195.7 a	32.1 a	10.3 a	238.0 a
2. Dithane NT 75DF (2 lb)	C				
2. Headline 2.08EC (6 fl oz) + NIS (0.25 % v/v)	E				
2. Dithane NT 75DF (2 lb)	NA				
2. Headline 2.08EC (6 fl oz) + NIS (0.25 % v/v)	NA				
3. Endura 70WP (2.5 oz) + MSO (1% v/v)	A	208.4 a	33.9 a	11.1 a	253.4 a
3. Headline 2.08EC (6 fl oz) + NIS (0.25 % v/v)	C				
3. Dithane NT 75DF (2 lb)	E				
3. Endura 70WP (2.5 oz) + MSO (1% v/v)	NA				
3. Headline 2.08EC (6 fl oz) + NIS (0.25 % v/v)	NA				
4. Tanos 50WG (2 oz) + Manzate 75DF (1.5 lb)	A, C, E	187.4 a	26.0 a	16.8 a	230.1 a
4. Manzate 75DF (2 lb)	B, D, F				
5. Tanos 50WG (4 oz) + Manzate 75DF (1.5 lb)	A, C, E	183.1 a	41.6 a	8.4 a	233.1 a
5. Manzate 75DF (2 lb)	B, D, F				
6. Tanos 50WG (6 oz) + Manzate 75DF (1.5 lb)	A, C, E	200.2 a	40.7 a	6.4 a	247.2 a
6. Manzate 75DF (2 lb)	B, D, F				
7. Tanos 50WG (8 oz) + Manzate 75DF (1.5 lb)	A, C, E	169.0 a	38.5 a	5.8 a	213.3 a
7. Manzate 75DF (2 lb)	B, D, F				
8. JE874 50WG (2 oz) + Manzate 75DF (1.5 lb)	A, C, E	192.9 a	35.9 a	8.7 a	237.6 a
8. Manzate 75DF (2 lb)	B, D, F				
9. Tanos 50WG (6 oz) + Manzate 75DF (1.5 lb)	A, C	191.8 a	28.1 a	18.2 a	238.1 a
9. Manzate 75DF (2 lb)	B, D				
9. Super Tin 80WP (2.5 oz) + Manzate 75DF (1.5 lb)	E, F				
10. Manzate 75DF (2 lb)	A-F	190.9 a	34.8 a	15.0 a	240.8 a
11. Quadris 2.08SC (6.2 fl oz)	A, C, E				
11. Bravo Weather Stik 6F (1.5 pt)	B, D, F	184.9 a	31.6 a	16.5 a	233.0 a

Treatment and rate (product/A)[1]	Application dates[2]	US#1 (<10 oz)	Grade B	Culls	Total
		165.3 a[3]	33.2 a	6.7 a	205.3 a
13. Quadris 2.08SC (6.2 fl oz)	E				
13. Bravo Weather Stik 6F (1.5 pt)	F	186.4 a	31.6 a	15.3 a	233.3 a
14. Echo 825 82.5WG (1.36 lb)	A-F	187.1 a	30.9 a	9.3 a	227.4 a
15. Echo ZN 4.17F (2.125 pt)	A-F	171.7 a	33.4 a	10.0 a	215.1 a
16. Penncozeb 75DF (2 lb)	A-F	155.7 a	39.2 a	13.8 a	208.7 a

[1] The NIS (nonionic surfactant) used was X77 and the MSO (methylated seed oil) used was Destiny.

[2] The planting date was 11 May, 2004 with variety FL1867, and harvest was on 20 September. Fungicide application dates were: A= 14 Jul, B= 21 Jul, C= 28 Jul, D= 4 Aug, E= 11 Aug, F= 18 Aug, NA= not-applicable.

[3] Treatment means followed by different letters differ significantly (Fisher's protected LSD, $P \leq 0.05$).

Research Project	**Fungicide Timing for Early Blight Management; 2004**
Research Team Tel: 307-766-2397 FAX: 766-5549 francg@uwyo.edu	G.D. Franc and W.L. Stump University of Wyoming College of Agriculture- Plant Sciences, Dept 3354 1000 E. University Ave. Laramie, WY 82071
Field Plot Details	Torrington Research & Extension Center located at Torrington, WY 4104 MSL: sandy loam soil; overhead irrigation
Plot Design	Randomized complete block design with four replications; plots were four rows (36-in row centers) X 20 ft with 5 ft in-row buffer. All treatments were made to, and all data were collected from the center two rows.
Plot Management	**Planting Date:** 11 May, 2004 **Variety:** FL1867 **Fertilizer:** 150 lb N + 50 lb P_2O_5 **Herbicide:** Matrix 75DF (1 oz product/A) + Prowl (1.5 pt product/A) POST (irrigation incorporated) on 2 June, Sencor 75DF (4 oz product/A) POST on 23 June. **Insecticide:** Provado 1.6F (3.75 fl oz product/A) on 15 July; Asana (8 fl oz product/A) on 3 August for Colorado potato beetle.
Disease Development	On 14 July, a foliar application of *Alternaria solani* spores (2.7×10^3 infectious units/ml) was made to one border row of each plot in a total volume of 1.06 gal/1000 ft of row via a single-nozzle (8002 flat fan). Early blight lesions were first detected on 21 July. Plants in the plot area began a premature decline by 11 August. Most foliage was dead by the end of August.
Treatment Applications	Treatment timings for the single fungicide applications were originally set for; 3, 2, and 1 weeks **before** disease initiation, **at** disease initiation, and 1, 2, and 3 weeks **after** disease initiation. Additionally, there was an untreated check and a weekly fungicide program which began at 3 weeks before disease initiation and continued to season end. Disease initiation was considered to be the date lesions were first detected in the plots. Disease initiation for planning purposes was set for 14 July, based on historical data. Foliar treatment timings for foliar disease management began on 24 June. The weekly fungicide program (treatment 2) also began on 24 June. The revised treatment timings (based on 1st lesion appearance) and actual application dates are indicated in the Tables. Fungicides were applied with the aid of a portable (CO_2) sprayer in a total volume of 43 gal/A @ 30 psi boom pressure (four #8004 flat fan nozzles spaced @ 20 inches).
Disease and other Treatment Evaluations	Early blight disease severity was measured by calculating the average number of lesions per leaflet for leaves collected on 24, 30 June, 7, 14, 21, 28 July, 4, 11, and 18 August. Six leaves were randomly selected from each treatment plot (two leaves each from the top, middle, and bottom third of the canopy) and the number of early blight lesions, on up to seven leaflets from each leaf were counted. Disease severity data from 14 July to 18 August were used to calculate an area under the disease progress curve (AUDPC)

	rating for each treatment program. The AUDPC is a measure of season long disease severity for each treatment. Additionally, plots were visually rated using the Horsfall-Barratt scale (0-11) to estimate the percentage of foliar necrosis (combined effects of disease and senescence) on 12, 16, and 25 August. Only the 16 August data is shown.
Harvest	Two rows by 10 ft were dug with a one-row mechanical digger on 20 September. Tubers were sorted and weighed to determine yield and grade on 21 September. All yield data are summarized in Table 2.
Statistical Analysis	ANOVA with four replications. Mean separations were done using Fisher's protected LSD ($P \leq 0.05$).

Results and Discussion

Early blight disease development was light to moderate in 2004. Disease resulted from both natural and introduced inoculum and first lesions were detected on 21 July. This resulted in the actual fungicide timings being shifted backward one week. Phytotoxicity was not observed for any of the fungicide timings.

Effects of fungicide timings on disease are shown in Table 1. Quadris single application timings were on average almost five times more effective in reducing disease than the Bravo Weather Stik single application timings (linear contrast, $P<0.0001$). All of the Quadris single application timings except the last timing (+2 weeks), had equivalent disease suppression and were not significantly different from the weekly fungicide program ($P \leq 0.05$). The best disease reductions within the Bravo Weather Stik timings were the +1 week after time zero application ($P \leq 0.05$). Due to the advanced canopy decline, treatments had no effect on total crop necrosis on 16 August ($P=0.05$). Treatments had no significant effect on tuber yield and quality (Table 2, $P=0.05$).

Unfortunately the early blight epidemic was cut short as the crop began to decline due to other factors in late August. Because of this, meaningful comparisons between the various fungicide timings were difficult. However, under low to moderate disease pressure, the systemic fungicide Quadris was more forgiving in terms of timing when applied on the early side of the disease epidemic. However, if applied too late after the first detection of disease, resultant disease levels are frequently similar to that of the untreated check.

Table 1. Effects of fungicide timing on potato foliar disease (G.D. Franc and W.L. Stump, Univ. of WY; 2004)

Treatment and rate (ai/A)	Timing[1]	Application dates[2]	Early blight lesions per leaflet					AUDPC[3]	% necrosis
			21 Jul	28 Jul	4 Aug	11 Aug	18 Aug		16 Aug
1. Nontreated check		NA	0.00 a[4]	0.05 a	0.92 a	2.87 abc	2.60 bc	35.96 ab	78.0 a
2. Quadris/Bravo 5.5 SC premix (1.6 pt product) .. 2. Bravo Weather Stik 6F (1.25 pt)	-4 wk, full season	A, C, E, G, I B, D, F, H	0.00 a	0.00 a	0.01 e	0.00 f	0.02 f	0.11 g	65.0 a
3. Quadris 2.08 (0.2 lb)	-4 wk	A	0.01 a	0.00 a	0.03 e	0.21 ef	0.29 ef	2.70 fg	75.0 a
4. Quadris 2.08 (0.2 lb)	-3 wk	B	0.00 a	0.01 a	0.05 de	0.37 def	0.25 ef	3.87 fg	59.5 a
5. Quadris 2.08 (0.2 lb)	-2 wk	C	0.00 a	0.01 a	0.03 e	0.32 def	0.24 ef	3.42 fg	65.0 a
6. Quadris 2.08 (0.2 lb)	-1 wk	D	0.00 a	0.01 a	0.04 de	0.39 def	0.36 ef	4.31 fg	58.0 a
7. Quadris 2.08 (0.2 lb)	0	E	0.00 a	0.05 a	0.04 de	0.50 def	0.70 ef	6.66 efg	65.0 a
8. Quadris 2.08 (0.2 lb)	+1 wk	F	0.01 a	0.13 a	0.14 cde	0.14 ef	0.36 ef	4.25 fg	50.0 a
9. Quadris 2.08 (0.2 lb)	+2 wk	G	0.00 a	0.18 a	0.58 abc	1.08 d	1.12 de	16.79 de	69.0 a
10. Bravo Weather Stik 6F (1.5 pt)	-4 wk	A	0.00 a	0.01 a	0.47 bcd	3.03 ab	2.82 b	34.41 abc	56.0 a
11. Bravo Weather Stik 6F (1.5 pt)	-3 wk	B	0.00 a	0.01 a	0.41 cde	3.52 a	3.83 a	41.00 a	76.5 a
12. Bravo Weather Stik 6F (1.5 pt)	-2 wk	C	0.00 a	0.12 a	0.49 abc	2.37 bc	2.58 bc	29.89 bc	73.5 a
13. Bravo Weather Stik 6F (1.5 pt)	-1 wk	D	0.00 a	0.23 a	0.37 cde	2.00 c	1.88 cd	24.85 cd	56.0 a
14. Bravo Weather Stik 6F (1.5 pt)	0	E	0.01 a	0.01 a	0.31 cde	2.63 bc	2.76 bc	30.38 bc	58.0 a
15. Bravo Weather Stik 6F (1.5 pt)	+1 wk	F	0.00 a	0.12 a	0.25 cde	0.88 de	1.06 de	12.45 ef	78.0 a
16. Bravo Weather Stik 6F (1.5 pt)	+2 wk	G	0.00 a	0.01 a	0.87 ab	2.46 bc	2.09 bc	30.72 bc	73.5 a

[1] Treatment timings are in reference to disease initiation (0= first lesion detection on 21 Jul). A minus indicates weeks before disease initiation, a plus indicates weeks before disease initiation.

[2] The planting date was 11 May, 2004 with variety FL1867, and harvest was on 20 September. Fungicide application dates were: A= 24 Jun, B=1 Jul, C=8 Jul, D=14 Jul, E= 21 Jul, F= 28 Jul, G= 4 Aug, H= 11 Aug, I= 18 Aug, NA= not-applicable.

[3] Area under the disease progress curve for data collected from 14 July through 18 August.

