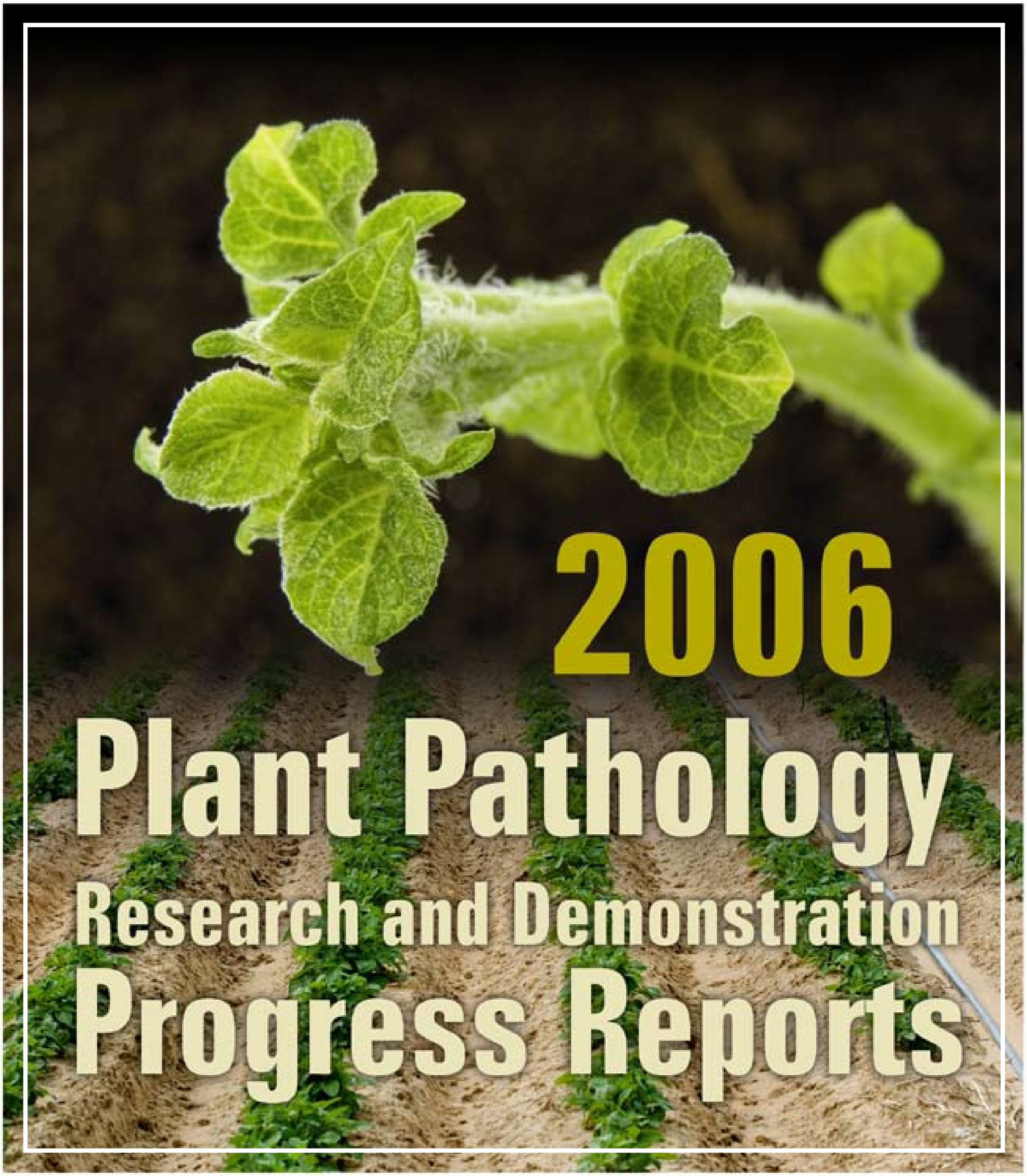

COMPILED BY G.D. FRANC AND W.L. STUMP

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OF WYOMING
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2006 Plant Pathology Research and Demonstration Progress Reports

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Additional copies are available by telephone (307-766-2397), or by e-mail: FrancG@UWYO.edu. This report will also be published during the spring of 2007 as MP101-07 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 Early Blight with Foliar Fungicide Programs in 2006**
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 Location	Field plots were placed at the Sustainable Agricultural Research & Extension Center (SAREC) located near Lingle, WY. The elevation of SAREC is placed at 4,165 ft MSL, and the soil type at the plot location was a Mitchell clay loam soil at pH = 7.9. Overhead sprinkler irrigation was applied as needed.
Plot Design	RCBD with 4 replications; plots were 4 rows (36-in row centers) by 20 ft long, with a 5 ft in-row buffer. All treatments were made to, and all data were collected from, the center two rows.
Plot Management	**Planting Date**: 10 May, 2006. **Variety**: FL1867 **Fertilizer**: 150 lb N + 80 lb P_2O_5 + 20lb S on 9 May, based on prior soil tests. **Herbicide**: Pre-emergence application of Dual II (1.33 pt product/A) + Prowl 3.3EC (1.5 pt product/A) on 15 May. Herbicides were then water (irrigation) incorporated.
Disease Development	On 20 and 26 July, foliar applications of *Alternaria solani* spores and hyphae harvested from culture plates (1 x 10^3 and 5.6 x 10^3 spores per ml, respectively) were made to the 5 ft in-row buffer rows of each plot in a total volume of 1.06 gal/1000 row-ft via a single-nozzle (8002 flat fan) equipped boom. On 9 August, a foliar application of *A. solani* spores also was made over the top of the center two treatment rows (inoculum concentration not determined). Early blight lesions were first detected in the inoculated buffer rows on 1 August and early blight quickly intensified in the buffer rows and placed considerable disease pressure on the treatment plots. White mold and late blight were not detected at any time during the growing season.
Treatment Applications	Treatments for foliar disease management consisted of spray programs initiated on 19 July and all application dates were as indicated in the following 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 Ratings	**Early blight** disease severity was measured by calculating the average number of lesions per leaflet for leaves collected on 1, 8, 16, 21, 29 August, and 6 September. Six leaves were randomly selected from each treatment plot; two leaves each from the top, middle, and bottom third of the canopy. The number of early blight lesions was counted on up to seven leaflets from each of the six leaves. Disease severity data from 1 August to 6 September 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 1, 6, and 12 September. A portion of the data is summarized in Table 1.
Harvest	Two rows by 10 ft were harvested with a one-row mechanical digger. Harvest was done on 21 September, and tubers were sorted and weighed to determine yield and grade on 25 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

Natural early blight disease development was greatly accelerated by inoculation, with severe disease development and defoliation first becoming evident in the buffer rows and then spreading to the treatment plots. By late season, early blight disease pressure was severe in the field plot area. White mold and late blight were not detected in the field plot area in 2006; the general weather trend was hot and dry with continued drought throughout the west, with very little natural precipitation. No foliar or tuber phytotoxicity was observed for any of the fungicide programs during 2006.

Disease severity data is summarized in Table 1. It should be noted that foliar lesion counts tend to underestimate disease severity as early blight progresses and becomes more severe in the plant canopy. This is because leaflets most affected by early blight are lost by the plant as defoliation occurs. Therefore, leaflets remaining on the plant and subsequently collected for disease ratings tend to be those less heavily infected. The AUDPC rating (measures season-long disease development) and late season foliar necrosis ratings in Table 1 become increasing important for rating fungicide program effects on early blight disease development, especially late in the season.

The nontreated check had a season-long early blight AUDC value of 106.1 and had almost total foliar necrosis (99.5 percent) evident by 12 September (Table 1). Endura applied alone (treatment 6; 8 applications) suppressed early blight almost completely with a season-long AUDPC value of 0.9 and foliar necrosis of only 11.5 percent on 12 September. Endura applied every third application in rotation with Echo ZN (treatment 12) was statistically equivalent to the Endura applied alone treatment ($P \leq 0.05$).

The SC formulation of LEM17 (treatment 3) was more effective than the WG formulation of LEM17 at the same use rate (treatment 2), with the liquid Lem17 formulation having significantly improved disease suppression and less foliar necrosis ($P \leq 0.05$). Treatment 2 (LEM17 1.67 SC @ 2 oz ai per acre) had significantly less foliar necrosis present on 12 September, than did all LEM17 WG formulations, even when compared to use rates of 5.0 oz ai per acre ($P \leq 0.05$).

Echo ZN (treatment 8), Bravo WeatherStik (treatment 9) and Manzate Prostick (treatment 11) all effectively suppressed early blight. The two chlorothalonil formulations (Echo ZN and Bravo WeatherStik) provided significantly better disease suppression when compared to Manzate Prostick ($P \leq 0.05$).

There is a trend in the data that may indicate Quadris is losing efficacy at the SAREC field plot location. Quadris applied in rotation with Echo ZN (treatment 7) resulted in more early blight development and had a greater season-long AUDPC compared to when Echo ZN was applied alone (treatment 8). Treatment 7 (Quadris/Echo) also had greater foliar necrosis evident on 12 September compared to treatment 8 (Echo only). Although these differences were not significant, the most effective azoxystrobin (Quadris) formulations in the past almost totally suppressed early blight development, and this failed to occur in 2006.

Garlic resulted in a significantly greater AUDPC value (137.1) and accelerated foliar necrosis (1 September data) compared to the nontreated check ($P \leq 0.05$). This is surprising, since garlic exhibited significant fungicidal properties when tested against Cercospora leaf spot on sugar beet in 2005 and 2006.

Treatment effects on yield and quality are shown in Table 2. Total yield was not significantly affected by treatment (P=0.05). The statistical variability inherent in small plot size and the abbreviated growing season often mask effects of early blight suppression on yield.

The contribution of properly timed fungicide applications to season-long early blight suppression was studied utilizing a series of Echo ZN treatments. Fungicide applications made at the time of disease onset are most important for season-long early blight suppression compared to applications made later in the season when disease is more evident. This is counterintuitive since the tendency is to wait until disease is more severe before applying fungicide. For making these comparisons, the initial application of Echo ZN was delayed 2 weeks (treatment 13) and 3 weeks (treatment 14), and subsequent early blight development for these treatments was compared to a fungicide program in which the initial application was not delayed (treatment 8). The AUDPC data revealed that the season-long Echo ZN program (treatment 8) suppressed early blight 76.6 percent compared to the nontreated check. Waiting either 2 weeks or 3 weeks to initiate the Echo ZN program resulted in a 180 percent or a 290 percent increase in the AUDPC values, respectively, compared to when fungicide application was not delayed.

Fungicide resistance management remains a critical need for our most effective fungicide formulations with single modes of action. Data for Endura revealed almost total early blight suppression, indicating that fungicide resistance management efforts must be put in place to preserve the useful life of this active ingredient. For example, azoxystrobin (Quadris) in the past provided almost total early blight suppression. Fungicide resistance management programs will include fungicides with active ingredients with differing modes of action applied either in combination or alternation. Although there are a number of factors to consider, the most effective fungicide partners for fungicide resistance management programs will be those fungicides effective for early blight suppression as a "stand-alone" product at similar application intervals.

Table 1. Effects of foliar fungicide programs on potato foliar disease (G.D. Franc and W.L. Stump, U of WY; 2006).

Treatment and rate (a.i./A)	Fungicide application dates[1]	Early blight lesions per leaflet				AUDPC[2]	Foliar necrosis (%)[2]		
		16 Aug	21 Aug	29 Aug	6 Sep		1 Sep	6 Sep	12 Sep
1. Nontreated check	NA	0.14 bc[3]	2.28 ab	7.56 b	7.29 b	106.1 b	72.8 b	97.0 a	99.5 a
2. LEM17 50WG (2 oz)	A-H	0.07 bcd	1.42 bcd	2.71 cd	7.15 bc	60.4 cd	17.0 cde	55.0 bc	91.5 b
3. LEM17 1.67SC (2 oz.)	A-H	0.05 bcd	0.51 def	1.18 fgh	5.78 b-e	36.3 efg	11.5 ef	27.2 ef	40.5 fg
4. LEM17 50WG (3.5 oz)	A-H	0.07 bcd	1.29 b-e	2.46 de	6.14 bcd	53.3 de	17.0 cde	55.0 bc	87.0 bcd
5. LEM17 50WG (5.0 oz)	A-H	0.06 bcd	0.88 c-f	1.57 efg	5.54 b-e	41.0 efg	17.0 cde	36.0 cde	62.0 def
6. Endura 70WG (3.9 oz)	A-H	0.00 d	0.05 ef	0.02 i	0.09 f	0.9 i	4.8 g	8.5 g	11.5 h
7. Quadris 2.08SC (0.15 lb) .... 7. Echo ZN 4.17F (1.11 lb)	A, D, G B, C, E, F, H	0.01 d	0.24 def	1.48 efg	5.37 cde	35.2 efg	11.5 ef	31.0 de	88.0 bc
8. Echo ZN 4.17F (1.11 lb): **0 wk delay** ...	A-H	0.06 bcd	0.16 ef	0.74 ghi	4.35 e	24.8 gh	12.0 def	36.0 cde	69.0 c-f
9. Bravo Weather Stik 6F (1.13 lb)	A-H	0.02 cd	0.16 ef	0.89 ghi	5.30 de	29.6 fg	12.0 def	31.0 de	59.5 ef
10. Garlic 1SC (10% v:v)	A-H	0.48 a	3.47 a	9.20 a	9.20 a	137.1 a	88.0 a	98.0 a	100.0 a
11. Manzate Prostick 75DF (1.13 lb)	A-H	0.04 bcd	0.73 def	2.42 de	6.89 bcd	52.3 de	19.8 cd	52.3 c	81.3 b-e
12. Endura 70WG (3.9 oz) .... 12. Echo ZN 4.17F (1.11 lb)	A, D, G B, C, E, F, H	0.01 d	0.02 f	0.23 hi	1.05 f	6.3 hi	7.3 fg	14.5 fg	16.1 gh
13. Echo ZN 4.17F (1.11 lb): **2 wk delay** ..	C-H	0.10 bcd	0.81 c-f	2.20 def	5.45 cde	45.6 def	23.5 c	50.0 cd	89.7 bc
14. Echo ZN 4.17F (1.11 lb): **3 wk delay** ..	D-H	0.08 b	1.98 bc	3.73 c	6.90 bcd	73.4 c	25.0 c	72.8 b	92.7 b

[1] Plots were planted 10 May, 2006 with variety FL1867, inoculated (early blight: 20, 26 July, & 9 August), and harvested 21 September. Fungicide applications were: A=19 July, B=25 July, C=1 August, D=8 August, E=16 August, F=22 August, G=29 August, H=6 September, NA = not-applicable.

[2] AUDPC = area under the disease progress curve for data collected from 1 August through 6 September. The AUDPC is an estimate of season-long disease severity. Foliar necrosis was estimated using the Horsfall-Barratt scale (0-11) and converted to percentage using the appropriate conversion table.

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

Table 2. The effects of foliar fungicide programs on potato yield and quality (G.D. Franc and W.L. Stump, U of WY; 2006).

Treatment and rate (a.i./A)	Fungicide application dates[1]	Yield (cwt)						
		US#1			US#2	Grade B	Cull	Total
		>10 oz	<10 oz	total				
1. Nontreated check	NA	19.3 a[2]	267.9 a	287.2 a	5.9 a	12.3 a	5.2 c	310.5 a
2. LEM17 50WG (2 oz)	A-H	24.5 a	255.7 a	280.2 a	3.1 a	11.0 ab	8.8 bc	303.1 a
3. LEM17 1.67SC (2 oz.)	A-H	32.3 a	237.0 a	269.3 a	11.0 a	11.1 ab	5.3 c	296.7 a
4. LEM17 50WG (3.5 oz)	A-H	17.2 a	275.3 a	292.6 a	2.3 a	10.3 ab	13.8 bc	319.0 a
5. LEM17 50WG (5.0 oz)	A-H	21.8 a	296.6 a	318.4 a	2.3 a	12.3 a	4.4 c	337.3 a
6. Endura 70WG (3.9 oz)	A-H	16.0 a	288.4 a	304.4 a	5.7 a	11.0 ab	19.4 ab	340.5 a
7. Quadris 2.08SC (0.15 lb) 7. Echo ZN 4.17F (1.11 lb)	A, D, G B, C, E, F, H	12.6 a	325.6 a	338.2 a	2.0 a	9.2 abc	15.6 bc	365.0 a
8. Echo ZN 4.17F (1.11 lb): **0 wk delay**	A-H	9.0 a	250.3 a	259.3 a	2.5 a	9.2 abc	28.3 a	299.2 a
9. Bravo Weather Stik 6F (1.13 lb)	A-H	22.4 a	257.7 a	280.1 a	2.5 a	6.9 bc	4.8 c	294.3 a
10. Garlic 1SC (10% v:v)	A-H	12.4 a	299.5 a	311.9 a	7.2 a	11.7 a	4.7 c	335.5 a
11. Manzate Prostick 75DF (1.13 lb)	A-H	27.2 a	301.1 a	328.3 a	0.0 a	12.1 a	13.9 bc	354.3 a
12. Endura 70WG (3.9 oz) 12. Echo ZN 4.17F (1.11 lb)	A, D, G B, C, E, F, H	26.5 a	259.6 a	286.1 a	4.7 a	10.1 ab	18.1 ab	319.0 a
13. Echo ZN 4.17F (1.11 lb): **2 wk delay**	C-H	17.5 a	301.3 a	318.8 a	6.5 a	7.3 bc	5.7 c	338.3 a
14. Echo ZN 4.17F (1.11 lb): **3 wk delay**	D-H	27.6 a	293.1 a	320.7 a	5.8 a	5.3 c	8.7 bc	340.5 a

[1] Plots were planted 10 May, 2006 with variety FL1867, inoculated (early blight: 20, 26 July, & 9 August), and harvested 21 September. Fungicide applications were: A=19 July, B=25 July, C=1 August, D=8 August, E=16 August, F=22 August, G=29 August, H=6 September, NA = not-applicable.

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

Research Project	**Soil-borne Nematode Suppression with Vydate C-LV, Telone, and Combined Applications for Potato Production and Potato Quality Improvement, 2006**
Research Team Tel: 307-766-2397 FAX: 766-5549 francg@uwyo.edu	G.D. Franc, W.L. Stump and M.T. Edwards* University of Wyoming College of Agriculture- Plant Sciences, Dept 3354 1000 E. University Ave. Laramie, WY 82071 * Dupont
Field Plot Location	Two separate field plots (potato cultivar Pike) were established at two field locations in cooperation with Jensen Farms. Both fields were located near Wiggins, Colorado. Overhead sprinkler irrigation was applied as needed.
Plot Design	The statistical design was a RCBD with 4 replications; plots were three rows (36-in row centers) by 15 ft long. All soil collections were associated with the center row of each plot and two rows by 10 feet were harvested for tuber yield, grade and quality.
Plot Management	**Location 1:** Jensen #21 whole field "strip plot" was located at the intersection over-lap of two center-pivot fields**.** **Planting Date**: Approximately 10 May. **Variety**: Cultivar "Pike." **Prior crop:** Corn 2005. **Location 2:** Jensen # 17/Munson field "half-circle" plot was located under center pivot irrigation. **Planting Date**: Approximately 13 May. **Variety**: Cultivar "Pike." **Prior crop:** fallow 2005, silage corn 2004.
Disease Development	Prior soil tests by the Cooperator revealed that stubby root nematodes were present at Location 1 and that abundant Pratylenchus were present at Location 2.

Treatment Applications

The four treatments tested for nematode suppression were a **Nontreated Check**, **Telone Standard** (25 gallons per acre knifed to a depth of 20 inches), **Vydate C-LV** (three applications by chemigation in ca. 0.1 inch water; each at 2.1 pints product per acre), and **Telone followed by Vydate C-LV**. Tarped areas (three rows by 15 feet) were covered during chemigation to shield plots [treatments 1 (Nontreated) and 2 (Telone)] from exposure to Vydate. Tarps were placed immediately prior to chemigation and then withdrawn immediately after chemigation.

Location 1: Telone was applied on 17 and 18 March, 2006. Vydate C-LV applications were made on 5 July, 26 July, and 17 August.

Location 2: Telone was applied on 20 March, 2006. Vydate C-LV applications were made on 22 June, 14 July, and 4 August.

Disease and other Treatment Ratings

Soil samples were collected on 20 June prior to Vydate application, and on 19 September, immediately before tuber harvest. Soil samples were represented by approximately 12 cores per field plot, each collected to a depth of approximately 12 inches. Soil cores from each plot were mixed by hand and approximately 1 L soil was placed in a zip-lock bag. This bag was placed in a second zip-lock bag which also contained a descriptive label for the field plot treatment represented by the sample.

Field plots were observed by the Cooperator throughout the season for appearance of phytotoxicity and/or growth response. Field plots were harvested with a small plot harvester on 19 September 2006. Total tuber yields were collected, and tubers were hand-sorted to determine tuber grade. After ca. 3 months storage at 38-39 F, 48 tubers per treatment plot for each location were rated for evidence of nematode related injury, including corky ring-spot (external and internal incidence, and internal severity) caused by tobacco rattle virus. Tubers were rated on 4 January, 2007.

Harvest

Two rows by 10 ft were harvested with a one-row mechanical digger. Harvest was done on 21 September, and tubers were sorted and weighed to determine yield and grade on 25 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

No phytotoxicity was observed during the growing season for any of the treatments, and no visible growth response was observed in the foliage during the growing season.

Table 1 summarizes nematode populations present in the soil on 20 June, following Telone application and prior to any Vydate application. Therefore, since no Vydate had been applied by this date, treatments 1 (nontreated) and 4 (Vydate) are equivalent on 20 June, and treatments 2 (Telone) and 3 (Telone + Vydate) are equivalent. These data reveal that Telone significantly reduced parasitic nematode populations compared to the plots that did not receive Telone, and that Telone had no significant effect on the non-parasitic nematode populations ($P \leq 0.05$). During soil collection for nematode assay, it was evident that Telone-treated soil had little “soil” odor (geosmin) associate with samples relative to the non-Telone treated soil. This difference was not evident during soil collections made on 19 September.