[4] Treatment means followed by different letters differ significantly (Fisher's protected LSD, $P \leq 0.05$)

Table 2 Effects of fungicide timing on potato yield and quality (G.D. Franc and W.L. Stump, Univ. of WY; 2004)

Treatment and rate (product/A)	Timing[1]	Application dates[2]	Potato yield (cwt/A)			
			US#1 (<10 oz)	Grade B	Culls	Total
1. Nontreated check		NA	168.1 a[3]	34.5 a	2.9 a	205.5 a
2. Quadris/Bravo 5.5 SC premix (1.6 pt product) ... 2. Bravo Weather Stik 6F (1.25 pt)	-4 wk, full season	A, C, E, G, I B, D, F, H	188.9 a	41.9 a	7.0 a	237.9 a
3. Quadris 2.08 (0.2 lb)	-4 wk	A	169.3 a	33.0 a	7.5 a	209.9 a
4. Quadris 2.08 (0.2 lb)	-3 wk	B	188.0 a	29.8 a	6.5 a	224.3 a
5. Quadris 2.08 (0.2 lb)	-2 wk	C	171.0 a	42.7 a	7.4 a	221.1 a
6. Quadris 2.08 (0.2 lb)	-1 wk	D	197.3 a	34.3 a	5.0 a	236.6 a
7. Quadris 2.08 (0.2 lb)	0	E	186.0 a	41.2 a	6.0 a	233.2 a
8. Quadris 2.08 (0.2 lb)	+1 wk	F	166.6 a	36.3 a	4.5 a	207.5 a
9. Quadris 2.08 (0.2 lb)	+2 wk	G	168.3 a	32.5 a	7.1 a	207.8 a
10. Bravo Weather Stik 6F (1.5 pt)	-4 wk	A	186.4 a	37.6 a	6.5 a	230.5 a
11. Bravo Weather Stik 6F (1.5 pt)	-3 wk	B	161.1 a	35.8 a	8.5 a	205.5 a
12. Bravo Weather Stik 6F (1.5 pt)	-2 wk	C	165.9 a	40.5 a	7.5 a	213.9 a
13. Bravo Weather Stik 6F (1.5 pt)	-1 wk	D	169.2 a	40.1 a	7.9 a	217.2 a
14. Bravo Weather Stik 6F (1.5 pt)	0	E	191.7 a	41.9 a	5.6 a	239.2 a
15. Bravo Weather Stik 6F (1.5 pt)	+1 wk	F	165.7 a	35.8 a	4.8 a	206.3 a
16. Bravo Weather Stik 6F (1.5 pt)	+2 wk	G	162.6 a	34.3 a	6.1 a	203.0 a

[1] Treatment timings are in reference to disease initiation (0= first lesion detection on 21 Jul). A minus indicates weeks before disease initiation, a plus indicates weeks before disease initiation.

[2] The planting date was 11 May, 2004 with variety FL1867, and harvest was on 20 September. Fungicide application dates were: A= 14 Jul, B= 21 Jul, C= 28 Jul, D= 4 Aug, E= 11 Aug, F= 18 Aug, NA= not-applicable.

[3] Treatment means followed by different letters differ significantly (Fisher's protected LSD, $P \leq 0.05$).

Research Project	**Field Test of the DACOM Plant Service Forecast System for Early Blight and Late Blight Suppression, 2004**
Research Team Tel: 307-766-2397 FAX: 766-5549 francg@uwyo.edu	G.D. Franc and W.L. Stump University of Wyoming College of Agriculture- Plant Sciences, Dept 3354 1000 E. University Ave. Laramie, WY 82071
Field Plot Details	Torrington Research & Extension Center located at Torrington, WY 4104 MSL: sandy loam soil; overhead irrigation
Plot Design	Randomized complete block design with four replications; plots were four rows (36-in row centers) X 20 ft with 5 ft in-row buffer. All treatments were made to, and all data were collected from, the center two rows.
Plot Management	**Planting Date:** 11 May, 2004 **Variety:** FL1867 **Fertilizer:** 150 lb N + 50 lb P_2O_5 **Herbicide:** Matrix 75DF (1 oz product/A) + Prowl 3.3EC (1.5 pt product/A) early POST (irrigation incorporated) on 2 June, Sencor 75DF (4 oz product/A) POST on 23 June. **Insecticide:** Provado 1.6F (3.75 fl oz product/A) on 15 July; Asana (8 fl oz product/A) on 3 August for Colorado potato beetle.
Disease Development	On 14 July, a foliar application of *Alternaria solani* spores (2.7×10^3 infectious units/ml) was made to one border row of each plot in a total volume of 1.06 gal/1000 ft of row via a single-nozzle (8002 flat fan) equipped boom. Application of inoculum corresponded to when the first early blight lesions appeared in the general plot area, and culture-based recoveries from early blight lesions (ca. 1 cm diameter) collected 21 July from treatment plots (non-inoculated rows) yielded *A. solani*. Late blight was not detected during the growing season. Plants in the plot area began to decline by 11 August and most foliage was dead by the end of August.
Treatment Applications	Treatments for foliar disease consisted of spray programs initiated on 14 July (prior to inoculation) and application dates are indicated in the Tables. Note that treatments 2 and 3 were on a 14-day application interval, while all other treatments were made at 7-day application intervals. The DACOM system, a disease forecasting service based in the Netherlands, is being tested in North America and was included in the trial. Treatment 13 was intended to follow the DACOM forecast schedule for fungicide application timings and treatment 11 was the "grower standard" schedule. The DACOM grower standard schedule was initiated on 14 July and the DACOM forecast treatment was initiated on 11 August. Thus, all fungicide treatments also could serve as a grower standard for comparison to treatment 13. Fungicide for all treatments was applied with the aid of a portable (CO_2) sprayer in a total volume of 43 gal/A at 30 psi boom pressure (four #8004 flat fan nozzles spaced at 20 inches).
Disease and other Treatment	Early blight disease severity was measured by counting lesions on foliage and then calculating the average number of lesions per leaflet for leaves collected on 14, 21, 28 July, 4, 11, and 18 August. Six leaves were randomly

Evaluations	selected from each treatment plot (two leaves each from the top, middle, and bottom third of the canopy) and the number of early blight lesions, on up to seven leaflets from each leaf were counted. Disease severity data from 14 July to 18 August were used to calculate an area under the disease progress curve (AUDPC) rating for each treatment program. The AUDPC is a measure of season long disease severity for each treatment. Additionally, plots were visually rated using the Horsfall-Barratt scale (0-11) to estimate the percentage of foliar necrosis (combined effects of disease and senescence) on 12, 16, and 25 August. A portion of the data is summarized in the Tables.
Harvest	Two rows by 10 ft were dug with a one-row mechanical digger on 20 September. Tubers were sorted and weighed to determine yield and grade on 21 September. All yield data are summarized in Table 2.
Statistical Analysis	ANOVA with four replications. Mean separations were done using Fisher's protected LSD ($P \leq 0.05$).

Results and Discussion

Early blight disease development was light to moderate in 2004. Disease resulted from both natural and introduced inoculum. The application of introduced inoculum coincided with the appearance of the first natural early blight lesions. The objective of inoculation was to provide increased disease pressure that coincided with the natural initiation of the "epidemic." However, unusually cool and moist weather conditions throughout the High Plains during July and August were not conducive to severe epidemic development. Although variously reported to have occurred in the region, late blight was not detected in the research plots nor was late blight found in any nearby fields. Phytotoxicity was not observed for any of the fungicide treatment programs.

All fungicide programs except the DACOM forecast schedule (treatment 13) resulted in a lower AUDPC value compared to the nontreated check (Table1: $P \leq 0.05$). Effects on potato yield and quality were not affected by treatment ($P=0.05$).

The DACOM grower standard schedule was initiated on 14 July along with all other fungicide treatments. In contrast, the DACOM forecast schedule plots (treatment 13) did not receive the first fungicide application until 11 August (Quadris) and a second was made on 18 August (Bravo Weather Stik), for a total of two fungicide applications. While treatment 11 resulted in the lowest AUDPC, treatment 13 had the greatest AUDPC and was statistically equivalent to the nontreated check ($P \leq 0.05$). **However, due to weekly access of the DACOM schedule, fungicide applications for treatment 13 were not initiated according to the model and important applications were missed.** Access to the model should have been made at least once per day, or more frequently. End-of-season data review by DACOM revealed that the first two fungicide applications for treatment 13 should have been made on 16 and 24 July.

The potential effect(s) of the missed fungicide applications on early blight disease suppression can be estimated utilizing data from a nearby plot. The nontreated check of this second study had a season-long AUDPC of 35.96, with the same data collection format and dates as those used for the Dacom study. The nontreated check in the Dacom plot had an AUDPC of 39.97, indicating

that similar disease pressure existed in both plots. In this second study, the contribution that a single fungicide application made to season long early blight suppression was:

- 88% (Quadris) or 31% (Bravo) for a 14 July application (i.e., the total AUDPC was 12% of the nontreated check AUDPC for a Quadris spray made on 14 July)

- 87.5% (Quadris) or 16% (Bravo) for a 21 July application

- 88.2% (Quadris) or 66% (Bravo) for a 28 July application

The "best" fungicide program made without consideration for cost (nine weekly applications) resulted in 99.7% disease suppression on the same AUDPC scale. Therefore, the single fungicide applications of Quadris made on one of the above three dates had only about 11% to 12% more disease than the program that included nine weekly applications of fungicide versus about 33% to 84% more disease for Bravo Weatherstik. [Variability is typically greater for plots utilizing chlorothalonil.] Therefore, the two sprays (16 July and 24 July) recommended by Dacom would probably have had a marked effect on season-long disease progress. It is encouraging that the two recommendations were grouped in this time interval, as field observations indicated that this was a critical time for disease suppression in agreement with the model. However, on the other hand, the Dacom model also stated on the July 27 "Torrington dcm" print out that "application of fungicide is not necessary" and that the infections are "too old to fight." The above results for applications made on 28 July suggest that an application made on 28 July (or July 27th, for that matter) would have contributed as much towards season-long disease suppression as applications made earlier. It may be that the Dacom model does not consider some factors important to the epidemiology of early blight (at least in the western irrigated states). For example, the ability of spores to survive on leaflets and the ability of a single spore to re-initiate infection may be an important consideration.

In summary, results from 2004 are encouraging and the Dacom model warrants further testing to demonstrate its efficacy. Additional information is presented in Table 1 and following figures (see below).

Table 1. Effects of foliar fungicide programs on potato early blight disease severity (G.D. Franc and W.L. Stump, Univ. of WY; 2004)

Treatment and rate (product/A)[1]	Application dates[2]	AUDPC[3]	% necrosis 16 Aug
1. Nontreated check	NA	39.97 a	67.0 a
2. Headline 2.08EC (6 fl oz) + NIS (0.25 % v/v)	A	12.50 b	65.0 a
2. Dithane NT 75DF (2 lb)	C		
2. Headline 2.08EC (6 fl oz) + NIS (0.25 % v/v)	E		
2. Dithane NT 75DF (2 lb)	NA		
2. Headline 2.08EC (6 fl oz) + NIS (0.25 % v/v)	NA		
3. Endura 70WP (2.5 oz) + MSO (1% v/v)	A	1.77 de	59.5 a
3. Headline 2.08EC (6 fl oz) + NIS (0.25 % v/v)	C		
3. Dithane NT 75DF (2 lb)	E		
3. Endura 70WP (2.5 oz) + MSO (1% v/v)	NA		
3. Headline 2.08EC (6 fl oz) + NIS (0.25 % v/v)	NA		
4. Tanos 50WG (2 oz) + Manzate 75DF (1.5 lb)	A, C, E	3.92 cde	58.0 a
4. Manzate 75DF (2 lb)	B, D, F		
5. Tanos 50WG (4 oz) + Manzate 75DF (1.5 lb)	A, C, E	3.41 cde	67.0 a
5. Manzate 75DF (2 lb)	B, D, F		
6. Tanos 50WG (6 oz) + Manzate 75DF (1.5 lb)	A, C, E	1.71 de	48.0 a
6. Manzate 75DF (2 lb)	B, D, F		
7. Tanos 50WG (8 oz) + Manzate 75DF (1.5 lb)	A, C, E	4.25 cde	76.5 a
7. Manzate 75DF (2 lb)	B, D, F		
8. JE874 50WG (2 oz) + Manzate 75DF (1.5 lb)	A, C, E	3.45 cde	56.0 a
8. Manzate 75DF (2 lb)	B, D, F		
9. Tanos 50WG (6 oz) + Manzate 75DF (1.5 lb)	A, C	3.07 cde	50.0 a
9. Manzate 75DF (2 lb)	B, D		
9. Super Tin 80WP (2.5 oz) + Manzate 75DF (1.5 lb)	E, F		
10. Manzate 75DF (2 lb)	A-F	7.58 bcd	56.0 a
DACOM grower standard schedule			
11. Quadris 2.08SC (6.2 fl oz)	A, C, E	0.25 e	56.0 a
11. Bravo Weather Stik 6F (1.5 pt)	B, D, F		
12. Bravo Weather Stik 6F (1.5 pt)	A-F	5.75 b-e	69.0 a
DACOM forecast schedule			
13. Quadris 2.08SC (6.2 fl oz)	E	33.98 a	59.5 a
13. Bravo Weather Stik 6F (1.5 pt)	F		
14. Echo 825 82.5WG (1.36 lb)	A-F	5.99 b-e	67.0 a
15. Echo ZN 4.17F (2.125 pt)	A-F	4.06 cde	65.0 a
16. Penncozeb 75DF (2 lb)	A-F	9.40 bc	59.5 a

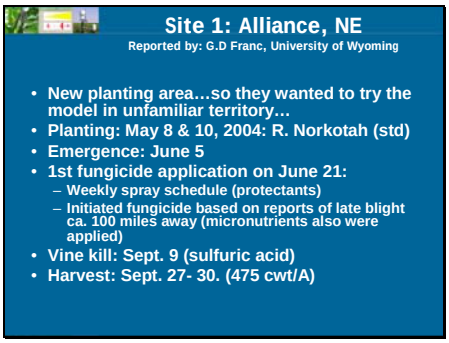
[1] The NIS (nonionic surfactant) used was X77 and the MSO (methylated seed oil) used was Destiny.

[2] The planting date was 11 May, 2004 with variety FL1867, and harvest was on 20 September. Fungicide application dates were: A= 14 Jul, B= 21 Jul, C= 28 Jul, D= 4 Aug, E= 11 Aug, F= 18 Aug, NA= not-applicable.

[3] Area under the disease progress curve for data collected from 14 Jul through 18 August.

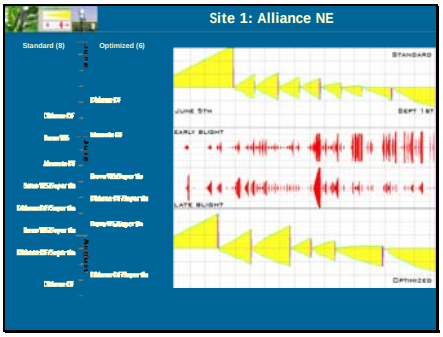
[4] Treatment means followed by different letters differ significantly (Fisher's protected LSD, $P \leq 0.05$).

Slide 1



Slide 2

Slide 3



Slide 4

Site 1: Alliance, NE

- Comments:
  - Dacom optimized started approx. 1 wk earlier (late blight threat) and had two less sprays over the season (efficacy was untested by grower).
  - Yield ranges: 240 - 580 cwt/A…(some hail)
  - 475 cwt/A in Dacom/standard plots
  - Appreciated the importance of the model
  - "would be interested in trying Dacom again…it might save us some sprays…"

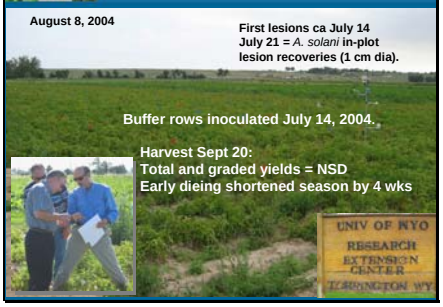
Slide 5

Site 2: Torrington, WY

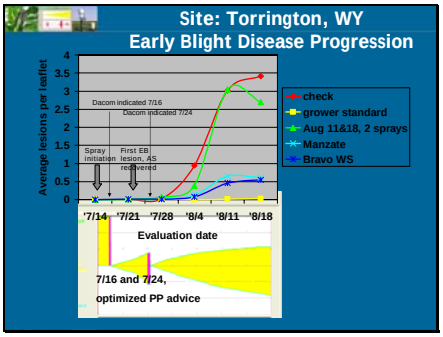
- Research-plot potato ground, sandy loam, & OH irrigation. RCBD (4 reps X 16 treatments).
- Planted May 11 cv FL1867; emerged May 27.
- Fungicide initiated July 14 (via scouting).
- Weekly & biweekly (14 total) different spray schedules were tested
- Early dieing problem; plants declining by 1st wk of Aug, UTC foliage mostly gone by Aug. 18.
- Early blight (low to moderate), no late blight in 2004

Slide 6

University of Wyoming, Torrington WY



Slide 7



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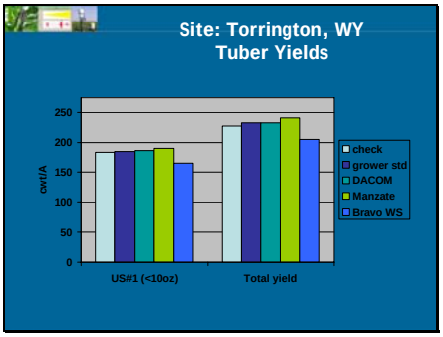

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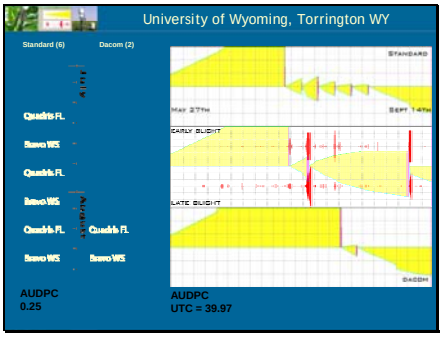

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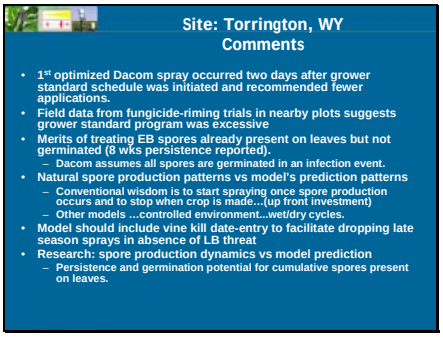
Site: Torrington, WY
Comments
• 1st optimized Dacom spray occurred two days after grower standard schedule was initiated and recommended fewer applications.
• Field data from fungicide-riming trials in nearby plots suggests grower standard program was excessive
• Merits of treating EB spores already present on leaves but not germinated (8 wks persistence reported).
– Dacom assumes all spores are germinated in an infection event.
• Natural spore production patterns vs model's prediction patterns
– Conventional wisdom is to start spraying once spore production occurs and to stop when crop is made…(up front investment)
– Other models …controlled environment…wet/dry cycles.
• Model should include vine kill date-entry to facilitate dropping late season sprays in absence of LB threat
• Research: spore production dynamics vs model prediction
– Persistence and germination potential for cumulative spores present on leaves.

Research Project	**Management of Potato Insects with Seedpiece Insecticide Treatments, 2004**
Research Team Tel: 307-766-2397 FAX: 766-5549 francg@uwyo.edu	G.D. Franc and W.L. Stump University of Wyoming College of Agriculture- Plant Sciences Dept-3354 1000 E. University Ave. Laramie, WY 82071
Field Plot Details	Torrington Research & Extension Center located at Torrington, WY at 4104 MSL elevation: sandy loam soil; overhead irrigation
Plot Design	Randomized complete block design with four replications; plots were four rows (36-in row centers) X 20 ft with 5 ft in-row buffer. All treatments were made to, and all data were collected from, the center two rows.
Plot Management	**Planting Date:** 17 May, 2004 **Variety:** FL1867 **Seeding rate:** All treatments except treatment 6 were planted at the normal rate of 23 cwt/A in rows spaced at 36-inches (center to center). Treatment 6 was planted at the higher rate of 27 cwt/A with row centers spaced at 36-inches. **Fertilizer:** 150 lb N + 50 lb P_2O_5 **Herbicide:** Matrix 75DF (1 oz product/A) + Prowl (1.5 pt product/A) POST (irrigation incorporated) on 2 June, Sencor 75DF (4 oz product/A) POST on 23 June. **Fungicide:** Quadris (12.3 fl oz product/A) was applied on 28 July for early blight management.
Treatment Applications	**Seedpiece** treatments were applied to freshly cut seed on 13 May. Seed pieces (2-3 oz size) were sprayed with a hand plant-mister at a rate of 4 fl oz of water carrier per 100 lbs of seed. The **in-furrow** treatment was applied at planting on 17 May. Application was made in a 7-inch band directed over seed pieces already placed in an open furrow. Following application, furrows were closed with a tractor-mounted finishing disc. Insecticide was applied in-furrow with the aid of a portable CO_2 sprayer with a boom equipped with a single #8002 flat fan nozzle. The total volume applied was 1.1 gal carrier per 1000 row-ft at 50 psi boom pressure.
Potato Development	Potato stands were determined on 1, 9, 17, and 30 June, and an area under the emergence progress curve was calculated (AUEPC). A plant vigor rating was made on 30 June (worst 0-10 best, with the nontreated check = 5).
Insect Development	All insect population development relied on natural infestations. The buffer rows were left untreated to provide greater pest pressure. Colorado potato beetle pressure was moderate and developed late in the season. Potato psyllid and aphid pressures were very light in 2004 and these data are not presented in the Tables.
Insect Treatment Evaluations	Plants were visually inspected and Colorado potato beetle larvae, adults and egg masses were recorded on a per-plant basis on 24 June, 1, 7, 15, and 22 July. Defoliation due to insect feeding was visually estimated on 1, 15, and 22 July. Sweep net counts were conducted on 21, 29 July, and 12 August. A

	portion of the data is shown in the Tables.
Harvest	Two rows by 10 ft were dug with a one-row mechanical digger on 20 September. Tubers were sorted and weighed to determine yield and grade on 21 September. All yield data are summarized in Table 5.
Statistical Analysis	ANOVA with four replications. Mean separations were done using Fisher's protected LSD ($P \leq 0.05$).

Results and Discussion

Potato seedpiece insecticide treatment effects on emergence and vigor are shown in Table 1. Seedpiece treatments had no effect on emergence or vigor compared to the nontreated check ($P=0.05$). The high seeding rate in treatment 6 resulted in greater stands and a greater AUEPC compared to all other treatments which were planted at normal seeding rates ($P \leq 0.05$).

Colorado potato beetle (CPB) development was moderate but populations developed late in the season, resulting in a vigorous test for persistence of seedpiece applied insecticides (Table 2). On 15 July most insecticide treatments had significantly suppressed CPB larval numbers compared to the nontreated check and treatment 2, which received only Maxim and no insecticide ($P \leq 0.05$). These same treatments effects were readily apparent for data collected 22 July, greater than 60 days after seedpiece treatment ($P \leq 0.05$). Adult CPB populations did not appear to be effected by seedpiece treatments, probably because adults were able to migrate among plots and blur treatment effects ($P=0.05$). Few potato pysllid nymphs or aphids were detected during plant evaluations. These data are shown in the appendices.

Due to the late development of CPB during the growing season, potato defoliation was minor during most of the bulking period (Table 3). However, the data reveal that most seedpiece treatments containing insecticide had reduced defoliation levels compared to the nontreated check and the Maxim-only treatment ($P \leq 0.05$).

The effects of seedpiece insecticide treatments on mid to late-season insect pest populations are shown in Table 4. Treatments had no effect on mid to late-season CPB, flea beetle, or leafhopper populations ($P=0.05$). There was a trend of reduced CPB larval populations with insecticide seedpiece treatments on 12 August.

Due to the minor insect damage to plants, treatments had no significant effect on potato yields or quality (Table 5, $P=0.05$). A trend in the data for total tuber yields and the yield of US#1 tubers less than 10 ounces for treatments that received seedpiece treatments is apparent compared to the nontreated check.

Table 1 Effects of potato seedpiece insecticide treatments on potato emergence and vigor (G.D. Franc and W.L. Stump, Univ. of WY; 2004).

Treatment and rate (product/100 lb seed) [1]	Potato stands (40 row ft)					Vigor[3] 30 Jun
	1 Jun	9 Jun	17 Jun	30 Jun	AUEPC[2]	
1. Nontreated check	2.8 a[4]	33.8 a	37.5 b	38.5 b	930.5 b	5.0 a
2. Maxim 4SC (0.08 fl oz)	1.0 a	37.0 a	39.5 b	39.8 b	975.1 b	5.0 a
3. Maxim 4SC (0.08 fl oz) + Cruiser 5SC (0.14 fl oz)	0.8 a	35.5 a	38.5 b	39.3 b	947.9 b	5.0 a
4. Tops MZ-Gaucho 9.75DS (12 oz)	0.5 a	37.0 a	38.5 b	39.8 b	961.6 b	5.5 a
5. Maxim 4SC (0.08 fl oz) + Poncho 250 5SC (0.16 fl oz).	0.8 a	36.8 a	38.8 b	39.0 b	958.9 b	5.5 a
High seeding rate						
6. Maxim 4SC (0.04 fl oz) + Cruiser 5SC (0.12 fl oz)	2.5 a	40.0 a	45.5 a	44.8 a	1103.6 a	5.0 a
7. Maxim 4SC (0.08 fl oz)						
7. Platinum 2SC (0.55 fl oz/1000 row ft)	1.3 a	34.8 a	38.3 b	38.0 b	934.1 b	5.0 a

[1] Seedpieces were cut and treated on 13 May and planted on 17 May, 2004 (cultivar FL1867). Treatment 6 was planted at a higher seeding rate (27 cwt/A, 36-in rows) and all other treatments were planted at normal seeding rates (23 cwt/A, 36-in rows). Platinum (treatment 7) was applied in a 7-inch band over the top of seedpieces at planting.