Table 2 summarizes nematode populations present in the soil on 19 September, following all treatment applications and immediately prior to harvest. Results reveal no significant effect of Vydate applied alone compared to the nontreated check for both Pratylenchus and total parasitic nematode population suppression ($P \leq 0.05$). Telone significantly reduced both Pratylenchus and total parasitic nematode populations ($P \leq 0.05$). The best nematode suppression was achieved when Telone + Vydate were applied in combination; both Pratylenchus and total parasitic nematode suppression was superior to that provided by Telone alone ($P \leq 0.05$). It also was interesting that none of the soil treatments significantly reduced nonparasitic nematode populations relative to the nontreated check ($P \leq 0.05$).

Tuber yield data in Table 4 reveal that the Telone + Vydate combination resulted in significantly greater yields for US#1 less than 10 ounce, total US#1, and total yield tuber categories compared to when Telone was applied alone. Vydate applied alone also was superior to Telone applied alone for the total yield category ($P \leq 0.05$). The data in Table 2 reveal that this total yield improvement was not correlated with superior parasitic nematode suppression.

Total yields for research plots at location 1 ranged from 247 to 351 cwt/acre, while the total yield from the commercial field was estimated at 448 cwt/acre. Yields for the nontreated and Vydate only treatments were negatively impacted by grassy weed pressure that developed over the growing season. Total yields for research plots at location 2 ranged from 290 to 423 cwt/acre, while the total yield from the commercial field was estimated at 454 cwt/acre.

Tuber quality ratings after ca. 3 month storage at 38-39 F indicated no evidence of corky ring-spot symptomatology on tuber surfaces or internally. A trace amount of necrosis was observed in a small number of tubers harvested from various plots, but none of this internal necrosis was indicative of corky ring-spot. No tuber deformity or any other manifestation of nematode infection or infestation was observed. In summary, it was not possible to measure any effect of soil treatment on tuber quality related to nematodes.

Table 1. Soil treatment effects on soil-borne nematode populations for collections on 20 June made at two field plot locations. Potato cultivar "Pike" was planted on ca. 10 May at location 1 and on ca. 13 May at location 2 (G.D. Franc, W.L. Stump, University of Wyoming, and M.E. Edwards, DuPont, Wiggins CO, 2006).

Treatment[1, 2]	Location[3]	Parasitic nematode populations (per 100 g soil) on 20 June, 2006[4]					Total parasitic nematodes	Total nonparasitic nematodes
		Praty	Root Knot	Stubby root	Stunt	Helico		
1. Nontreated	1	8.5	0.0	5.0	0.0	0.0	13.5	273.5
2. Telone	1	2.0	0.0	0.0	0.0	0.0	2.0	788.0
3. Telone + Vydate C-LV (3.77SL)	1	0.0	0.0	0.0	0.0	0.0	0.0	281.5
4. Vydate C-LV (3.77SL)	1	20.0	0.0	4.5	0.0	0.0	24.5	543.0
1. Nontreated	2	359.5	0.0	15.5	1.5	0.0	376.5	514.5
2. Telone only	2	42.0	0.0	0.0	0.0	0.0	42.0	193.5
3. Telone + Vydate C-LV (3.77SL)	2	81.0	0.0	0.0	0.0	0.0	81.0	457.0
4. Vydate C-LV (3.77SL)	2	252.0	0.0	0.0	2.5	0.0	254.5	285.5
1. Nontreated	**combined**	**184.0 a**	**0.0 a**	**10.3 a**	**0.8 a**	**0.0 a**	**195.0 a**	**394.0 a**
2. Telone only	**combined**	**22.0 b**	**0.0 a**	**0.0 a**	**0.0 a**	**0.0 a**	**22.0 b**	**490.8 a**
3. Telone + Vydate C-LV (3.77SL)	**combined**	**40.5 b**	**0.0 a**	**0.0 a**	**0.0 a**	**0.0 a**	**40.5 b**	**369.3 a**
4. Vydate C-LV (3.77SL)	**combined**	**136.0 a**	**0.0 a**	**2.3 a**	**1.3 a**	**0.0 a**	**139.5 a**	**414.3 a**

1 Telone standard fumigation treatments were applied at the rate of 25 gallons per acre by knives set at a 20 inch depth. **Location 1** = 17 and 18 March; **Location 2** = 20 March.

2 Vydate C-LV applications were made at a rate of 2.1 pints product per acre, with three applications made at each location. **Location 1** = 5 July, 26 July, and 17 August, **Location 2** = 22 June, 14 July, and 4 August.

3 **Location descriptions:** Location 1 = Jensen #21 whole field "strip plot" located at the intersection of two center-pivot fields. Plots received center pivot irrigation. Location 2 = Jensen # 17/Munson field "half-circle" plot located under center pivot irrigation.

4 Data were transformed (log 10) prior to analysis, nontransformed data is presented in the table. Treatment means followed by different letters differ significantly (Fisher's protected LSD, $P \leq 0.05$).

Table 2. Soil treatment effects on soil-borne nematode populations for collections on 19 September at two field plot locations. Potato cultivar "Pike" was planted on ca. 10 May at Location 1 and on ca. 13 May at Location 2 (G.D. Franc, W.L. Stump, University of Wyoming, and M.E. Edwards, DuPont, Wiggins CO, 2006).

Treatment[1,2]	Location[3]	Parasitic nematode numbers (per 100 g soil) on 19 September[4]					Total parasitic nematodes*	Total nonparasitic nematodes**
		Praty*	Root Knot	Stubby root	Stunt	Helico		
1. Nontreated	1	137.0	0.0	2.0	5.0	0.5	144.5	337.0
2. Telone	1	17.0	0.0	3.0	10.0	0.0	30.0	310.0
3. Telone + Vydate C-LV (3.77SL)	1	0.0	0.0	0.0	0.0	0.0	0.0	63.5
4. Vydate C-LV (3.77SL)	1	108.0	0.0	0.5	7.0	0.5	116.0	311.0
1. Nontreated	2	542.0	0.0	3.0	29.5	0.5	575.0	575.0
2. Telone only	2	130.0	0.0	0.0	13.0	0.0	143.0	886.5
3. Telone + Vydate C-LV (3.77SL)	2	114.0	0.0	0.0	0.0	0.0	114.0	666.0
4. Vydate C-LV (3.77SL)	2	355.0	0.0	1.0	1.5	0.0	357.0	371.5
1. Nontreated	combined	339.5 a	0.0 a	2.5 a	17.3 a	0.5 a	359.8 a	456.0 a
2. Telone only	combined	73.5 b	0.0 a	1.5 a	11.5 a	0.0 a	86.5 b	598.3 a
3. Telone + Vydate C-LV (3.77SL)	combined	57.0 c	0.0 a	0.0 a	0.0 a	0.0 a	57.0 c	364.8 a
4. Vydate C-LV (3.77SL)	combined	231.5 a	0.0 a	0.8 a	4.3 a	0.3 a	236.8 a	341.3 a

[1] Telone standard fumigation treatments were applied at the rate of 25 gallons per acre by knives set at a 20 inch depth. **Location 1** = 17 and 18 March; **Location 2** = 20 March.

[2] Vydate C-LV applications were made at a rate of 2.1 pints product per acre, with three applications made at each location. **Location 1** = 5 July, 26 July, and 17 August, **Location 2** = 22 June, 14 July, and 4 August.

[3] **Location descriptions:** Location 1 = Jensen #21 whole field "strip plot" located at the intersection of two center-pivot fields. Plots received center pivot irrigation. Location 2 = Jensen # 17/Munson field "half-circle" plot located under center pivot irrigation.

[4] Data were transformed (log 10) prior to analysis, nontransformed data is presented in the table. Treatment means followed by different letters differ significantly (Fisher's protected LSD, $P \leq 0.05$).

* Note: Significant location x treatment effect.

** Data were not transformed as it was deemed inappropriate for this data set.

Table 3. Soil treatment effects on soil-borne nematode populations for collections on 20 June made at two field plot locations. Potato cultivar "Pike" was planted on ca. 10 May at location 1 and on ca. 13 May at location 2 (G.D. Franc, W.L. Stump, University of Wyoming, and M.E. Edwards, DuPont, Wiggins CO, 2006).

Treatment[1,2]	Location[3]	Yield (cwt/A) on 19 September[4]						
		US#1			US#2	Grade B	Cull	Total
		>10 oz	<10 oz	Total				
1. Nontreated	1	0.0	196.2	196.2	1.4	48.9	0.0	246.6
2. Telone	1	24.1	248.7	272.8	0.0	33.7	8.6	315.1
3. Telone + Vydate C-LV (3.77SL)	1	35.0	277.2	312.2	0.0	35.1	3.5	350.8
4. Vydate C-LV (3.77SL)	1	3.5	235.6	239.1	0.0	37.0	8.2	284.4
1. Nontreated	2	13.4	232.6	246.0	2.6	34.7	6.2	289.5
2. Telone only	2	16.1	225.0	241.0	0.0	42.4	13.4	296.9
3. Telone + Vydate C-LV (3.77SL)	2	17.1	343.9	361.1	3.2	51.9	7.0	423.2
4. Vydate C-LV (3.77SL)	2	44.1	282.1	326.3	0.0	36.9	32.6	395.8
1. Nontreated	combined	6.7 a	214.4 b	221.1 c	2.0 a	41.8 a	3.1 a	268.0 c
2. Telone only	combined	20.1 a	236.9 b	256.9 bc	0.0 a	38.1 a	11.0 a	306.0 bc
3. Telone + Vydate C-LV (3.77SL)	combined	26.1 a	310.6 a	336.6 a	1.6 a	43.5 a	5.3 a	387.0 a
4. Vydate C-LV (3.77SL)	combined	23.8 a	258.9 b	282.7 b	0.0 a	37.0 a	20.4 a	340.1 ab

1 Telone standard fumigation treatments were applied at the rate of 25 gallons per acre by knives set at a 20 inch depth. **Location 1 =** 17 and 18 March; **Location 2 =** 20 March.

2 Vydate C-LV applications were made at a rate of 2.1 pints product per acre, with three applications made at each location. **Location 1** = 5 July, 26 July, and 17 August, **Location 2** = 22 June, 14 July, and 4 August.

3 **Location descriptions:** Location 1 = Jensen #21 whole field "strip plot" located at the intersection of two center-pivot fields. Plots received center pivot irrigation. Location 2 = Jensen # 17/Munson field "half-circle" plot located under center pivot irrigation.

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

Table 4. Soil treatment effects on nematode symptoms associated with tubers harvested from two field plot locations (G.D. Franc, W.L. Stump, University of Wyoming, and M.E. Edwards, DuPont, Wiggins CO, 2006).

Treatment[1,2]	Location[3]	Tuber Ratings for the presence of Nematode Symptoms[4]		
		External Incidence (%)	Internal Incidence (%)	Internal Severity (0-11)
1. Nontreated	1	0.0[5]	2.5	0.5
2. Telone	1	0.0	0.5	0.5
3. Telone + Vydate C-LV (3.77SL)	1	0.0	1.0	0.5
4. Vydate C-LV (3.77SL)	1	0.0	1.0	1.0
1. Nontreated	2	0.0	0.0	0.0
2. Telone only	2	0.0	0.0	0.0
3. Telone + Vydate C-LV (3.77SL)	2	0.0	0.0	0.0
4. Vydate C-LV (3.77SL)	2	0.0	0.0	0.0
1. Nontreated	**combined**	**0.0 a**	**1.25 a**	**0.25 a**
2. Telone only	**combined**	**0.0 a**	**0.25 a**	**0.25 a**
3. Telone + Vydate C-LV (3.77SL)	**combined**	**0.0 a**	**0.5 a**	**0.25 a**
4. Vydate C-LV (3.77SL)	**combined**	**0.0 a**	**0.5 a**	**0.50 a**

[1] Telone standard fumigation treatments were applied at the rate of 25 gallons per acre by knives set at a 20 inch depth. **Location 1 =** 17 and 18 March; **Location 2 =** 20 March.