[2] Area under the emergence progress curve for data collected from 1 through 30 June. Both the number and speed of emergence contribute to this value.

[3] Plant vigor is rated on a scale of 0 worst to 10 best (nontreated check= 5).

[4] Treatment means followed by different letters differ significantly (Fisher's protected LSD, $P \leq 0.05$).

Table 2 Effects of potato seedpiece insecticide treatments on Colorado potato beetle populations (G.D. Franc and W.L. Stump, Univ. of WY; 2004).

Treatment and rate (product/100 lb seed) [1]	Colorado potato beetle									
	per 5 plants								per 20 row feet	
	24 Jun		1 Jul		7 Jul		15 Jul		22 Jul	
	Larvae	Adult	Larvae	Adult	Larvae	Adult	Larvae	Adult	Larvae	Adult
1. Nontreated check	0.13 a[2]	0.00 a	0.00 a	0.71 a	0.25 a	0.00 a	1.25 b	1.00 a	0.75 b	3.75 a
2. Maxim 4SC (0.08 fl oz)	0.38 a	0.00 a	0.25 a	1.00 a	0.00 a	0.50 a	3.50 a	0.25 a	1.25 a	1.75 a
3. Maxim 4SC (0.08 fl oz) + Cruiser 5SC (0.14 fl oz)	0.00 a	0.00 a	0.00 a	0.84 a	0.00 a	0.00 a	0.25 bc	0.00 a	0.00 c	4.50 a
4. Tops MZ-Gaucho 9.75DS (12 oz)	0.00 a	0.13 a	0.00 a	0.71 a	0.00 a	0.00 a	0.00 c	0.25 a	0.00 c	3.00 a
5. Maxim 4SC (0.08 fl oz) + Poncho 250 5SC (0.16 fl oz).	0.00 a	0.00 a	0.00 a	0.71 a	0.00 a	0.00 a	0.00 c	0.25 a	0.00 c	3.50 a
High seeding rate										
6. Maxim 4SC (0.04 fl oz) + Cruiser 5SC (0.12 fl oz)	0.00 a	0.13 a	0.00 a	0.71 a	0.00 a	0.00 a	0.00 c	0.50 a	0.00 c	3.75 a
7. Maxim 4SC (0.08 fl oz)										
7. Platinum 2SC (0.55 fl oz/1000 row ft)	0.00 a	0.00 a	0.00 a	0.84 a	0.00 a	0.00 a	0.00 c	1.00 a	0.00 c	3.00 a

[1] Seedpieces were cut and treated on 13 May and planted on 17 May, 2004 (cultivar FL1867). Treatment 6 was planted at a higher seeding rate (27 cwt/A, 36-in rows) and all other treatments were planted at normal seeding rates (23 cwt/A, 36-in rows). Platinum (treatment 7) was applied in a 7-inch band over the top of seed pieces at planting.

[2] Treatment means followed by different letters differ significantly (Fisher's protected LSD, $P \leq 0.05$).

Table 3 Effects of potato seedpiece insecticide treatments on potato defoliation levels (G.D. Franc and W.L. Stump, Univ. of WY; 2004).

Treatment and rate (product/100 lb seed) [1]	Defoliation (%)		
	1 Jul	15 Jul	22 Jul
1. Nontreated check	0.50 ab[2]	1.25 b	3.50 ab
2. Maxim 4SC (0.08 fl oz)	1.00 a	2.50 a	5.00 a
3. Maxim 4SC (0.08 fl oz) + Cruiser 5SC (0.14 fl oz)	0.00 b	0.00 c	1.00 cd
4. Tops MZ-Gaucho 9.75DS (12 oz)	0.00 b	0.25 c	2.50 bc
5. Maxim 4SC (0.08 fl oz) + Poncho 250 5SC (0.16 fl oz).	0.00 b	0.25 c	0.50 d
High seeding rate			
6. Maxim 4SC (0.04 fl oz) + Cruiser 5SC (0.12 fl oz)	0.00 b	0.00 c	0.75 d
7. Maxim 4SC (0.08 fl oz)			
7. Platinum 2SC (0.55 fl oz/1000 row ft)	0.00 b	0.00 c	0.25 d

[1] Seedpieces were cut and treated on 13 May and planted on 17 May, 2004 (cultivar FL1867). Treatment 6 was planted at a higher seeding rate (27 cwt/A, 36-in rows) and all other treatments were planted at normal seeding rates (23 cwt/A, 36-in rows). Platinum (treatment 7) was applied in a 7-inch band over the top of seed pieces at planting.

[2] Treatment means followed by different letters differ significantly (Fisher's protected LSD, $P \leq 0.05$).

Table 4 Effects of potato seedpiece insecticide treatments on insect pest populations (G.D. Franc and W.L. Stump, Univ. of WY; 2004).

Treatment and rate (product/100 lb seed) [1]	Insect populations by sweep net sampling[2]							
	21 Jul			29 Jul			12 Aug	
	CPB-adult	Flea beetle	Leaf hopper	CPB-larvae	CPB-adult	Flea beetle	CPB-larvae	CPB-adult
1. Nontreated check	0.75 a[3]	0.75 a	0.00 a	0.75 a	1.25 a	0.50 a	5.75 a	1.25 a
2. Maxim 4SC (0.08 fl oz)	0.00 a	1.00 a	0.00 a	0.75 a	0.75 a	0.75 a	3.25 a	0.25 a
3. Maxim 4SC (0.08 fl oz) + Cruiser 5SC (0.14 fl oz)	0.75 a	2.00 a	0.00 a	0.75 a	2.50 a	1.25 a	3.00 a	1.75 a
4. Tops MZ-Gaucho 9.75DS (12 oz)	0.25 a	3.75 a	0.75 a	0.25 a	1.50 a	3.75 a	1.25 a	0.25 a
5. Maxim 4SC (0.08 fl oz) + Poncho 250 5SC (0.16 fl oz).	1.50 a	0.75 a	0.25 a	0.00 a	3.00 a	0.50 a	1.75 a	2.50 a
High seeding rate								
6. Maxim 4SC (0.04 fl oz) + Cruiser 5SC (0.12 fl oz)	0.25 a	0.00 a	0.25 a	0.00 a	1.50 a	1.25 a	2.00 a	2.75 a
7. Maxim 4SC (0.08 fl oz)								
7. Platinum 2SC (0.55 fl oz/1000 row ft)	1.00 a	0.75 a	0.00 a	0.00 a	2.25 a	1.50 a	1.00 a	2.25 a

[1] Seedpieces were cut and treated on 13 May and planted on 17 May, 2004 (cultivar FL1867). Treatment 6 was planted at a higher seeding rate (27 cwt/A, 36-in rows) and all other treatments were planted at normal seeding rates (23 cwt/A, 36-in rows). Platinum (treatment 7) was applied in a 7-inch band over the top of seedpieces at planting.

[2] A total of 5 sweeps were made over the 20 feet of the two treated rows

[3] Treatment means followed by different letters differ significantly (Fisher's protected LSD, $P \leq 0.05$).

Table 5 Effect of potato seedpiece insecticide treatments on potato yield and quality (G.D. Franc and W.L. Stump, Univ. of WY; 2004).

Treatment and rate (product/100 lb seed) [1]	Potato yield (cwt/A)			
	US#1 (<10 oz)	Grade B	Culls	Total
1. Nontreated check	137.4 a[2]	16.5 a	8.9 a	162.8 a
2. Maxim 4SC (0.08 fl oz)	150.6 a	16.0 a	6.3 a	172.9 a
3. Maxim 4SC (0.08 fl oz) + Cruiser 5SC (0.14 fl oz)	150.5 a	13.9 a	11.8 a	176.1 a
4. Tops MZ-Gaucho 9.75DS (12 oz)	160.3 a	20.0 a	14.0 a	194.2 a
5. Maxim 4SC (0.08 fl oz) + Poncho 250 5SC (0.16 fl oz).	158.4 a	17.4 a	11.1 a	186.9 a
High seeding rate				
6. Maxim 4SC (0.04 fl oz) + Cruiser 5SC (0.12 fl oz)	154.1 a	18.2 a	15.2 a	187.5 a
7. Maxim 4SC (0.08 fl oz)				
7. Platinum 2SC (0.55 fl oz/1000 row ft)	158.1 a	17.4 a	8.2 a	183.7 a

[1] Seedpieces were cut and treated on 13 May and planted on 17 May, 2004 (cultivar FL1867). Treatment 6 was planted at a higher seeding rate (27 cwt/A, 36-in rows) and all other treatments were planted at normal seeding rates (23 cwt/A, 36-in rows). Platinum (treatment 7) was applied in a 7-inch band over the top of seedpieces at planting.

[2] Treatment means followed by different letters differ significantly (Fisher's protected LSD, $P \leq 0.05$).

Research Project	**Nebraska Potato Clone National Variety Trial, Wyoming Results; 2004**
Research Team Tel: 307-766-2397 FAX: 766-5549 francg@uwyo.edu	G.D. Franc and W.L. Stump University of Wyoming College of Agriculture- Plant Sciences, Dept 3354 1000 E. University Ave. Laramie, WY 82071 Gary Leever Potato Certification Association of Nebraska P.O. Box 339 Alliance, NE 69301-0339
Field Plot Details	Torrington Research & Extension Center located at Torrington, WY 4104 MSL: sandy loam soil; overhead irrigation
Plot Design	Randomized complete block design with three replications; plots were one row (36-in row centers) X 15 ft long (15 plants target).
Plot Management	**Planting Date:** 17 May, 2004 **Variety:** Russet Norkotah clones **Seeding rate:** Fifteen seedpieces per plot at 1 foot spacing, 36-in rows. **Fertilizer:** 150 lb N + 50 lb P_2O_5 **Herbicide:** Matrix 75DF (1 oz product/A) + Prowl (1.5 pt product/A) POST (irrigation incorporated) on 2 June, Sencor 75DF (4 oz product/A) POST on 23 June. **Fungicide:** Quadris (12.3 fl oz product/A) was applied on 28 July for early blight management.
Potato Development	Potato stands were determined on 1, 9, and 17 June. Emergence occurred when any portion of the plant was visible. Emergence data are summarized in Table 1.
Harvest	The center 10 feet of each plot was harvested with a one-row mechanical digger on 20 September. Tubers were sorted and weighed to determine yield and grade categories on 21 September. All yield data are summarized in Table 1.
Statistical Analysis	ANOVA with three replications. Mean separations were done using Fisher's protected LSD ($P \leq 0.05$).

Results and Discussion

Potato stand averages for the various Russet Norkotah clones for the Torrington, WY trial are shown in Table 1. Plots were planted 17 May, emergence started in most plots by 1 June, average emergence was approximately 75+ percent by 9 June, and final stand counts were collected on 17 June. There were no significant stand count differences among the clones for any date of data collection (P=0.05). Total yield and yield of each tuber class are summarized in Table 1. There were no significant differences among clones for tuber yield or grade quality (P=0.05).

Table 1 Nebraska Potato Clone National Variety Trial; Torrington, Wyoming emergence and yield results (G.D. Franc and W.L. Stump, Univ. of WY; G. Leever, PCAN, 2004).

Russet Norkotah clone strain type	Potato stand averages (per 15 row ft and 3 replications) 15 = 100% emergence			Potato yield (cwt/A)				
	1 Jun	9 Jun	17 Jun	US#1 (<10 oz)	US#2	Grade B	Culls	Total
1. Nebraska LT	0.3 a*	12.0 a	15.0 a	112.8 a	9.0 a	39.6 a	4.4 a	165.8 a
2. Nebraska LW	0.0 a	10.7 a	14.0 a	129.2 a	7.3 a	34.8 a	5.8 a	177.1 a
3. Nebraska LS-2	0.0 a	11.3 a	14.3 a	160.7 a	3.3 a	34.1 a	8.7 a	206.9 a
4. Nebraska LS-1	0.3 a	10.3 a	15.0 a	124.4 a	4.8 a	39.5 a	9.2 a	177.9 a
5. Nebraska LS-3	0.3 a	11.3 a	14.0 a	166.0 a	1.9 a	44.0 a	2.9 a	214.9 a
6. Texas 278	0.7 a	11.0 a	13.7 a	109.3 a	1.0 a	44.8 a	9.2 a	164.4 a
7. Texas 223	0.3 a	14.0 a	14.7 a	149.6 a	1.5 a	64.6 a	2.7 a	218.3 a
8. Texas 112	0.0 a	11.7 a	15.0 a	142.3 a	5.6 a	46.9 a	2.4 a	197.2 a
9. Colorado #8	0.3 a	13.3 a	14.7 a	143.7 a	9.2 a	32.9 a	2.7 a	188.5 a
10. Colorado #3	0.3 a	12.7 a	15.0 a	118.0 a	10.9 a	44.0 a	4.8 a	177.9 a
11. Regular from Thompson source	0.0 a	12.0 a	15.0 a	117.6 a	3.6 a	40.9 a	1.5 a	163.6 a
12. Regular from Schekall source	1.0 a	11.7 a	14.3 a	120.5 a	1.7 a	32.2 a	5.8 a	160.2 a

* Plots were planted on 17 May, 2004. Plants were significantly water-stressed during the first and second week of August (due to reduced water availability). Treatment means followed by different letters differ significantly (Fisher's protected LSD, $P \leq 0.05$).

Research Project	**Cercospora Leaf Spot Management with Fungicide Programs in Sugar Beet, 2004**
Research Team Tel: 307-766-2397 FAX: 766-5549 francg@uwyo.edu	G.D. Franc and W.L. Stump University of Wyoming College of Agriculture- Plant Sciences, Dept 3354 1000 E. University Ave. Laramie, WY 82071
Field Plot Details	Torrington Research & Extension Center located at Torrington, WY 4104 MSL: sandy loam soil; overhead irrigation
Plot Design	Randomized complete block design with four replications; plots were four rows (30-in row centers) X 20 ft with 5 ft in-row buffer. Fungicide treatments were made to, and all data were collected from the center two rows.
Plot Management	**Planting Date:** 19 May, 2004 (replant) **Variety:** Monohikari **Fertilizer:** 150 lb N + 50 lb P_2O_5 **Herbicide:** Post-emergence applications of Progress + Upbeet (18 fl oz + 0.5 oz product) on 2 June; Progress + Stinger (24 fl oz + 4 fl oz product) on 8 June; and Progress + Stinger (22 fl oz + 4 fl oz product) on 14 June.
Disease Development	On 12 August, two greenhouse-grown sugar beet plants infected with local *Cercospora beticola* isolates were transplanted into the buffer row of each treatment plot. Additionally, on 18 August, a foliar application of *Cercospora beticola* spores (4×10^2 infectious units/ml) was made to the border row of each plot in a total volume of 1.06 gal/1000 ft of row via a single-nozzle (8002 flat fan).
Treatment Applications	Foliar fungicide applications indicated as A, B, and C in the Tables were made on 11, 25 August, and 8 September respectively. Fungicides were applied with the aid of a portable (CO_2) sprayer in a total volume of 43 gal/A at 30 psi boom pressure (four #8004 flat fan nozzles spaced at 20 inches).
Disease Ratings	Cercospora leaf spot severity was determined on 11, 18, 25 August, and 1, 15, 29 September. The lesions on 5 randomly selected leaves per plot were counted and an average was calculated for each plot.
Harvest	One 20 ft row of the two treated rows was harvested on 6 October and the total root yield was determined. The percentage of total sucrose was determined by Western Sugar's laboratory.
Statistical Analysis	ANOVA with four replications. Mean separations were done using Fisher's protected LSD ($P \leq 0.05$).

Results and Discussion

Cercospora leaf spot (CLS) development was very light in 2004 despite inoculation efforts at two separate times. Environmental conditions were not particularly favorable for disease development because late summer evening temperatures were cooler than normal throughout the High Plains. Treatments containing Headline resulted in minor phytotoxicity that was observed on 15 September. This phytotoxicity was in the form of minor leaf necrotic spotting.

Fungicide program effects on CLS are shown in Table 1. Due to low disease pressure, fungicide programs had no significant effects on disease level (P=0.05). All fungicide treatments reduced the season-long AUDPC (P=0.42), but this effect was not significant at P=0.05. Effects on beet root yield and quality are shown in Table 2. Trends also observed were that all fungicide treatments increased the percentage of total sucrose (P=0.21). However, fungicide programs had no significant effect on beet root yield or sugar quality in the absence of disease (P=0.05).

Table 1. Effects of foliar fungicide programs on Cercospora leaf spot management (G.D. Franc and W.L. Stump, Univ. of WY; 2004).

Treatment and rate (ai/A)	Application dates[1]	Number of Cercospora lesions per leaf						CLS AUDPC[2]
		11 Aug	18 Aug	25 Aug	1 Sep	15 Sep	29 Sep	
1. Untreated check	NA	0.1 a[3]	0.0 a	0.1 a	0.3 a	0.2 a	0.3 a	7.7 a
2. Headline 2.08EC + X77 (0.15 lb + 0.25% v/v)	A	0.0 a	0.0 a	0.1 a	0.0 a	0.1 a	0.0 a	1.1 a
2. Eminent 125SL (1.6 oz)	B							
2. Super Tin 80WP (4 oz)	C							
3. Eminent 125SL (1.6 oz)	A	0.0 a	0.2 a	0.0 a	0.2 a	0.1 a	0.1 a	4.4 a
3. Headline 2.08EC + X77 (0.15 lb + 0.25% v/v)	B							
3. Super Tin 80WP (4 oz)	C							
4. Topsin M 70WP (0.27 lb)	A	0.0 a	0.0 a	0.1 a	0.1 a	0.0 a	0.0 a	1.1 a
4. Eminent 125SL (1.6 oz)	B							
4. Headline 2.08EC + X77 (0.15 lb + 0.25% v/v)	C							
5. Eminent 125SL (1.6 oz)	A	0.0 a	0.0 a	0.1 a	0.3 a	0.0 a	0.0 a	1.9 a
5. Headline 2.08EC + X77 (0.15 lb + 0.25% v/v)	B							
5. Eminent 125SL (1.6 oz)	C							
6. Eminent 125SL (1.6 oz)	A	0.0 a	0.0 a	0.1 a	0.1 a	0.0 a	0.0 a	1.1 a
6. Super Tin 80WP (4 oz)	B							
6. Eminent 125SL (1.6 oz)	C							

[1] Fungicide application dates were: A= 11 Aug, B= 25 Aug, C= 8 Sep, NA= not-applicable.

[2] Cercospora leaf spot area under the disease progress curve for data collected from 11 August through 29 September. Buffer rows of field plots were inoculated via infected transplants on 12 August and via foliar inoculation on 18 August.

[3] Treatment means followed by different letters differ significantly (Fisher's protected LSD, $P \leq 0.05$).

Table 2. Effects of foliar fungicide programs for Cercospora leaf spot management on beet root yield and quality (G.D. Franc and W.L. Stump, Univ. of WY; 2004).

Treatment and rate (ai/A)	Application dates[1]	Beet root yield and quality	
		Yield (tons/A)	% total sucrose
1. Untreated check	NA	13.8 a[2]	13.8 a
2. Headline 2.08EC + X77 (0.15 lb + 0.25% v/v)	A	16.0 a	15.0 a
2. Eminent 125SL (1.6 oz)	B		
2. Super Tin 80WP (4 oz)	C		
3. Eminent 125SL (1.6 oz)	A	12.6 a	14.6 a
3. Headline 2.08EC + X77 (0.15 lb + 0.25% v/v)	B		
3. Super Tin 80WP (4 oz)	C		
4. Topsin M 70WP (0.27 lb)	A	16.8 a	14.4 a
4. Eminent 125SL (1.6 oz)	B		
4. Headline 2.08EC + X77 (0.15 lb + 0.25% v/v)	C		
5. Eminent 125SL (1.6 oz)	A	15.7 a	14.3 a
5. Headline 2.08EC + X77 (0.15 lb + 0.25% v/v)	B		
5. Eminent 125SL (1.6 oz)	C		
6. Eminent 125SL (1.6 oz)	A	13.3 a	14.6 a
6. Super Tin 80WP (4 oz)	B		
6. Eminent 125SL (1.6 oz)	C		

[1] Fungicide application dates were: A= 11 Aug, B= 25 Aug, C= 8 Sep, NA= not-applicable. Buffer rows of field plots were inoculated via infected transplants on 12 August and via foliar inoculation on 18 August.

[2] Treatment means followed by different letters differ significantly (Fisher's protected LSD, $P \leq 0.05$).

Research Project	**Rhizoctonia Root and Crown Rot Management with Banded Fungicide Applications in Sugar Beet, 2004**
Research Team Tel: 307-766-2397 FAX: 766-5549 francg@uwyo.edu	G.D. Franc and W.L. Stump University of Wyoming College of Agriculture- Plant Sciences, Dept 3354 1000 E. University Ave. Laramie, WY 82071
Field Plot Details	Torrington Research & Extension Center located at Torrington, WY. Plots were at 4104 MSL: sandy loam soil; overhead irrigation.
Plot Design	Randomized complete block design with four replications; plots were four rows (30-in row centers) X 20 ft with a 5 ft in-row buffer. Inoculations and fungicide treatments were made to, and all data were collected from, the center two rows.
Plot Management	**Planting Date:** 19 May, 2004 (replant due to environmental conditions) **Variety:** Monohikari **Fertilizer:** 150 lb N + 50 lb P_2O_5 **Herbicide:** Post-emergence applications of Progress + Upbeet (18 fl oz + 0.5 oz product/A) on 2 June; Progress + Stinger (24 fl oz + 4 fl oz product/A) on 8 June; and Progress + Stinger (22 fl oz + 4 fl oz product/A) on 14 June.
Disease Development	Immediately following the fungicide applications made on 30 June, inoculum (0.25 tsp= 0.8 g) was applied to the crown of each plant in the two center rows of each plot. Plants were in the 8-12 leaf stage when inoculated. Immediately after inoculation, plots were cultivated then watered with 1 inch of water to favor infection. Inoculum used in 2004 was prepared at the USDA lab in Ft. Collins, CO using cultures of *Rhizoctonia solani* AG2-2 grown on grain.
Treatment Applications	Fungicides in a 7-inch band were applied to the crown of each plant on 30 June (immediately prior to inoculation). Fungicide was applied with the aid of a portable (CO_2) sprayer in a total volume of 1.06 gal/1000 row ft at 50 psi boom pressure. The boom was equipped with a single #8002 flat fan nozzle.
Disease Ratings	Initial beet stands (2 x 20 row ft) were determined on 30 June. Rhizoctonia crown rot incidence ratings were expressed as a percentage of the initial stands to standardize disease ratings. Rhizoctonia crown rot incidence was rated for both center rows on 7, 14, 21, 29 July, 5, 12, 18, and 25 August. Infected beets were those that had rapidly wilting leaves, darkened petioles and/or decayed crowns evident with necrotic leaves present. An area under the disease progress curve (AUDPC) was calculated for disease incidence data from 7 July to 25 August. Additionally, plots were visually rated for the percentage of total canopy necrosis present on 14, 21, 29 July, 5, 12, 18, 25 August, and 1 September and an AUDPC also was calculated for these data. At harvest, a final harvestable beet root count was determined. Harvested beet roots were those that had less than 50% volume lost to rot. Rhizoctonia disease severity and incidence were rated on harvested beet roots that contributed to final yield. Disease severity was determined by visually estimating the surface area of beet root affected by decay while disease

	incidence was the percentage of the harvested roots with any visible decay.
Harvest	Two treated rows X 20 ft were dug by hand on 6 October and total root yields were determined. The percentage of total sucrose was determined by Western Sugar's laboratory.
Statistical Analysis	ANOVA with four replications. Mean separations were done using Fisher's protected LSD ($P \leq 0.05$). Because of severe disease some treatments had either none or only one beet to rate at harvest time (disease was sufficiently severe to destroy some treatment plots), therefore, no statistics were run on beet disease evaluations or total sugars at harvest.

Results and Discussion

Rhizoctonia root and crown rot (RRCR) developed quickly following inoculation on 30 June, with symptoms first appearing after 1 week. The first RRCR symptoms observed in the plots were rapidly wilting leaves with petioles darkened near the crown. All plants in the untreated inoculated check were symptomatic 21 July and dead by 5 August. The untreated non-inoculated check (treatment 2) showed low to moderate natural disease pressure mid to late summer with 8.8% of the plants symptomatic by 25 August, thus, most disease development resulted from inoculum applied on 30 June. Rapid and severe RRCR development following inoculation provided for a rigorous test of fungicide efficacy in 2004.

Fungicide treatment effects on RRCR incidence and severity are summarized in Tables 1 and 2. Initially both fungicide treatments provided equivalent suppression of RRCR ($P=0.05$). However, by 21 July, the Gem treatment started to fail and by 5 August, this treatment was similar to the untreated inoculated check in terms of disease incidence and severity ($P=0.05$). Because of the early protection provided by Gem, this treatment had a significantly lower AUDPC for incidence and severity compared to the untreated inoculated check ($P \leq 0.05$). The JAU6476 significantly suppressed disease compared to Gem for all measurements after 14 July ($P \leq 0.05$). Season long disease suppression provided by JAU6476 was significantly better than that provided by Gem ($P \leq 0.05$).

Treatment effects on final harvestable beet counts, yield and quality are shown in Table 3. Due to severe disease pressure following inoculation, no beets were recovered from the untreated inoculated check and only one beet was harvested from the Gem treatment plots. The JAU6476 treatment significantly improved yields compared to the Gem treatment ($P \leq 0.05$). Disease incidence and severity in the JAU6476 plot at harvest was greater because more roots were present at harvest and could be rated, versus treatments where roots had already decayed and were no longer present. These results indicate that this field trial was a vigorous test of fungicide efficacy.