[2] Vydate C-LV applications were made at a rate of 2.1 pints product per acre, with three applications made at each location. **Location 1** = 5 July, 26 July, and 17 August, **Location 2** = 22 June, 14 July, and 4 August.

[3] **Location descriptions:** Location 1 = Jensen #21 whole field "strip plot" located at the intersection of two center-pivot fields. Plots received center pivot irrigation. Location 2 = Jensen # 17/Munson field "half-circle" plot located under center pivot irrigation.

[4] Incidence is the percentage of tubers (48 tubers rated per treatment) exhibiting symptoms consistent with corky-ring-spot (presumptive tobacco rattle virus). Severity ratings are for only those tubers with internal incidence of internal necrosis. A rating of 1 = trace internal necrosis was found that was not indicative of corky ring-spot.

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

Research Project — **Management of Potato Insects with Foliar Insecticide Programs, 2006**

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Field Plot Location

Field plots were placed at the Sustainable Agricultural Research & Extension Center (SAREC) located near Lingle, WY. The elevation of SAREC is placed at 4,165 ft MSL, and the soil type at the plot location was a Mitchell clay loam soil at pH = 7.9. Overhead sprinkler irrigation was applied as needed.

Plot Design

RCBD with 4 replications; plots were 4 rows (36-in row centers) by 20 ft long, with a 5 ft in-row buffer. All treatments were made to, and all data were collected from, the center two rows. Border rows were not treated with insecticide to enable insect pest development. A six foot, unplanted buffer also existed between blocks. These buffers were allowed to become weedy to attract additional insect pressure.

Plot Management

Planting Date: 10 May, 2006.
Variety: FL1867
Fertilizer: 150 lb N + 80 lb P_2O_5 + 20lb S on 9 May.
Herbicide: Pre-emergence application of Dual II (1.33 pt product/A) + Prowl 3.3EC (1.5 pt product/A) on 15 May. Herbicides were then water (irrigation) incorporated.

Insect Development

All insect development relied on natural infestations. The buffer rows were left untreated to increase insect pressure.

Treatment Applications

Treatments for insect management were initiated on 13 July and application dates are indicated in the Tables. Insecticide applications were based on insect pest monitoring. Insecticides 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).

Insect Treatment Ratings

Initial insect populations were estimated on 13 July by conducting sweep net counts (5 sweeps along the length of the plot) for 12 randomly chosen plots. Additionally, potato psyllid (*Paratrioza cockerelli*) populations were estimated by randomly selecting 10 lower leaves and counting the number of psysllid nymphs present. Insects and spiders collected by the sweep net were sorted into groups that included flea beetles, leafhoppers, and "beneficials" (primarily nabids, lace wings, ladybugs and spiders). Sweep net collections were repeated during the season, with population estimates made on 19, 25 July, and 1, 11, 21, 28 August. A portion of the data are summarized in the

	Tables. The specific flea beetle and leaf hopper species captured by the sweep net was not determined. Beneficials were broadly categorized and counted, and the combined total was analyzed. Psyllid nymph populations were monitored on each date (see above) by randomly collecting five lower on each nontreated check plot. When psyllid nymphs were detected in the nontreated check, psyllid populations were estimated for all plots.
Harvest	No yield data were collected.
Statistical Analysis	ANOVA with four replications. Mean separations were done using Fisher's protected LSD ($P \leq 0.05$).

Results and Discussion

Insect pest development was not severe during in the plots in 2006. One potato psyllid nymph was detected on 13 July and no other nymphs were detected later during the growing season (data not shown). Also, several Colorado potato beetle adults and larvae were detected in the plots, but populations failed to develop (data not shown). Therefore, it was not possible to collect meaningful data for potato psyllid and Colorado potato beetle.

Flea beetle populations (potato flea beetle, presumptive *Epitrix cucumeris*, and to a lesser extent the Western pale-striped flea beetle, presumptive *Systena blanda*) were moderate and resulted in visible feeding injury to the foliage. Treatment effects on flea beetle populations are summarized in Table 1. Treatments generally caused a significant reduction in flea beetle populations during the week following application ($P \leq 0.05$), and then populations tended to recover. For example, the treatment effects of 13 July were measurable on 19 July, but not on 25 July ($P \leq 0.05$). The treatment effects from 25 July were measurable on 1 August, but not on 11 August ($P \leq 0.05$). Treatment effects from 16 August appeared to linger longer in the late season flea beetle population compared to early-season persistence, with significant differences detected on 28 August ($P \leq 0.05$). The effect of Lannate LV (treatment 7) appeared to be less consistent than the other insecticide treatments.

Treatment effects on leaf hopper (Cicadellidae) populations are shown in Table 2. Leaf hopper populations levels were low in all plots and failed to develop. On 21 August when the greatest leaf hopper populations were present, all insecticide treatments resulted in significant reductions of leaf hoppers compared to the nontreated check ($P \leq 0.05$).

Treatment effects on total “beneficial” insect and spider populations are summarized in Table 3. There were no significant treatment affects on these populations compared to the nontreated check (P=0.05).

Table 1. Effects of foliar insecticides on flea beetle populations following application to potato (G.D. Franc and W.L. Stump, SAREC: U of WY, 2006).

Treatment and rate (a.i. /A)	Application dates[1]	Flea beetle population estimates (per 5 sweeps)						
		13 Jul ave. initial population	19 Jul	25 Jul	1 Aug	11 Aug	21 Aug	28 Aug
1. Nontreated check	NA	7.2	11.5 a[2]	8.8 a	8.5 b	8.5 a	16.8 a	22.5 a
2. Proprietary compound (1x) + 2. Dyne-Amic (0.5% v:v)	A-C	7.2	2.0 b	7.5 a	3.3 cd	8.5 a	1.3 b	2.3 bc
3. Proprietary compound (2x) + 3. Dyne-Amic (0.5% v:v)	A-C	7.2	1.8 b	5.8 a	2.8 cd	6.8 a	0.8 b	3.8 bc
4. Proprietary compound (3x) + 2. Dyne-Amic (0.5% v:v)	A-C	7.2	1.0 b	5.8 a	2.0 d	7.0 a	0.5 b	0.5 c
5. Proprietary compound (3x)	A-C	7.2	0.5 b	5.0 a	5.5 bc	8.3 a	0.3 b	1.3 bc
6. Asana XL 0.66EC (0.03 lb)	A-C	7.2	0.0 b	6.3 a	0.8 d	7.0 a	0.5 b	2.5 bc
7. Lannate LV 2.4SC (0.63 lb) + 7. X77 (0.25% v:v)	A-C	7.2	3.5 b	11.0 a	12.0 a	8.5 a	0.0 b	10.5 b

[1] Plots were planted on 10 May, 2006 with variety FL1867. Insecticide application dates were: A = 13 July, B = 25 July, C = 16 August, and NA = not-applicable. Populations were estimated on the dates indicated for each column.

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

Table 2. Effects of foliar insecticides on leaf hopper populations following application to potato (G.D. Franc and W.L. Stump, SAREC: U of WY, 2006).

Treatment and rate (a.i. /A)	Application dates[1]	Leaf hopper population estimates (per 5 sweeps)						
		13 Jul ave. initial population	19 Jul	25 Jul	1 Aug	11 Aug	21 Aug	28 Aug
1. Nontreated check	NA	1.0	0.5 a[2]	0.8 a	0.0 a	0.5 a	1.3 a	1.0 a
2. Proprietary compound (1x) + 2. Dyne-Amic (0.5% v:v)	A-C	1.0	0.3 a	0.0 a	1.0 a	0.5 a	0.3 b	0.8 a
3. Proprietary compound (2x) + 3. Dyne-Amic (0.5% v:v)	A-C	1.0	1.0 a	0.3 a	0.5 a	0.5 a	0.3 b	0.0 a
4. Proprietary compound (3x) + 2. Dyne-Amic (0.5% v:v)	A-C	1.0	0.3 a	0.0 a	0.5 a	0.3 a	0.3 b	1.5 a
5. Proprietary compound (3x)	A-C	1.0	0.3 a	0.3 a	0.3 a	0.5 a	0.3 b	0.5 a
6. Asana XL 0.66EC (0.03 lb)	A-C	1.0	0.0 a	0.0 a	0.0 a	0.3 a	0.0 b	0.0 a
7. Lannate LV 2.4SC (0.63 lb) + 7. X77 (0.25% v:v)	A-C	1.0	0.5 a	0.5 a	0.0 a	0.0 a	0.0 b	0.0 a

[1] Plots were planted on 10 May, 2006 with variety FL1867. Insecticide application dates were: A = 13 July, B = 25 July, C = 16 August, and NA = not-applicable. Populations were estimated on the dates indicated for each column.

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

Table 3. Effects of foliar insecticides on "beneficial" populations following application to potato (G.D. Franc and W.L. Stump, SAREC: U of WY, 2006).

Treatment and rate (a.i. /A)	Application dates[1]	Total beneficial population estimates (per 5 sweeps)[2]						
		13 Jul ave. initial population	19 Jul	25 Jul	1 Aug	11 Aug	21 Aug	28 Aug
1. Nontreated check	NA	1.1	1.3 a[3]	0.5 a	1.3 a	2.0 a	0.5 a	0.3 a
2. Proprietary compound (1x) + 2. Dyne-Amic (0.5% v:v)	A-C	1.1	1.3 a	0.5 a	1.3 a	0.8 a	0.3 a	0.5 a
3. Proprietary compound (2x) + 3. Dyne-Amic (0.5% v:v)	A-C	1.1	1.0 a	0.8 a	0.8 a	0.3 a	0.0 a	0.0 a
4. Proprietary compound (3x) + 2. Dyne-Amic (0.5% v:v)	A-C	1.1	1.0 a	0.8 a	0.5 a	0.8 a	0.3 a	0.5 a
5. Proprietary compound (3x)	A-C	1.1	2.3 a	2.3 a	1.0 a	1.3 a	0.3 a	0.5 a
6. Asana XL 0.66EC (0.03 lb)	A-C	1.1	0.0 a	0.3 a	0.0 a	0.3 a	0.0 a	0.8 a
7. Lannate LV 2.4SC (0.63 lb) + 7. X77 (0.25% v:v)	A-C	1.1	0.5 a	0.8 a	0.8 a	0.5 a	0.5 a	1.0 a

[1] Plots were planted on 10 May, 2006 with variety FL1867. Insecticide application dates were: A = 13 July, B = 25 July, C = 16 August, and NA = not-applicable. Populations were estimated on the dates indicated for each column.

[2] Beneficial insects include the following: nabids, lace wings, lady bug beetles and spiders.