Table 1. Effects of banded fungicide applications on Rhizoctonia root and crown rot (RRCR) incidence (G.D. Franc and W.L. Stump, University of WY; 2004).

Treatment and rate (oz ai/1000 ft)[1]	Initial Stand (40 row ft)	RRCR incidence as a percentage of initial stand								AUDPC[2]
	30 Jun	7 Jul	14 Jul	21 Jul	29 Jul	5 Aug	12 Aug	18 Aug	25 Aug	
1. Untreated inoculated check	90.0 a[3]	17.8 a	99.3 a	100.0 a	100.0 a	100.0 a	100.0 a	100.0 a	100.0 a	4669.5 a
2. Untreated non-inoculated check	86.3 a	0.3 b	0.5 b	1.1 c	3.7 d	4.9 c	7.2 c	8.3 c	8.8 c	207.5 d
3. JAU6476 4SC (0.16)	97.0 a	0.2 b	0.3 b	11.1 c	24.3 c	39.1 b	47.6 b	58.2 b	61.6 b	1445.2 c
4. Gem 25WP (0.10)	89.0 a	0.2 b	9.2 b	74.4 b	90.4 b	99.6 a	99.6 a	99.6 a	99.6 a	3642.1 b

[1] All applications were made in 7-inch banded spray in 1.06 gal/1000 row ft at 50 psi boom pressure. Plants in the two center rows of each treatment plot were inoculated with *Rhizoctonia solani* AG2-2 on 30 June, 2004 (8-12 leaf stage) immediately following fungicide application.

[2] Area under the disease progress curve for data collected from 7 July through 25 August.

[3] Treatment means followed by different letters differ significantly (Fisher's protected LSD, $P \leq 0.05$).

Table 2. Effects of banded fungicide applications on Rhizoctonia root and crown rot (RRCR) severity (G.D. Franc and W.L. Stump, University of WY; 2004).

Treatment and rate (oz ai/1000 ft)[1]	RRCR severity as a percentage of total canopy necrosis								AUDPC[2]
	14 Jul	21 Jul	29 Jul	5 Aug	12 Aug	18 Aug	25 Aug	1 Sep	
1. Untreated inoculated check	85.5 a[3]	98.5 a	99.8 a	100.0a	100.0 a	100.0 a	100.0 a	100.0 a	5135.4 a
2. Untreated non-inoculated check	0.0 b	0.3 c	2.3 d	4.0 c	4.0 c	9.3 c	9.3 c	9.3 c	230.0 d
3. JAU6476 4SC (0.16)	0.0 b	2.0 c	10.5 c	28.8 b	37.5 b	43.8 b	48.8 b	53.8 b	1352.5 c
4. Gem 25WP (0.10)	5.0 b	43.8 b	77.5 b	96.3 a	97.0 a	98.5 a	98.5 a	99.0 a	3924.9 b

[1] All applications were made in 7-inch banded spray in 1.06 gal/1000 row ft at 50 psi boom pressure. Plants in the two center rows of each treatment plot were inoculated with *Rhizoctonia solani* AG2-2 on 30 June, 2004 (8-12 leaf stage) immediately following fungicide application.

[2] Area under the disease progress curve for data collected from 14 July through 1 September.

[3] Treatment means followed by different letters differ significantly (Fisher's protected LSD, $P \leq 0.05$).

Table 3. Effects of banded fungicide applications for Rhizoctonia root and crown rot (RRCR) severity on beet root characteristics at harvest (G.D. Franc and W.L. Stump, University of WY; 2004).

Treatment and rate (oz ai/1000 ft)[1]	Beet root numbers per 40 row ft	Beet root yield and quality		Disease incidence (%) and disease severity at harvest[2]	
		% total sucrose[2]	Beet yield (tons/A)	Symptomatic beets (%)	Surface area of root decayed (%)
1. Untreated inoculated check	0.00 c[3]	NA	0.00 c	NA	NA
2. Untreated non-inoculated check	44.25 a	15.00	14.46 a	0.64	0.25
3. JAU6476 4SC (0.16)	28.25 b	12.27	7.18 b	44.38	14.50
4. Gem 25WP (0.10)	0.25 c	NA	0.15 c	25.0	1.50

[1] All applications were made in 7-inch banded spray in 1.06 gal/1000 row ft at 50 psi boom pressure. Plants in the two center rows of each treatment plot were inoculated with *Rhizoctonia solani* AG2-2 on 30 June, 2004 (8-12 leaf stage) immediately after the first fungicide application.

[2] Because of severe disease some plots had none or few beets to rate or determine sugar content, therefore no statistics were run on these data. NA= non-applicable.

[3] Treatment means followed by different letters differ significantly (Fisher's protected LSD, $P \leq 0.05$).

2004 Survey Results: Fungicide Sensitivity Characteristics of *Cercospora beticola* Isolates Recovered from Infected Sugarbeet in the High Plains of Colorado, Montana, Nebraska, and Wyoming

Research Team:
Gary D. Franc, William L. Stump, and Eric D. Kerr

Contact information:
G.D. Franc; francg@uwyo.edu
W.L. Stump; wstump@uwyo.edu
University of Wyoming
Department of Plant Sciences-3354
1000 E. University Ave.
Laramie, WY 82071

Abstract

The 2004 Cercospora leaf spot survey included 96 separate *Cercospora beticola* isolates recovered from 40 fields: twelve fields from Colorado, six fields from Montana, twenty fields from Nebraska, and two fields from Wyoming. All isolates were tested for sensitivity to benzimidazole (Benlate®, Topsin®), triphenyltin hydroxide (Super Tin®, Agritin®), tetraconazole (Eminent®), propiconazole (Tilt®), azoxystrobin (Quadris/Amistar®), and pyraclostrobin (Headline®). No appreciable insensitivity was observed for these fungicides, except benzimidazole; 68 percent of the fields had a benzimidazole insensitive isolate present. Surveys initiated in 1998 throughout the High Plains revealed that fields with at least one benzimidazole insensitive isolate present increased from a low of 26 percent in 1998 to 80 percent in 2003, with 68 percent detected in 2004. Results reveal the consistent trend that benzimidazole insensitivity is widespread in sugar beet fields of the High Plains. Therefore, reliance on benzimidazole for Cercospora leaf spot suppression may result in lack of disease control. Tests with diethofencarb in 2004 revealed that all isolates insensitive to benzimidazole were sensitive to diethofencarb (negative cross resistance), suggesting diethofencarb plus benzimidazole use as a potential tank mix to suppress the spectrum of isolates present in the field. However, this approach had limited success in other production regions because tank mixes resulted in isolates insensitive to both diethofencarb and benzimidazole. The availability of other effective fungicide chemistries for the control benzimidazole insensitive isolates further reduces our need to incorporate diethofencarb into fungicide programs. Diethofencarb may become a more viable option if our High Plains isolates develop resistance to triazoles, strobilurins, and/or triphenyltin hydroxide. The 2004 survey revealed that our fungicide chemistries remain effective, except for benzimidazole, and that fungicide resistance management must be practiced by growers.

Materials and Methods

Cercospora leaf spot samples were collected from commercial sugar beet fields during the late growing season by Western Sugar personnel and sample collections in Wyoming were made by UW personnel. The 2004 survey consisted of leaf samples collected from 40 fields throughout

the High Plains growing region: twelve fields from Colorado, six fields from Montana, twenty fields from Nebraska, and two fields from Wyoming. Leaf samples were air-dried and stored for approximately one month prior to assay. Up to several isolation attempts were made for each sample so that each field was represented by at least one fungal isolate. A maximum of six isolates was tested per field.

Fungicide sensitivity tests:

The media for testing the strobilurin fungicides azoxystrobin (Quadris/Amistar®) and pyraclostrobin (Headline®) was made amending glycerol medium and all other fungicides were added to potato dextrose agar (PDA). Diethofencarb, a fungicide which has activity against benzimidazole-resistant fungi, also was tested. Media was autoclaved as per label instruction then cooled to approximately 48°C. Stock suspensions of 500 ppm of benzimidazole (Benlate®), triphenyltin hydroxide (Super Tin®, Agritin®), tetraconazole (Eminent®), propiconazole (Tilt®), azoxystrobin (Quadris/Amistar®), and pyraclostrobin (Headline®) were prepared in sterile distilled water, and a stock suspension of 2500 ppm of diethofencarb was prepared in 10 mL of acetone. Stock suspensions were added to achieve concentrations in the media listed below. Fourteen mL of cool amended medium was dispensed into each Petri dish with the aid of an automatic dispensing unit. The poured plates were allowed to dry in the hood for at least 24 hr prior to use. The concentrations of amended media prepared were benzimidazole (BM) 1 and 5 ppm, triphenyltin hydroxide (TPTH) 1 and 5 ppm, tetraconazole 1 ppm, propiconazole 1 ppm, azoxystrobin 1 ppm, pyraclostrobin 1ppm, and diethofencarb 5 and 50 ppm.

Each isolate recovered from infected leaves was cultured onto a SBLEA source plate, followed by subculturing onto PDA. Subcultures were incubated for 12 to 14 days at 23°C with a 12 hr photoperiod. Conidial suspensions from each isolate were prepared by scraping a small section of colony mycelium and adding it to small centrifuge tube containing 1 mL of sterile distilled water and then agitating with a vortex for 10 seconds. The conidial suspension was collected with an Eppendorf Repeater Plus® pipettor fitted with a sterile 0.1 mL pipette tip. For each isolate, non-amended and amended PDA and glycerol plates were inoculated with three evenly spaced 1.0 μL aliquots of the conidia suspension. Therefore, for each isolate tested there were ten amended plates plus a glycerol and PDA non-amended control plates. All 12 plates for a given isolate were sleeved together for incubation. Sixty isolates were tested in the first batch (15 Nov) and 40 isolates in the second batch (16 Nov). Known *Cercospora beticola* strains sensitive and insensitive to benzimidazole were included in each batch as a positive and negative control. Inoculated plates were incubated at 23°C with a 12 hr photoperiod. An additional third run was made for seven of the isolates to double-check their growth in the presence of fungicide.

Colony diameters for each inoculation site were measured after 7 days growth with the aid of a digital caliper and the mean value for the three inoculation sites was computed for each isolate on each medium. The percent inhibition of radial growth for each test isolate grown on fungicide-amended media was compared to its growth on its corresponding non-amended media after 7 days. Because the diameter of the initial inoculum drop was approximately 3 mm (± 0.1 mm, 95% CI), 3 mm was subtracted from the mean colony diameter for each isolate before computing the percentage of growth inhibition in the presence of fungicide. The percent inhibition for each isolate was then calculated with the following equation, [(non-amended

control – amended)/non-amended control X 100]. Isolates producing colonies with diameters greater than 3 mm after 7 days of incubation had some degree of "insensitivity" to the fungicide present in the amended medium. However, from a practical standpoint, isolates that exhibited 20 percent or less inhibition (at least 80% or more growth) in the presence of a specific fungicide were considered to be insensitive to that fungicide.

Results and Discussion

A total of 96 isolates was recovered in 2004 from 40 sugar beet fields with symptoms of Cercospora leaf spot. Each isolate was recovered from a separate foliar lesion. All isolates were tested for growth on the 12 different media plates. Several known benzimidazole sensitive and insensitive *C. beticola* isolates from prior surveys also were tested and reacted consistently on the test media, indicating that the test protocol was performed correctly.

The *C. beticola* isolates that were inhibited 20 percent or less in the presence of fungicide were considered insensitive. In other words, these isolates grew at least 80 percent of their colony size in the presence of fungicide compared to their growth in the absence of fungicide. Isolate insensitivity data are summarized in Table 1. No insensitivity to triphenyltin hydroxide, tetraconazole, propiconazole, azoxystrobin, or pyraclostrobin was detected. However, a total of 53 isolates (55.2 percent) were found to be insensitive to benzimidazole at 1 and 5 ppm. Colorado had the greatest percentage of insensitive isolates (76.2 percent) followed by Nebraska (60.4 percent), Montana (33.3 percent), and Wyoming (0 percent).

The number of fields in which at least one benzimidazole insensitive isolate was detected is shown in Table 2. Overall, 67.5 percent of the fields tested in the High Plains region had detectable benzimidazole insensitivity in 2004. Nebraska had the greatest number of fields represented with 20 fields tested and 80 percent (16/20) of these fields had at least one benzimidazole insensitive *C. beticola* isolate; five of these 16 fields had a mixed population of sensitive and insensitive isolates. In Colorado, 75 percent (9/12) of the fields exhibited had at least one benzimidazole insensitive isolate, followed by Montana with 33.3 percent (2/6) of the fields with an insensitive isolate detected. The small sample size must be considered when evaluating data trends.

The range of insensitivity of *C. beticola* isolates in the presence of 1 ppm azoxystrobin and pyraclostrobin fungicides are shown in Table 3. In general, isolates had greater inhibition with pyraclostrobin than with azoxystrobin. Although difficult to extrapolate to the field, these findings support field research that revealed pyraclostrobin to be more effective on Cercospora leaf spot than azoxystrobin. None of the isolates were considered insensitive because they all were inhibited in their growth more than 20 percent. However, there were two isolates that did grow more than others, and exhibited between 40 percent to 49 percent growth inhibition to azoxystrobin.

Isolate inhibition in the presence of 1 ppm tetraconazole and propiconazole fungicides are summarized in Table 4. For the majority of the isolates, tetraconazole and propiconazole inhibited growth 100 percent (none of the isolates grew in the presence of these fungicides). There were two isolates recovered from the same field in Nebraska that exhibited only 47 and 59

percent inhibition. These same isolates also had 79 percent inhibition (21 percent growth) in the presence of propiconazole whereas all other isolates had no growth (100 percent inhibition).

Isolate inhibition in the presence of triphenyltin hydroxide at 1 and 5 ppm are summarized in Table 5. The majority of the isolates were inhibited 100 percent at 1 ppm and all of isolates were inhibited 100 percent by 5 ppm triphenyltin hydroxide.

Isolate inhibition in the presence of benzimidazole at 1 and 5 ppm are summarized in Table 6. Isolates either were completely inhibited or not inhibited at all (<9 percent inhibition). Results were identical for 1 and 5 ppm benzimidazole concentrations. Fifty-three of the 96 isolates were inhibited less than 9 percent. The distribution of these isolates in the High Plains was discussed above for Table 1. Results for diethofencarb revealed that all isolates insensitive to benzimidazole were sensitive to diethofencarb, and isolates sensitive to benzimidazole were not affected by diethofencarb (negative cross resistance; data not shown).

Trends in survey results over the years for benzimidazole at 5 ppm are shown in Table 7. Based on total fields from the High Plains region, benzimidazole insensitivity increased from 26 percent in 1998 to 80 percent in 2003, with 68 percent detected for 2004. Results reveal the consistent trend that benzimidazole insensitivity is widespread in High Plains sugar beet fields. Therefore, reliance on benzimidazole for Cercospora leaf spot suppression may result in lack of disease control.

Tests with diethofencarb reveal that all isolates insensitive to benzimidazole were sensitive to diethofencarb (negative cross resistance), suggesting diethofencarb plus benzimidazole use as a potential tank mix to suppress the spectrum of isolates present in the field. This approach had limited success in other production regions because tank mixes resulted in isolates insensitive to both diethofencarb and benzimidazole. The availability of other effective fungicide chemistries for the control of benzimidazole insensitive isolates further reduces our need to incorporate diethofencarb into fungicide programs. Diethofencarb may become a more viable option if our High Plains isolates develop resistance to triazole, strobilurins, and/or triphenyltin hydroxide. The 2004 survey reveals that our fungicide chemistries remain effective and that fungicide resistance management must be practiced by growers.

Table 1. The number of insensitive *Cercospora beticola* isolates (20 percent or less growth inhibition in the presence of various fungicides) recovered in 2004 from symptomatic leaves collected from Colorado, Nebraska, Montana, and Wyoming sugar beet fields.

Fungicide (ppm)*	Number of insensitive isolates (20% or less inhibition)**				
	CO	MT	NE	WY	Total
Azoxystrobin (1)	0	0	0	0	0
Pyraclostrobin (1)	0	0	0	0	0
Tetraconazole (1)	0	0	0	0	0
Propiconazole (1)	0	0	0	0	0
TPTH (1)	0	0	0	0	0
TPTH (5)	0	0	0	0	0
Benzimidazole (1)	16	8	29	0	53
Benzimidazole (5)	16	8	29	0	53
Total isolates tested	21	24	48	3	96

* Azoxystrobin and Pyraclostrobin used a glycerol based media, all others potato dextrose agar.

** Percent inhibition: Mean colony diameter was first computed for both the amended and non-amended control for each isolate and 3mm was subtracted from each value to account for the initial inoculum deposition area. The percent inhibition for each isolate was calculated with the formula [(non-amended control-amended control)/non-amended control] X 100.

Table 2. The number of fields with at least one benzimidazole insensitive *Cercospora beticola* isolate (20 percent or less inhibition). Isolates were recovered in 2004 from symptomatic leaves collected from Colorado, Nebraska, Montana, and Wyoming sugar beet fields.

Fungicide (ppm)*	Number of fields with at least one insensitive isolate (20% or less inhibition)**				
	CO	MT	NE	WY	Total
Benzimidazole (1)	9	2	16	0	27
Benzimidazole (5)	9	2	16	0	27
Total fields tested	12	6	20	2	40

* Azoxystrobin and Pyraclostrobin used a glycerol based media, all others potato dextrose agar.

** Percent inhibition: Mean colony diameter was first computed for both the amended and non-amended control for each isolate and 3mm was subtracted from each value to account for the initial inoculum deposition area. The percent inhibition for each isolate was calculated with the formula: [(non-amended control-amended control)/non-amended control] X 100.

Table 3. Sensitivity distribution of *Cercospora beticola* isolates to azoxystrobin (Quadris/Amistar), and pyraclostrobin (Headline) fungicides. Isolates were recovered from symptomatic leaves collected in 2004 from Colorado, Nebraska, Montana, and Wyoming sugar beet fields.

Percent inhibition*	Number of isolates within a category									
	azoxystrobin (1 ppm)					pyraclostrobin (1 ppm)				
	CO**	MT	NE	WY	Total	CO	MT	NE	WY	Total
0-9	0	0	0	0	0	0	0	0	0	0
10-19	0	0	0	0	0	0	0	0	0	0
20-29	0	0	0	0	0	0	0	0	0	0
30-39	0	0	0	0	0	0	0	0	0	0
40-49	1	0	1	0	2	0	0	0	0	0
50-59	3	9	10	1	23	0	0	0	0	0
60-69	6	10	17	2	35	0	0	0	0	0
70-79	6	1	10	0	17	2	5	6	1	14
80-89	4	4	6	0	14	6	7	14	2	29
90-99	1	0	3	0	4	9	11	17	0	37
100	0	0	1	0	1	4	1	11	0	16
Total tested	21	24	48	3	96	21	24	48	3	96

* Percent inhibition: Mean colony diameter was first computed for both the amended and non-amended control for each isolate and 3mm was subtracted from each value to account for the initial inoculum deposition area. The percent inhibition for each isolate was calculated with the formula [(non-amended control-amended control)/non-amended control] X 100.

** State codes: CO= Colorado, MT= Montana, NE= Nebraska, WY= Wyoming.

Table 4. Sensitivity distribution of *Cercospora beticola* isolates to tetraconazole (Eminent) and propiconazole (Tilt) fungicides. Isolates were recovered from symptomatic leaves collected in 2004 from Colorado, Nebraska, Montana, and Wyoming sugar beet fields.

Percent inhibition*	Number of isolates within a category									
	Tetraconazole (1 ppm)					Propiconazole (1 ppm)				
	CO**	MT	NE	WY	Total	CO	MT	NE	WY	Total
0-9	0	0	0	0	0	0	0	0	0	0
10-19	0	0	0	0	0	0	0	0	0	0
20-29	0	0	0	0	0	0	0	0	0	0
30-39	0	0	0	0	0	0	0	0	0	0
40-49	0	0	1	0	1	0	0	0	0	0
50-59	0	0	1	0	1	0	0	0	0	0
60-69	0	0	0	0	0	0	0	0	0	0
70-79	0	0	0	0	0	0	0	2	0	2
80-89	0	0	0	0	0	0	0	0	0	0
90-99	8	1	13	2	24	0	0	0	0	0
100	13	23	33	1	70	21	24	46	3	94
Total tested	21	24	48	3	96	21	24	48	3	96

* Percent inhibition: Mean colony diameter was first computed for both the amended and non-amended control for each isolate and 3mm was subtracted from each value to account for the initial inoculum deposition area. The percent inhibition for each isolate was calculated with the formula [(non-amended control-amended control)/non-amended control] X 100.

** State codes: CO= Colorado, MT= Montana, NE= Nebraska, WY= Wyoming.

Table 5. Sensitivity distribution of *Cercospora beticola* isolates to triphenyltin hydroxide (Super Tin, Agritin) fungicide. Isolates were recovered from symptomatic leaves collected in 2004 from Colorado, Nebraska, Montana, and Wyoming sugar beet fields.

Percent inhibition*	Number of isolates within a category									
	Triphenyltin (1 ppm)					triphenyltin (5 ppm)				
	CO**	MT	NE	WY	Total	CO	MT	NE	WY	Total
0-9	0	0	0	0	0	0	0	0	0	0
10-19	0	0	0	0	0	0	0	0	0	0
20-29	0	0	0	0	0	0	0	0	0	0
30-39	0	0	0	0	0	0	0	0	0	0
40-49	0	0	0	0	0	0	0	0	0	0
50-59	0	0	0	0	0	0	0	0	0	0
60-69	0	0	0	0	0	0	0	0	0	0
70-79	0	0	0	0	0	0	0	0	0	0
80-89	0	0	2	0	2	0	0	0	0	0
90-99	0	0	2	0	2	0	0	0	0	0
100	21	24	44	3	92	21	24	48	3	96
Total tested	21	24	48	3	96	21	24	48	3	96

* Percent inhibition: Mean colony diameter was first computed for both the amended and non-amended control for each isolate and 3mm was subtracted from each value to account for the initial inoculum deposition area. The percent inhibition for each isolate was calculated with the formula [(non-amended control-amended control)/non-amended control] X 100.

** State codes: CO= Colorado, MT= Montana, NE= Nebraska, WY= Wyoming.

Table 6. Sensitivity distribution of *Cercospora beticola* isolates to benzimidazole (Topsin) fungicide. Isolates were recovered from symptomatic leaves collected in 2004 from Colorado, Nebraska, Montana, and Wyoming sugar beet fields.

Percent inhibition*	Number of isolates within a category									
	benzimidazole (1 ppm)					benzimidazole (5 ppm)				
	CO**	MT	NE	WY	Total	CO	MT	NE	WY	Total
0-9	16	8	29	0	53	16	8	29	0	53
10-19	0	0	0	0	0	0	0	0	0	0
20-29	0	0	0	0	0	0	0	0	0	0
30-39	0	0	0	0	0	0	0	0	0	0
40-49	0	0	0	0	0	0	0	0	0	0
50-59	0	0	0	0	0	0	0	0	0	0
60-69	0	0	0	0	0	0	0	0	0	0
70-79	0	0	0	0	0	0	0	0	0	0
80-89	0	0	0	0	0	0	0	0	0	0
90-99	0	0	0	0	0	0	0	0	0	0
100	5	16	19	3	43	5	16	19	3	43
Total tested	21	24	48	3	96	21	24	48	3	96

* Percent inhibition: Mean colony diameter was first computed for both the amended and non-amended control for each isolate and 3mm was subtracted from each value to account for the initial inoculum deposition area. The percent inhibition for each isolate was calculated with the formula [(non-amended control-amended control)/non-amended control] X 100.

** State codes: CO= Colorado, MT= Montana, NE= Nebraska, WY= Wyoming.

Table 7. Survey trends (1998-2004) for the number of fields / number of fields tested with at least one isolate exhibiting insensitivity (20 percent or less inhibition) to benzimidazole (5 ppm).

State	Survey year						
	1998	1999	2000	2001	2002	2003	2004
Colorado	19/36 53%	14/29 48%	9/23 39%	18/29 62%	3/5 60%	17/21 81%	9/12 75%
Montana	0/19 0%	1/5 20%	3/5 60%	6/11 55%	0/1 0%	3/5 60%	2/6 33%
Nebraska	4/33 12%	8/39 21%	8/32 25%	7/29 24%	21/27 78%	13/16 81%	16/20 80%
Wyoming	NT*	0/1 0%	0/1 0%	NT	1/1 100%	3/3 100%	0/2 0%
Total	23/88 26%	23/74 31%	20/61 33%	31/69 45%	25/34 74%	36/45 80%	27/40 68%

* NT=Not tested

FISCAL YEAR FY 2004 Report for the:

SUDDEN OAK DEATH NATIONAL SURVEY: WYOMING

Project Duration: June 1, 2004 – December 31, 2004

Prepared by: G. D. Franc

University of Wyoming, Dept. of Plant Sciences-3354

1000 E. University Ave.

Laramie WY 82071

I. Background and Justification

Sudden Oak is caused by the fungus-like organism *Phytophthora ramorum*. This organism was first recovered from diseased plants in Germany and the Netherlands in 1993 and subsequently was found in the United States (California) in 1995. Since its discovery in North America, thousands of oak trees have died along the western coast of the United States and numerous others are in declining health. Certain native California oak and at least 40 other native and horticultural species can act as hosts for the fungus, with various symptoms and signs resulting from infection. The recent widespread dispersal of infected plant material means it is probable that infection can occur in the absence of symptoms.