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

Research Project	**Potato Vine Desiccant (Reglone) Efficacy when Tank-Mixed with Tin- and Copper-based Fungicides, 2006**
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 Location	Field plots were placed at the Sustainable Agricultural Research & Extension Center (SAREC) located near Lingle, WY. The elevation of SAREC is placed at 4,165 ft MSL, and the soil type at the plot location was a Mitchell clay loam soil at pH = 7.9. Overhead sprinkler irrigation was applied as needed.
Plot Design	The field plot design was a RCBD with four replications; each plot was four rows (36-in row centers) by 20 ft long, with a 5 ft in-row buffer. All treatments were made to, and all data were collected from, the center two rows.
Plot Management	**Planting Date**: 10 May, 2006. **Variety**: FL1867 **Fertilizer**: 150 lb N + 80 lb P_2O_5 + 20 lb S on 9 May. **Herbicide**: A pre-emergence application of Dual II (1.33 pt product/A) + Prowl 3.3EC (1.5 pt product/A) was applied on 15 May. Herbicides were then water (irrigation) incorporated.
Treatment Applications	Vine desiccation and fungicide treatments were made on 28 August and repeated on 5 September. The potato foliage on 28 August was still relatively green and vines were ca. 80 percent lodged at that time. However, foliar necrosis from early blight disease was present and the foliage was estimated at 14 to 24 percent necrosis and all stems were green. Environmental conditions at the time of treatment applications (10 AM) were an air temperature of 79 F, 75 percent cloud cover and good soil moisture was present. Treatments 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). Fungicides for treatments 2, 3 and 4 were added to the container followed by the desiccant (tank-mix sequence), agitated and then the treatments were immediately applied. Gramoxone (paraquat) was included as a vine desiccation standard for comparison of efficacy.
Desiccation Treatment Evaluations	Vine desiccation effects were visually estimated by rating vines for the percentage of foliar and stem necrosis present using the Horsfall-Barratt rating scale (0-11). Foliar and stem necrosis were both rated on 28 August (prior to initial treatment application), 29 August, and 1, 5, 6, and 12 September. For an overall estimate of necrosis, an area under the desiccation progress curve (AUDesPC) was individually calculated for both foliar and stem necrosis ratings.

Harvest On 21 September, 20 US #1 tubers were randomly selected from the treated rows in each plot. These tubers stored in paper bags, and 10 tubers were evaluated per replication for decay (disease) and internal defects 4 January, 2007 after ca. 3 months storage at 38-39 F.

Statistical Analysis ANOVA with four replications. Mean separations were done using Fisher's protected LSD ($P \leq 0.05$).

Results and Discussion

Foliar and stem necrosis ratings are important for assessment of vine dessication efficacy; if green tissue remains on plants, this increases the potential for tuber skinning (lack of skin set) and the subsequent post-harvest disease development by a number of fungi that gain entry through breaks in the periderm associated with harvest injury. Green tissue also represents potential sites for infection and spore development by the late blight fungus, as well as late season feeding sites for viruliferous aphids. Late season translocation of virus to tubers can occur in hours or days, depending on the virus involved and site of plant inoculation during feeding. Therefore, rapid and complete vine dessication is important for tubers destined for storage and essential for tubers used as seed.

Initial foliar necrosis ratings on 28 August revealed that the plots randomly selected for treatment 6 (Gramoxone) had significantly more foliar necrosis present compared to treatment 3 ($P \leq 0.05$). This measurement was independent of treatment effect, since this estimate was made immediately before treatment application. All treatments had significantly more foliar necrosis present compared to the non-treated check (treatment 1) within the first day following application, as well as through the 6 September data collection (Table 1: $P \leq 0.05$). By 12 September, foliar necrosis in the non-treated check reached 100 percent, the same value as that measured for all treatments on this date. All dessication treatments were statistically equivalent to Gramoxone (treatment 6; paraquat) throughout the data collection period for both foliar necrosis (Table 1) and stem necrosis ratings (Table 2: $P \leq 0.05$). The AUDesPC estimate of foliar necrosis (Table 1) and stem necrosis (Table 2) revealed that all dessication treatments were statistically equivalent, and significantly better than the non-treated check ($P \leq 0.05$). Therefore, there is no indication that the tank-mix application of Super Tin (triphenyl tin) or Kocide (copper hydroxide) and Reglone affected the desiccant activity of Reglone ($P \leq 0.05$). No treatment effects were observed for tuber storage quality ($P \leq 0.05$).

Table 1. Reglone vine desiccant efficacy when tank-mixed with tin- and copper-based fungicides; effects on foliar necrosis (G.D. Franc and W.L. Stump, SAREC, Univ. of WY; 2006).

Treatment and rate (product /A)	Application dates[1]	Foliar necrosis ratings (%)						AUDesPC[2]
		Initial 28 Aug	29 Aug	1 Sep	5 Sep	6 Sep	12 Sep	
1. Non-treated check	NA	20.2 ab[3]	23.5 b	58.0 b	97.0 b	98.0 b	100.0 a	107.2 b
2. Super Tin 80WP (3.75 oz)	A	17.0 ab	59.5 a	98.0 a	100.0 a	100.0 a	100.0 a	126.8 a
2. Reglone 3.73SC (2 pt)	A							
2. Reglone 3.73SC (2 pt)	B							
3. Kocide 2000 53.8WP (2.0 lb)	A	14.5 b	47.3 a	98.0 a	99.5 a	100.0 a	100.0 a	125.0 a
3. Reglone 3.73SC (2 pt)	A							
3. Reglone 3.73SC (2 pt)	B							
4. Super Tin 80WP (3.75 oz)	A	20.2 ab	59.5 a	98.5 a	100.0 a	100.0 a	100.0 a	127.5 a
4. Reglone 3.73SC (2 pt)	A							
4. Kocide 2000 53.8WP (2.0 lb)	B							
4. Reglone 3.73SC (2 pt)	B							
5. Reglone 3.73SC (2 pt)	A, B	20.2 ab	59.5 a	98.5 a	100.0 a	100.0 a	100.0 a	127.5 a
6. Gramoxone 3SC (1.3 pt) + X77 (0.25% v:v)	A, B	23.5 a	55.0 a	98.0 a	100.0 a	100.0 a	100.0 a	126.5 a

[1] Field plots were planted on 10 May, 2006 with variety FL1867 and harvested by hand on 21 September. Tubers were placed in cold storage for 2 months and will be evaluated for external and internal defects. Treatment application dates were: A = 28 August, B = 5 September and NA = not-applicable.

[2] Area under the desiccation progress curve was calculated for data collected from 28 August through 12 September. Data were collected as Horsfall-Barratt ratings (0-11) on the dates indicated in the Table.

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

Table 2. Reglone vine desiccant efficacy when tank-mixed with tin- and copper-based fungicides; effects on stem necrosis (G.D. Franc and W.L. Stump, SAREC, Univ. of WY; 2006)

Treatment and rate (product /A)	Application dates[1]	Stem necrosis ratings (%)						AUDesPC[2]
		Initial 28 Aug	29 Aug	1 Sep	5 Sep	6 Sep	12 Sep	
1. Non-treated check	NA	0.0 a[3]	14.5 b	23.5 b	45.0 b	55.0 b	96.0 b	73.0 b
2. Super Tin 80WP (3.75 oz)	A	0.0 a	27.2 a	72.7 a	94.0 a	95.2 a	100.0 a	104.3 a
2. Reglone 3.73SC (2 pt)	A							
2. Reglone 3.73SC (2 pt)	B							
3. Kocide 2000 53.8WP (2.0 lb)	A	0.0 a	23.5 a	64.0 a	91.5 a	96.0 a	100.0 a	102.6 a
3. Reglone 3.73SC (2 pt)	A							
3. Reglone 3.73SC (2 pt)	B							
4. Super Tin 80WP (3.75 oz)	A	0.0 a	31.0 a	72.7 a	95.2. a	97.0 a	100.0 a	106.9 a
4. Reglone 3.73SC (2 pt)	A							
4. Kocide 2000 53.8WP (2.0 lb)	B							
4. Reglone 3.73SC (2 pt)	B							
5. Reglone 3.73SC (2 pt)	A, B	0.0 a	27.2 a	69.0 a	91.5 a	97.0 a	100.0 a	104.6 a
6. Gramoxone 3SC (1.3 pt) + X77 (0.25% v:v)	A, B	0.0 a	23.5 a	79.7 a	95.2 a	98.0 a	100.0 a	108.0 a

[1] Field plots were planted on 10 May, 2006 with variety FL1867 and harvested by hand on 21 September. Tubers were placed in cold storage for 2 months and will be evaluated for external and internal defects. Treatment application dates were: A = 28 August, B = 5 September and NA = not-applicable.

[2] Area under the desiccation progress curve was calculated for data collected from 28 August through 12 September. Data were collected as Horsfall-Barratt ratings (0-11) on the dates indicated in the Table.

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

Table 3. Reglone vine desiccant efficacy when tank-mixed with tin- and copper-based fungicides; effects on tuber quality (G.D. Franc and W.L. Stump, SAREC, Univ. of WY; 2006).

Treatment and rate (product/A)	Application dates[1]	Potato tuber ratings[2]	
		Surface area decayed (%)	Stem end discoloration (0-10)
1. Nontreated check	NA	3.0 a[3]	0.1 a
2. Super Tin 80WP (3.75 oz)	A	3.5 a	0.1 a
2. Reglone 3.73SC (2 pt)	A		
2. Reglone 3.73SC (2 pt)	B		
3. Kocide 2000 53.8WP (2.0 lb)	A	1.7 a	0.0 a
3. Reglone 3.73SC (2 pt)	A		
3. Reglone 3.73SC (2 pt)	B		
4. Super Tin 80WP (3.75 oz)	A	2.0 a	0.2 a
4. Reglone 3.73SC (2 pt)	A		
4. Kocide 2000 53.8WP (2.0 lb)	B		
4. Reglone 3.73SC (2 pt)	B		
5. Reglone 3.73SC (2 pt)	A, B	2.1 a	0.2 a
6. Gramoxone 3SC (1.3 pt) + X77 (0.25% v:v)	A, B	2.0 a	0.2 a

1 Field plots were planted on 10 May, 2006 with variety FL1867 and harvested by hand on 21 September. Treatment application dates were: A = 28 August, B = 5 September and NA = not-applicable.

2 Tubers were harvested 21 September and evaluated 4 January, 2007 after ca. 3 months storage at ca. 39 F. Ten tubers per replication were rated. Surface area values indicate the estimated percentage of the tuber surface affected by any lesion; most lesions observed were associated with pitting (presumptive insect injury) and no surface decay was observed that was associated with bacteria or "fungi" (soft rot, late blight, or early blight). Stem end discoloration values indicate the estimated percentage of the vascular ring discolored at that 1/8 inch depth.