The epidemiology of this fungus is not well characterized and certain assumptions have been made about its spread and the ecological conditions that favor its survival. Efforts to manage this disease have concentrated on the detection and diagnosis of infected plants via intensive surveys and, once they are found, to eradicate infected plants, thereby, eliminating the pathogen. Environmental conditions that enable the pathogen to become established in natural settings are not well characterized. Infected plant material transplanted into environments otherwise unfavorable for pathogen spread may serve to protect the pathogen and allow it to persist undetected in an asymptomatic host. At least several potential hosts are present in Wyoming. For example, the natural range of Douglas fir overlaps with urban areas in Wyoming where susceptible landscape plants are likely to be placed. It is not known if a pathogen reservoir may be established in Wyoming.

During the spring of 2004, it was determined that one to several west coast nurseries had this disease present in some of their nursery stock. Unfortunately, these nurseries had a large number of clients to which they shipped material. Fortunately, Wyoming was not a primary recipient of potentially infected material from nurseries that were confirmed positive. However, secondary and tertiary shipments of plant material place our greenhouse and horticultural industry at risk. A coordinated survey and documented freedom from detectable disease will enable sale and shipment of plant materials from Wyoming. If the pathogen is detected by survey before it is widespread, eradication of the infestation is more likely to protect the healthy plant community.

II. Objective

The objective is to survey nurseries identified with host plants and associated host plants susceptible to infection by *P. ramorum*. Up to 15 sites identified by the Wyoming Department of Agriculture in cooperation with the USDA APHIS PPQ will be surveyed in Wyoming using criteria found in the USDA APHIS PPQ Surveyor's Manual. The Wyoming sites will be surveyed in July and August, as per instructions in the USDA APHIS PPQ Surveyor's Manual. The University of Wyoming Cooperative Extension plant pathology program will offer training on disease recognition and the Cooperative Extension Plant Pathology diagnostic lab will conduct analysis of plant samples for pathogen detection.

III. Results or Benefits Expected

Samples will be identified by a unique number that characterizes the location including the latitude and longitude, host, collection date, and other relevant information as outline on page 11 of the Surveyor's manual. All diagnostic results for each sample number will be summarized by the Cooperator into a database. These data will be entered into the NAPIS database by Margaret Rayda, Wyoming State Survey Coordinator. This data entry component is a function of the CORE Project funded through Pest Detection. The first record for the State and/or County will be entered within **48 hours** of confirmation of identification by a qualified identifier. All other required records, both positive and negative, will be entered **within two weeks** of confirmation. All records are to be entered into the NAPIS database by **December 1** of the year of survey, so these data are included in the yearly WR Statistical Report.

IV. Approach

Sample Collection and Testing: The fifteen collection sites will be determined by the Wyoming Department of Agriculture (WDA) and the USDA APHIS PPQ office in Cheyenne, WY. Sample collection and sample collection protocols will be as determined by these two entities following the guidelines of the USDA APHIS PPQ Surveyor's Manual. Samples will be delivered to the Cooperator in Laramie, WY for processing. The Surveyor's Manual Addendum II reveals that Wyoming is located in zone IV, with a survey priority of July-August, 2004.

The Cooperator will provide training on disease recognition to WDA site inspectors in July, immediately prior to sample collection. In addition to collecting and testing symptomatic plant tissue as per the guidelines, it is anticipated that sample "over-collection" will be done by site inspectors to increase the potential for detecting latent infections. Up to 40 samples per site will be tested (600 samples total). The Cooperator will conduct the testing protocol for *P. ramorum* detection and identification as per guidelines provided by Mary Palm (March, 2004). Briefly, primary screening of samples will be performed by ELISA followed by plating to PARP medium, as outlined in the testing protocol. Secondary screening also will include ELISA re-testing, morphological characteristics, and/or PCR detection by qualified individuals. The USDA APHIS PPQ will provide financial support to the Cooperator for conducting this project.

Results:

The Wyoming nursery stock survey was conducted in July and August, as per USDA inspection priority guidelines for the Zone IV region. Sample collection exceeded that required because samples with few or no symptoms also were submitted for testing in an effort to increase the probability of detecting latent infections. Samples were received at the University of Wyoming EPPL, and all sample log-in and testing was performed by G.D. Franc. A sub-sample was removed from each sample, weighed and placed an individual sample extract bag. GEB2 buffer was added in the proper ratio and initial testing was via ELISA DAS (*Phytophthora* pathoscreen kit PSA 92600; Agdia Inc., agdia.com) performed according the protocol. Positive test samples and negative controls (both lilac and non-lilac) were included in each test. Sample reaction intensities were read with a spectrophotometer at 405 nm with a hard copy printout.

A total of 93 field samples were tested during the survey. Additional check samples were processed. The counties surveyed are presented in Table 1. Table 1 also includes information on visual inspections (samples not submitted) and the number of greenhouses inspected in which no known hosts were present. All samples submitted for testing, except one, were negative for the presence of *Phytophthora*. The single sample that was positive via ELISA was re-tested in ELISA (original sap and a second sample) and proved negative. Regardless, the DNA extraction was performed according to protocol and the DNA extract was submitted for testing via PCR. The DNA sample submitted to the USDA proved negative for *P. ramorum*. Plating of tissue from that sample onto PARP growth medium also failed to indicate the presence of *Phytophthora*. In summary, *P. ramorum* was not detected in any of the samples collected during the survey.

Table 1. Sudden Oak Death survey results for Wyoming FY04.

Wyoming County	Number of Samples ELISA (-)	Number of Samples ELISA (+)	Number of Different Species Visually Negative	Number of Greenhouses Inspected with No Hosts
ALBANY	0	0	0	0
BIG HORN	0	0	0	0
CAMPBELL	0	0	0	0
CARBON	0	0	0	0
CONVERSE	0	0	0	1
CROOK	0	0	0	0
FREMONT	10	0	10	0
GOSHEN	0	0	0	0
HOT SPRINGS	5	0	3	0
JOHNSON	0	0	0	4
LARAMIE	23	0	7	2
LINCOLN	6	0	6	0
NATRONA	16	0	9	2
NIOBRARA	0	0	0	0
PARK	10	0	19	0
PLATTE	0	0	0	0
SHERIDAN	10	0	8	0
SUBLETTE	0	0	0	0
SWEETWATER	2	0	3	1
TETON	6	0	5	0
UINTA	5	0	1	0
WASHAKIE	0	0	0	0
WESTON	0	0	0	0
YELLOWSTONE	0	0	0	0
TOTAL	**93**	**0**	**71**	**10**

Two training programs were presented to inspectors in performing the greenhouse site visits. Training material on disease recognition and alternate hosts was provided by G. D. Franc via power point presentations at Cheyenne, WY. Training material included adaptation of resources provided by the USDA APHIS PPQ and other materials provided by the University of Wyoming Cooperative Extension plant pathology program. Disease recognition skills were important to ensure that the appropriate tissue was sampled during the survey. Training also was provided by the USDA APHIS PPQ on use of GPS units and digital photography. After training, the inspectors were asked to respond to survey questions that were prepared and summarized by Margaret Rayda, Wyoming CAPS Program (caps@uwyo.edu). The questions and inspector responses are listed below in Table 2. In summary, training was presented at the appropriate level for inspectors to recognize likely plant symptoms for *P. ramorum* detection. Additionally, suggestions were offered by inspectors for approaches that may improve this and other similar future programs.

Table 2. Summary of survey questions submitted to Wyoming Department of Agriculture inspectors following two training programs for detection of Sudden Oak Death disease for *P. ramorum* detection in Wyoming greenhouse nursery stocks.

Q1: Before the training, how well do you think you could have identified possible SOD symptoms and taken a sample?

- *NOT AT ALL*
- *NOT AT ALL new to the nursery industry in general*
- *NOT AT ALL*
- *NOT AT ALL*
- *IN A FEW CASES – not to the degree of after the training*

Q2: Since the training, how well do you feel that you can identify possible SOD symptoms and take samples?

- *ALL OF THE TIME – well, did I?*
- *ALL OF THE TIME – I think so, how did I do?*
- *ALL OF THE TIME – I don't know if I am comfortable to train others*
- *ALL OF THE TIME – I felt that I got the basic idea*
- *ALL OF THE TIME – I fell I am definitely able to do it*

Q3: Did you receive enough training in how to fill out the paperwork?

- *YES – that was OK. and it was so much better than the original government paperwork*
- *YES – it was clear and adequate*
- *YES – all of training and explanation was outstanding*
- *YES – it was just the right amount – I was able to take notes too*
- *YES – the paperwork cheat-sheet was great*

Q4: Did you receive enough training in how to take a sample?

- *YES*
- *YES*
- *YES*
- *NO – co-workers showed me*
- *YES – I think that I did o.k. – how did I do?*

Q5: Did you receive enough training to utilize the GPS to obtain the location of the nursery?

- *YES – I just need to use it more often … no way to train that*
- *YES – that part was simple (just turn it on) but the rest of the GPS training will help with other stuff*
- *YES – not a problem at all*
- *YES – no problem*
- *YES – I made a mistake, but I learned from it*

Q6: What information in the training would you have liked more explanation on?

- *NONE – the training was fine*
- *NONE – I felt comfortable doing the survey after the training*
- *NONE BUT – I would have liked help with the camera and CD burning, but that wasn't really a part of the training*
- *NONE*
- *BACKGROUND INFORMATION – I went online a looked up some basic information about why the disease was so bad, etc, after the first meeting … it helped me to understand why we were doing the survey in the first place.*

Q7: What information in the training would you have liked to have less explanation on?

- *NONE – the training went very well*
- *NONE*
- *NONE – all of the topics were covered adequately*
- *NONE*
- *NONE*

Q8: Is there anything that you would change in the training if it were to be done again next year, or do you have any other suggestions?

- *It would be good to have a real SOD sample, or samples of plants that have similar looking diseases rather than the pictures, then we could see the sample that we would take too*
- *It may be better to just have one training session – but both were great (put on well)*
- *The two training sessions allowed us to let the information set in, and then before we actually went out we had the refresher to update and get us out*

- The place on the paperwork that requires you to draw a map was a little repetitive and is hard if you aren't an artist
- We should have done this training and survey in May, when there is actually stock to survey, I felt like I was there too late and had nothing to test
- We should have started earlier in the year when there was more to look at.

End of report.

Products Tested in 2004 Research Studies.

Product	Class*	Manufacturer	Composition
Bravo Weather Stik 6F	F	Syngenta Crop Protection, Inc. P.O. Box 18300 Greensboro, NC 27419	54% Chlorothalonil
Cruiser 5SC	I	Syngenta Crop Protection, Inc.	47.6% Thiamethoxam
Destiny	S	Agriliance P.O. Box 64089 St. Paul, MN 55164-0069	Methylated soybean oil (MSO)
Dithane NT 75DF	F	Dow AgroSciences LLC Indianapolis, IN 46268	75% Mancozeb
Echo 825 82.5WG	F	Sipcam Agro USA, Inc. 70 Mansell Ct., Suite 230 Roswell, GA 30076	82.5% Chlorothalonil
Echo ZN 4.17F	F	Sipcam Agro USA, Inc.	38.5% Chlorothalonil
Eminent 125SL	F	Sipcam Agro USA, Inc.	11.6% Tetraconazole
Endura 70WP	F	BASF Corp. 26 Davis Dr. Research Triangle Park, NC 27709	70% Boscalid
Gem 25WP	F	Bayer Corp. Agricultue Division P.O. Box 4913, Hawthorn Rd Kansas City, MO 64120	25% Trifloxystrobin
Headline 2.08EC	F	BASF Corp.	22.9% Pyraclostrobin
JAU6476 4SC	F	Bayer Corp.	Information not provided
JE874 50WG	F	Dupont Agricultural Products Wilmington, DE 19880-0402	Information not provided
Manzate 75DF	F	Dupont	75% Mancozeb
Maxim 4SC	F	Syngenta Crop Protection, Inc.	40.3% Fludioxomil
Penncozeb 75DF	F	Cerexagri 900 First Ave. King of Prussia, PA 19406	75% Mancozeb
Platinum 2SC	I	Syngenta Crop Protection, Inc.	21.6% Thiamethoxam
Poncho 250 5SC	I	Gustafson LLC 1400 Preston Rd., Suite 400 Plano, TX 75093	48% Clothianidin
Quadris 2.08SC	F	Syngenta Crop Protection, Inc.	22.9% Azoxystrobin
Quadris/Bravo 5.5SC	F	Syngenta Crop Protection, Inc.	Premix of azoxystrobin and chlorothalonil
Super Tin 80WP	F	Dupont	80% Triphenyltin Hydroxide
Tanos 50WG	F	Dupont	25% Cymoxanil + 25% Famoxadone
Tops MZ-Gaucho 9.75DS	F + I	Gustafson LLC	1.25% Imidacloprid + 2.5% Thiophanate methyl + 6% Mancozeb
Topsin M 70WP	F	Cerexagri	70% Thiophanate methyl
X77	S	Loveland Industries, Inc. P.O. Box 1289 Greeley, CO 80632-1289	Nonionic surfactant

* F= fungicide, I= insecticide, S= surfactant