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

Research Project	**Russet Norkotah Clonal Selection Performance Trial; Wyoming Results for 2006 at SAREC (Lingle, WY).**
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 Location	Field plots were placed at the Sustainable Agricultural Research & Extension Center (SAREC) located near Lingle, WY. The elevation of SAREC is placed at 4,165 ft MSL, and the soil type at the plot location was a Mitchell clay loam soil at pH = 7.9. Overhead sprinkler irrigation was applied as needed.
Plot Design	Randomized complete block design with three replications. Each plot was one row (36-in row centers) by 15 ft long (15 seed pieces were planted per plot). [Note: clone 9 (replication #1) had only five seed pieces planted due to shortage of seed; all data from replication 1 were multiplied by 3 to standardize the data set. Replication numbers 2 and 3 for clone 9 each had 15 seed pieces planted per plot.]
Plot Management	**Planting Date**: 10 May, 2006. **Variety**: Various clones of Russet Norkotah **Fertilizer**: 150 lb N + 80 lb P_2O_5 + 20 lb S on 9 May. **Herbicide**: Pre-emergence application of Dual II (1.33 pt product/A) + Prowl 3.3EC (1.5 pt product/A) on 15 May. Herbicides were then water (irrigation) incorporated. No fungicides and no insecticides were applied to the plants.
Potato Development	Potato stands were determined on 6, 9, and 15 June. Plant vigor (scale 0 = dead to 10 = maximum vigor) was visually evaluated on 11 August. An overall "average" crop appearance was assigned the value = 5; therefore, all clonal comparisons were made relative to this value. Data are summarized in Table 1.
Harvest	The entire 15 ft for each plot was harvested with a one-row mechanical digger on 21 September. Tubers were sorted and weighed to determine the yield and grade categories on 25 September. All yield and tuber quality data are summarized in Table 2.
Statistical Analysis	ANOVA with three replications. Mean separations were done using Fisher's protected LSD ($P \leq 0.05$).

Results and Discussion

There were no significant differences detected for plant stand, plant population vigor, plot yield and tuber quality (grade) among the twelve clones (*P*=0.05). However, trends in the data indicate that all selections except Texas 278 (treatment 6) had improved vigor relative to the Norkotah standard selection (treatments 11 and 12). Trends also indicate that the total tuber yield of the Norkotah selections exceeded that of the Norkotah standards, except for Nebraska LT and Nebraska LS-3 (treatments 1 and 5, respectively). Data over years and location needs to be combined to determine if these trends are meaningful.

Table 1. Emergence and plant vigor comparisons among Russet Norkotah clones planted at Lingle, Wyoming (G.D. Franc and W.L. Stump, Univ. of WY & G. Leever, PCAN; 2006).

Russet Norkotah Clone [1]	Plant stand (15 max)			Relative plant vigor[2]
	6 June	9 June	15 June	11 August
1. Nebraska LT	12.0 a[3]	14.0 a	14.7 a	4.7 a
2. Nebraska LW	12.3 a	14.0 a	14.0 a	5.3 a
3. Nebraska LS-2	11.3 a	13.3 a	13.3 a	5.3 a
4. Nebraska LS-1	12.7 a	14.7 a	15.0 a	5.0 a
5. Nebraska LS-3	14.3 a	14.7 a	14.7 a	5.0 a
6. Texas 278	14.0 a	14.3 a	14.3 a	4.0 a
7. Texas 223	12.7 a	13.0 a	13.7 a	5.0 a
8. Texas 112	11.3 a	12.7 a	13.3 a	5.0 a
9. Colorado #8	10.3 a	10.3 a	10.7 a	5.3 a
10. Colorado #3	12.7 a	13.7 a	14.7 a	6.0 a
11. Regular; Thompson	12.7 a	13.3 a	13.7 a	4.0 a
12. Regular; Schekall	9.7 a	11.7 a	13.3 a	4.0 a

1 Plots were planted on 10 May, 2006; 15 seed pieces were planted per plot.

2 Plant population vigor included overall clonal plant size and appearance; the rating scale ranged from 0 (dead) to 10 (maximum vigor), with an overall “average” crop appearance assigned the value = 5. Therefore, all clonal comparisons were made relative to this average value (5).

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

Table 2. Potato yield and quality among Russet Norkotah clones at Lingle, Wyoming (G.D. Franc and W.L. Stump, Univ. of WY & G. Leever, PCAN; 2006).

Russet Norkotah Clone[1]	Yield (cwt)						
	US#1			US#2	Grade B	Cull	Total
	>10 oz	<10 oz	Total				
1. Nebraska LT	141.6 a[2]	113.6 a	255.2 a	45.5 a	16.5 a	13.9 a	331.1 a
2. Nebraska LW	123.6 a	125.2 a	248.8 a	57.4 a	16.0 a	36.1 a	358.3 a
3. Nebraska LS-2	168.1 a	131.6 a	299.8 a	74.9 a	13.4 a	13.7 a	401.7 a
4. Nebraska LS-1	125.2 a	122.3 a	247.5 a	62.9 a	16.8 a	35.8 a	363.0 a
5. Nebraska LS-3	128.7 a	104.2 a	233.0 a	42.3 a	18.1 a	23.2 a	316.5 a
6. Texas 278	153.6 a	132.6 a	286.2 a	38.4 a	11.6 a	3.2 a	339.4 a
7. Texas 223	172.9 a	139.4 a	312.3 a	40.7 a	19.5 a	19.5 a	392.0 a
8. Texas 112	182.3 a	105.2 a	287.5 a	76.5 a	16.5 a	18.2 a	398.7 a
9. Colorado #8	179.4 a	89.7 a	269.1 a	52.3 a	20.0 a	35.7 a	377.0 a
10. Colorado #3	199.4 a	133.6 a	333.0 a	101.0 a	25.8 a	33.6 a	493.4 a
11. Regular; Thompson	139.1 a	121.6 a	260.7 a	43.9 a	17.7 a	8.7 a	331.1 a
12. Regular; Schekall	153.9 a	120.4 a	274.3 a	39.0 a	18.2 a	6.0 a	337.5 a

[1] The planting date was 10 May, 2006; 15 seed pieces were planted per plot.
[2] Treatment means followed by different letters differ significantly (Fisher's protected LSD, $P \leq 0.05$).

Research Project	**Cercospora Leaf Spot and Powdery Mildew Management in Sugar Beet with Foliar Fungicide Programs, 2006**
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	Field plots were placed at the Sustainable Agricultural Research & Extension Center (SAREC) located near Lingle, WY. The elevation of SAREC is placed at 4,165 ft MSL, and the soil type at the plot location was a Mitchell clay loam soil at pH = 7.9. Overhead sprinkler irrigation was applied as needed.
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:** 28 April, 2006 **Variety:** Monohikari **Fertilizer:** 150 lb N + 75 lb P_2O_5 + 20 lb S **Herbicide:** Post-emergence applications (all rates in product/A) of Betamix (24 oz) + Upbeet (1 oz); followed by Beta Progress (21 oz) + Upbeet (1 oz); followed by Beta Progress (21 oz) + Select (8 fl oz).
Disease Development	Field plots were exposed to powdery mildew and Cercospora leaf spot to increase disease pressure. On 8 August, 2-3 greenhouse-grown sugar beet plants (one pot) infected with Cercospora leaf spot (CLS) and powdery mildew symptoms and signs were transplanted into the buffer rows of alternating treatment plots. On 10 and 21 August, foliar applications of *Cercospora beticola* spores were 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). On 28 August, sugar beet leaves with abundant CLS lesions were spread around the plot area (about 1 leaf per plot).
Treatment Applications	Foliar fungicide applications indicated as A, B and C in the Tables, were made on 9, 21 August, and 6 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 15, 21, 28 August, and 5, 12, 21 September. The lesions on five randomly selected

leaves per plot were counted and an average was calculated for each plot. Disease severity data from 15 August through 21 September 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. Powdery mildew did not develop in the field plot area.

Harvest One 20 ft row of the two treated rows was harvested on 2 October and the total beet root yield was determined. The percentage of total sucrose was determined by Western Sugar's tare laboratory.

Statistical Analysis ANOVA with four replications. Mean separations were done using Fisher's protected LSD ($P \leq 0.05$).

Results and Discussion

Weather conditions in 2006 were not conducive for the development of powdery mildew and Cercospora leaf spot (CLS). Therefore, inoculation had little influence on disease development. Inoculation was more successful for CLS than for PM; CLS development was light for 2006.

CLS disease severity data are summarized in Table 1. Fungicide treatments had significant effects on the AUDPC (season-long CLS) values ($P \leq 0.05$). Most fungicide programs reduced the AUDPC compared to the non-treated check ($P \leq 0.05$). Treatments 6 (LEM17 at 4 oz product/acre) 8 (LEM17 at 10 oz product/A), and 13 (Eminent/Headline/Eminent) had AUDPC values equivalent to the non-treated check (P=0.05).

The efficacy of LEM17 applied alone was similar to that of Punch applied alone (P=0.05). However, results for treatment 9 suggest that a synergy exists when LEM17 and Punch are simultaneously applied as a tank-mix. Eminent and strobilurin programs that include more traditional chemistries such as Super Tin and Topsin offered the most consistent CLS suppression at the 2006 field plot area. Cercospora isolates recovered from the field plot area will be tested for benzimidazole (Topsin) sensitivity. Benzimidazole insensitivity is widespread in the High Plains production region; field plot inoculations were done with benzimidazole sensitive isolates. Garlic significantly reduced CLS compared to the non-treated check (P=0.05) for the second year of testing.

Treatment effects on root yield, sugar content and sugar quality are summarized in Table 2. Fungicide treatments did not significantly effect root yield, sugar or the sugar lost to molasses (P=0.05). However, there was a general trend in the data towards improved percentage of total sucrose and improved sugar quality (percentage of sucrose lost to molasses) when fungicide was applied.

Table 1. Effects of foliar fungicide programs on Cercospora leaf spot development (G.D. Franc and W.L. Stump, Univ. of WY; 2006).

Treatment and rate (product/A)	Application dates[1]	Number of Cercospora lesions per leaf						AUDPC[2]
		15 Aug	21 Aug	28 Aug	5 Sep	12 Sep	21 Sep	
1. Nontreated check	NA	0.1 a[3]	0.2 a	1.0 a	3.2 a	10.0 a	13.5 a	172.5 a
2. Gem 4.16SC (3.5 fl oz)	A	0.0 a	0.2 a	0.1 a	0.3 a	0.1 a	0.3 a	5.4 d
2. Eminent 125SL (13 fl oz)	B							
2. Super Tin 80WP (3.75 oz)	C							
2. Topsin M 70WP (6.1 oz)	C							
3. Eminent 125SL (13 fl oz)	A	0.0 a	0.0 a	0.0 a	0.4 a	0.9 a	0.8 a	12.8 cd
3. Gem 4.16SC (3.5 fl oz)	B							
3. Super Tin 80WP (3.75 oz)	C							
3. Topsin M 70WP (6.1 oz)	C							
4. Gem 4.16SC (3.5 fl oz)	A	0.1 a	0.0 a	0.0 a	0.1 a	0.5 a	0.1 a	5.5 d
4. Proline 4EC (5 fl oz)	B							
4. Induce (0.125% v:v)	B							
4. Super Tin 80WP (3.75 oz)	C							
4. Topsin M 70WP (6.1 oz)	C							
5. Proline 4EC (5 fl oz)	A	0.0 a	0.3 a	1.5 a	0.3 a	0.6 a	0.4 a	20.7 bcd
5. Induce (0.125% v:v)	A							
5 Gem 4.16SC (3.5 fl oz)	B							
5. Super Tin 80WP (3.75 oz)	C							
5. Topsin M 70WP (6.1 oz)	C							
6. LEM17 50WP (4 oz)	A-C	0.3 a	0.3 a	1.9 a	1.5 a	4.2 a	7.5 a	95.1 ab
7. LEM17 50WP (7 oz)	A-C	0.2 a	0.5 a	0.4 a	4.2 a	2.8 a	6.7 a	89.6 bc
8. LEM17 50WP (10 oz)	A-C	0.5 a	0.0 a	0.1 a	1.9 a	6.3 a	6.3 a	94.9 ab
9. LEM17 50WP (4 oz)	A-C	0.0 a	0.1 a	0.1 a	0.6 a	0.2 a	0.1 a	7.0 d
9. Punch 3.3EC (4 fl oz)	A-C							

Treatment and rate (product/A)	Application dates[1]	Number of Cercospora lesions per leaf						AUDPC[2]
		15 Aug	21 Aug	28 Aug	5 Sep	12 Sep	21 Sep	
10. Punch 3.3EC (5 fl oz)	A-C	2.2 a	0.0 a	0.2 a	1.6 a	2.9 a	7.4 a	75.1 bcd
11. Mankocide 61.1WP (2.5 lb)	A-C	0.1 a	0.3 a	0.3 a	2.3 a	3.0 a	2.3 a	55.5 bcd
12. Headline 2.08EC (9 fl oz)	A	0.0 a	0.1 a	0.0 a	0.1 a	0.7 a	0.0 a	5.9 d
12. Super Tin 80WP (3.75 oz)	B							
12. Eminent 125SL (13 fl oz)	C							
13. Eminent 125SL (13 fl oz)	A	0.2 a	0.2 a	0.8 a	1.9 a	6.7 a	4.3 a	94.0 abc
13. Headline 2.08EC (9 fl oz)	B							
13. Eminent 125SL (13 fl oz)	C							
14. Eminent 125SL (13 fl oz)	A, C	0.4 a	0.3 a	0.2 a	1.6 a	0.3 a	0.3 a	18.6 bcd
14. Super Tin 80WP (3.75 oz)	A, C							
14. Headline 2.08EC (9 fl oz)	B							
15. Garlic 1SC (10% v:v)	A-C	0.1 a	0.1 a	0.4 a	2.2 a	2.3 a	1.4 a	44.7 bcd

[1] Field plots were planted on 28 April, 2006. Fungicide application dates were: A = 9 August, B = 21 August, and C = 6 September. NA = not-applicable.

[2] Cercospora leaf spot area under the disease progress curve was calculated for data collected from 15 August through 21 September. Border rows of field plots received greenhouse-grown sugar beet transplants possessing foliar powdery mildew and Cercospora leaf spot symptoms on 8 August. Foliar inoculations with *Cercospora beticola* spores were done on 10 and 21 August and on 28 August leaves with numerous CLS lesions were placed in the plots.

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

Table 2. Effects of foliar fungicide programs on sugar beet root yield and sucrose quality (G.D. Franc and W.L. Stump, Univ. of WY; 2006).

Treatment and rate (product/A)	Application dates[1]	Sugar beet root yield and quality		
		Root yield (tons/A)	% total sucrose	% sugar lost to molasses
1. Nontreated check	NA	20.1 a[2]	17.2 a	1.3 a
2. Gem 4.16SC (3.5 fl oz)	A	22.4 a	17.7 a	1.3 a
2. Eminent 125SL (13 fl oz)	B			
2. Super Tin 80WP (3.75 oz)	C			
2. Topsin M 70WP (6.1 oz)	C			
3. Eminent 125SL (13 fl oz)	A	22.1 a	17.5 a	1.2 a
3. Gem 4.16SC (3.5 fl oz)	B			
3. Super Tin 80WP (3.75 oz)	C			
3. Topsin M 70WP (6.1 oz)	C			
4. Gem 4.16SC (3.5 fl oz)	A	18.0 a	17.6 a	1.3 a
4. Proline 4EC (5 fl oz)	B			
4. Induce (0.125% v:v)	B			
4. Super Tin 80WP (3.75 oz)	C			
4. Topsin M 70WP (6.1 oz)	C			
5. Proline 4EC (5 fl oz)	A	20.0 a	17.6 a	1.2 a
5. Induce (0.125% v:v)	A			
5 Gem 4.16SC (3.5 fl oz)	B			
5. Super Tin 80WP (3.75 oz)	C			
5. Topsin M 70WP (6.1 oz)	C			
6. LEM17 50WP (4 oz)	A-C	23.1 a	17.7 a	1.2 a
7. LEM17 50WP (7 oz)	A-C	14.3 a	17.6 a	1.3 a
8. LEM17 50WP (10 oz)	A-C	16.4 a	17.3 a	1.3 a
9. LEM17 50WP (4 oz)	A-C	22.1 a	17.6 a	1.2 a
9. Punch 3.3EC (0.4 fl oz)	A-C			
10. Punch 3.3EC (0.5 fl oz)	A-C	25.5 a	17.4 a	1.3 a

Treatment and rate (product/A)	Application dates[1]	Sugar beet root yield and quality		
		Root yield (tons/A)	% total sucrose	% sugar lost to molasses
11. Mankocide 61.1WP (2.5 lb)	A-C	22.4 a[2]	17.2 a	1.3 a
12. Headline 2.08EC (9 fl oz)	A	21.6 a	18.7 a	1.2 a
12. Super Tin 80WP (3.75 oz)	B			
12. Eminent 125SL (13 fl oz)	C			
13. Eminent 125SL (13 fl oz)	A	19.5 a	18.1 a	1.3 a
13. Headline 2.08EC (9 fl oz)	B			
13. Eminent 125SL (13 fl oz)	C			
14. Eminent 125SL (13 fl oz)	A, C	20.8 a	17.8 a	1.2 a
14. Super Tin 80WP (3.75 oz)	A, C			
14. Headline 2.08EC (9 fl oz)	B			
15. Garlic 1SC (10% v:v)	A-C	20.9 a	17.6 a	1.3 a

1 Field plots were planted on 28 April, 2006. Fungicide application dates were: A = 9 August, B = 21 August, and C = 6 September. NA = not-applicable.

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 to Sugar Beet Crowns, 2006**

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Field Plot Details

Field plots were at the Sustainable Agricultural Research & Extension Center (SAREC) located at Lingle, WY. The elevation of the site was 4165 MSL. The soil was a Mitchell clay loam soil, pH = 7.9. Overhead irrigation was applied as needed.

Plot Design

The statistical design was a randomized complete block design with four replications; plots were four rows (30-in row centers) by 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.

An second study (**Maxim [fludioxonil] efficacy study**) was set up utilizing four unused plots already replicated into the larger study (one unused plot = one replicate block). Within each plot (four rows by 20 ft), each of the four treatments were randomly assigned to one row (one individual treatment = one row 20 ft long). Therefore, each plot contained all four treatments in random row order, with each plot replicated four times to complete the statistical design.

Plot Management

Planting Date: 28 April, 2005
Variety: Monohikari
Fertilizer: 150 lb N + 75 lb P_2O_5 + 20 lb S
Herbicide: Post-emergence applications of Betamix (24 oz product/A) + Upbeet (1 oz product/A); followed by Beta Progress (21 oz product/A) + Upbeet (1 oz product/A); followed by Beta Progress (21 oz product/A) + Select (8 fl oz product/A).

Disease Development

Immediately following fungicide applications on 15 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- to 12-leaf stage when inoculated. Shortly after inoculation, plots were cultivated to move soil onto the crown and then irrigated (0.5 inch) to create conditions that favored infection. Inoculum used in 2006 was prepared from *Rhizoctonia solani* AG2-2 cultured on grain that was subsequently pulverized.

Maxim study: Immediately following fungicide applications on 29 June, inoculum (0.25 tsp = 0.8 g) was applied to the crown of each plant in the treatment row of each plot. Plants were in the 14- to 20-leaf stage when inoculated. The same inoculum described above was utilized. These plots were not cultivated following inoculation, however, irrigation water was applied during the evening.

Treatment Applications

Fungicides were applied (7-inch band) to the plant crowns on 15 June (immediately prior to inoculation), and for the half-rate split application treatments, the second half-rate application was made on 29 June. Fungicide was applied with the aid of a portable (CO_2) sprayer in a total volume of 1.06 gal/1000 row ft at 45 psi boom pressure. The boom was equipped with a single #8002 flat fan nozzle.

Maxim study: Fungicides were applied (7-inch band) to the plant crowns on 29 June (immediately prior to inoculation). Fungicide was applied in the same manner as above.

Disease Ratings

Initial beet stands (two rows by 20 row-ft) were determined on 12 June (data shown in Appendix 1). Rhizoctonia root and crown rot (RRCR) incidence ratings were expressed as a percentage of the initial plant stand to standardize disease ratings. RRCR incidence was rated on 29 June, 6, 12, 20, 28 July, and 10, 18 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 15 June (time zero) through 18 August. Additionally, plots were visually rated for the percentage of total canopy necrosis present on 29 June, 6, 12, 20, 28 July, 10, August, and 5 September and an AUDPC also was calculated for this data collection period. At harvest, a final harvested beet root count was determined. Harvested beet roots were those that had less than 50% of the root volume lost due to rot. Rhizoctonia disease severity, incidence and root yield were determined on the harvested beet roots. Disease severity was determined by visually estimating the surface area of beet roots affected by decay (for the collective total surface area of all the beets for a given plot) while disease incidence was the percentage of the harvested roots with any visible decay present.

Maxim study: Initial beet stands (one by 20 row-ft) were determined on 6 July (data shown in Appendix 3). RRCR incidence ratings were expressed as a percentage of the initial plant stand to standardize disease ratings. RRCR incidence was rated on 29 June, 6, 12, 20, 28 July, and 10, 18 August. An area under the disease progress curve (AUDPC) was calculated for disease incidence data from 6 July (time zero) through 18 August. Additionally, plots were visually rated for the percentage of total canopy necrosis present on 15, 20, 28 July, 10, 18 August, and 5 September and an AUDPC also was calculated for this data collection period. At harvest, beet roots were evaluated as in the above study.

Harvest

The middle five feet of each of the two treated rows was harvested on 2 October (10 total row feet) and the total beet root yield was determined. The percentage of total sucrose and sugar lost to molasses was determined by Western Sugar's laboratory.

Maxim study: The middle 10 feet of row was harvested from the treated row on 2 October. The percentage of total sucrose and sugar lost to molasses was determined by Western Sugar's laboratory.

Statistical Analysis

For both studies an ANOVA with four replications was utilized. Mean separations were done using Fisher's protected LSD ($P \leq 0.05$).

Results and Discussion

Rhizoctonia root and crown rot (RRCR) rapidly developed following the 15 June inoculation. Symptoms appeared within 2 weeks, first appearing as rapidly wilting leaves with petioles becoming darkened near the crown. All plants in the nontreated inoculated check were infected and died by 28 July. Results for the nontreated non-inoculated check (treatment 1) revealed that naturally occurring disease pressure was low in the field plot area with only 1.4% of the plants becoming symptomatic by 10 August. Therefore, most disease development in the plots resulted from the 15 June inoculation. Rapid and severe RRCR development following inoculation provided for a rigorous test of fungicide efficacy in 2006.

All fungicide treatments reduced RRCR incidence and severity over the season compared to the nontreated inoculated check (Table 1; $P \leq 0.05$). Due to rapid disease onset, the single full rate application of Quadris (treatment 3) was generally superior to the half rate split application of Quadris (treatment 4; $P \leq 0.05$). The same pattern was true for the Proline treatments, with the full single rate of Proline (treatment 5) being superior to the half rate split application of Proline (treatment 6) for most evaluation dates and the season-long AUDPC value ($P \leq 0.05$). Beet root yield data (Table 3) revealed that only the two Proline treatments had yields statistically equivalent to the nontreated non-inoculated check ($P \leq 0.05$). Visual assessment of beet roots at harvest revealed that considerable disease was present (Table 3).

Maxim Study: Data for the inoculated nontreated check (Table 4, treatment 2) revealed that, following inoculation on 29 June, 32 and 80 percent disease incidence had developed by 20 July and 18 August, respectively (Table 4). Single applications of Quadris (treatment 3) and Maxim (treatment 4) fungicide resulted in AUDPC values, root yields and sugar quality (Table 6), all statistically equivalent to the nontreated non-inoculated check ($P \leq 0.05$).

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; 2006).

Treatment and rate (oz ai/1000 ft)[1]	Application dates[2]	RRCR incidence as a percentage of initial stand							AUDPC[3]
		29 Jun	6 Jul	12 Jul	20 Jul	28 Jul	10 Aug	18 Aug	
1. Nontreated non-inoculated check	NA	0.0 b[4]	0.0 c	0.0 d	0.0 c	0.0 f	1.4 d	3.0 f	26.3 e
2. Nontreated inoculated check	NA	51.7 a	79.5 a	93.2 a	98.6 a	100.0 a	100.0 a	100.0 a	5066.6 a
3. Quadris 2.08SC (0.15)	A	0.4 b	1.3 c	3.0 d	6.7 c	14.3 def	36.0c	49.4 d	812.9 cd
4. Quadris 2.08SC (0.075)	A, B	1.2 b	8.4 bc	14.3 bc	24.3 b	32.7 bc	44.8 bc	53.9 cd	1395.0 bc
5. Proline 2.08EC (0.16)	A	0.7 b	2.3 c	4.1 cd	5.5 c	11.5 ef	14.5 d	23.1 ef	462.3 de
6. Proline 2.08EC (0.08)	A, B	3.8 b	12.8 b	17.3 b	21.4 b	26.9 cde	36.5 c	43.3 de	1263.6 bc
7. Proprietary compound (0.15)	A	0.0 b	0.6 c	1.0 d	7.2 c	27.9 cd	45.3 bc	71.4 bc	1125.4 c
8. Moncut 70WP (0.73)	A	2.4 b	8.0 bc	16.4 b	26.3 b	44.6 b	58.7 b	78.5 b	1805.6 b

1 All applications were made in a 7-inch banded spray in 1.06 gal carrier/1000 row ft at 45 psi boom pressure. Plants in the two center rows of each treatment plot were inoculated with *Rhizoctonia solani* AG2-2 on 15 June, 2006 (8-12 leaf stage) immediately following fungicide application.

2 Fungicide application dates were A = 15 June, B = 29 June, and NA = not-applicable.

3 Area under the disease progress curve for data collected from 15 June through 18 August.

4 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 measured as foliar necrosis (G.D. Franc and W.L. Stump, University of WY; 2006).

Treatment and rate (oz ai/1000 ft)[1]	Application dates[2]	RRCR severity as a percentage of total canopy necrosis							AUDPC[3]
		29 Jun	6 Jul	12 Jul	20 Jul	28 Jul	10 Aug	5 Sep	
1. Nontreated non-inoculated check	NA	0.0 c[4]	0.0 d	0.0 e	0.0 d	0.0 f	0.0 e	0.0 e	0.0 e
2. Nontreated inoculated check	NA	28.0 a	59.5 a	88.0 a	98.0 a	100.0 a	100.0 a	100.0 a	686.8 a
3. Quadris 2.08SC (0.15)	A	0.5 c	1.5 bcd	1.5 cde	3.0 c	5.0 de	21.0 c	37.0 cd	173.8 cd
4. Quadris 2.08SC (0.075)	A, B	0.5 c	2.0 bcd	5.0 bcd	12.0 b	21.0 bc	31.0 bc	40.5 c	234.0 c
5. Proline 2.08EC (0.16)	A	0.5 c	1.5 bcd	2.0 cde	2.0 cd	3.0 ef	4.0 de	23.5 d	116.0 d
6. Proline 2.08EC (0.08)	A, B	3.0 b	5.0 b	8.5 b	10.5 b	10.5 cd	15.0 cd	33.0 cd	214.9 c
7. Proprietary compound (0.15)	A	0.0 c	0.5 cd	1.0 de	4.0 c	12.0 cd	23.5 c	59.5 b	201.3 c
8. Moncut 70WP (0.73)	A	1.5 bc	3.0 bc	6.0 b	17.0 b	31.0 b	65.0 b	73.5 b	310.5 b

1 All applications were made in a 7-inch banded spray in 1.06 gal carrier/1000 row ft at 45 psi boom pressure. Plants in the two center rows of each treatment plot were inoculated with *Rhizoctonia solani* AG2-2 on 15 June, 2006 (8-12 leaf stage) immediately following fungicide application.

2 Fungicide application dates were A = 15 June, B = 29 June, and NA = not-applicable.

3 Area under the disease progress curve for data collected from 15 June through 5 September.

4 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) management on sugar beet root yield and quality (G.D. Franc and W.L. Stump, Univ. of WY; 2006).

Treatment and rate (oz ai/1000 ft)[1]	Application dates[2]	Beet root yield and quality				Disease incidence and disease severity at harvest[3]	
		Beet no. per 10 row ft	Beet yield (tons/A)	% total sucrose	% sugar lost to Molasses[3]	Symptomatic beets (%)	Surface area of root decayed (%)
1. Nontreated non-inoculated check	NA	18.8 a[4]	23.9 a	17.7 a	1.2	0	0
2. Nontreated inoculated check	NA	0.0 c	0.0 e	0.0 c	NA	NA	NA
3. Quadris 2.08SC (0.15)	A	11.5 b	12.7 cd	15.4 ab	1.3	50	36
4. Quadris 2.08SC (0.075)	A, B	10.5 b	15.8 bc	15.3 ab	1.3	39	20
5. Proline 2.08EC (0.16)	A	12.0 b	18.1 abc	16.1 ab	1.3	35	17
6. Proline 2.08EC (0.08)	A, B	11.0 b	20.4 ab	15.0 ab	1.4	43	20
7. Proprietary compound (0.15)	A	2.8 c	6.0 de	13.1 b	1.5	75	27
8. Moncut 70WP (0.73)	A	1.3 c	4.1 e	3.5 c	0.5	75	90

1 All applications were made in a 7-inch banded spray in 1.06 gal carrier/1000 row ft at 45 psi boom pressure. Plants in the two center rows of each treatment plot were inoculated with *Rhizoctonia solani* AG2-2 on 15 June, 2006 (8-12 leaf stage) immediately following fungicide application.

2 Fungicide application dates were A = 15 June, B = 29 June, and NA = not-applicable.

3 Because severe disease resulted in some treatments that had no or few beets to rate, no statistics were run on these data. NA = non-applicable. Plots were harvested 2 October, 2006.

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

Table 4. Maxim Study: Effects of banded fungicide applications on Rhizoctonia root and crown rot (RRCR) incidence (G.D. Franc and W.L. Stump, University of WY; 2006).

Treatment and rate (oz ai/1000 ft)[1]	Application dates[2]	RRCR incidence as a percentage of initial stand						AUDPC[3]
		6 Jul	12 Jul	20 Jul	28 Jul	10 Aug	18 Aug	
1. Nontreated non-inoculated check	NA	0.0 a[4]	0.0 a	0.0 b	0.9 b	2.2 b	4.6 b	51.2 b
2. Nontreated inoculated check	NA	2.4 a	1.7 a	32.1 a	43.4 a	63.4 a	80.3 a	1728.0 a
3. Quadris 2.08SC (0.15)	A	0.0 a	0.0 a	0.0 b	0.0 b	1.5 b	6.4 b	41.0 b
4. Maxim 4EC (0.73)	A	0.0 a	0.0 a	0.0 b	3.5 b	5.4 b	7.3 b	122.4 b

1 All applications were made in a 7-inch banded spray in 1.06 gal carrier/1000 row ft at 45 psi boom pressure. Plants in the row of each treatment plot were inoculated with *Rhizoctonia solani* AG2-2 on 29 June, 2006 (14-20 leaf stage) immediately following fungicide application.

2 The fungicide application date was A = 29 June, and NA = not-applicable.

3 Area under the disease progress curve for data collected from 29 June through 18 August.

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

Table 5. Maxim Study: Effects of banded fungicide applications on Rhizoctonia root and crown rot (RRCR) severity measured as foliar necrosis (G.D. Franc and W.L. Stump, University of WY; 2006).

Treatment and rate (oz ai/1000 ft)[1]	Application dates[2]	RRCR severity as a percentage of total canopy necrosis					AUDPC[3]
		20 Jul	28 Jul	10 Aug	18 Aug	5 Sep	
1. Nontreated non-inoculated check	NA	0.0 a[4]	0.0 b	0.0 b	0.5 b	0.0 b	3.1 b
2. Nontreated inoculated check	NA	4.8 a	17.0 a	72.7 a	92.7 a	94.0 a	311.1 a
3. Quadris 2.08SC (0.15)	A	0.0 b	0.0 b	1.5 b	1.0 b	1.0 b	18.6 b
4. Maxim 4EC (0.73)	A	0.0 b	1.0 b	1.0 b	2.0 b	4.7 b	39.0 b

1 All applications were made in a 7-inch banded spray in 1.06 gal carrier/1000 row ft at 45 psi boom pressure. Plants in the row of each treatment plot were inoculated with *Rhizoctonia solani* AG2-2 on 29 June, 2006 (14-20 leaf stage) immediately following fungicide application.

2 The fungicide application date was A = 29 June, and NA = not-applicable.

3 Area under the disease progress curve for data collected from 15 July through 5 September.

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

Table 6. Maxim Study: Effects of banded fungicide applications for Rhizoctonia root and crown rot (RRCR) management on sugar beet root yield and quality (G.D. Franc and W.L. Stump, Univ. of WY; 2006).

Treatment and rate (oz ai/1000 ft)[1]	Application dates[2]	Beet root yield and quality				Disease incidence and disease severity at harvest[3]	
		Beet no. per 10 row ft	Beet yield (tons/A)	% total sucrose	% sugar lost to Molasses[3]	Symptomatic beets (%)	Surface area of root decayed (%)
1. Nontreated non-inoculated check	NA	15.5 a[4]	20.1 a	17.5 a	1.2	0	0
2. Nontreated inoculated check	NA	1.3 b	2.6 b	3.0 b	0.4	80	77
3. Quadris 2.08SC (0.15)	A	17.3 a	25.0 a	16.9 a	1.3	50	4
4. Maxim 4EC (0.73)	A	20.0 a	22.1 a	17.4 a	1.2	39	2

1 All applications were made in a 7-inch banded spray in 1.06 gal carrier/1000 row ft at 45 psi boom pressure. Plants in the row of each treatment plot were inoculated with *Rhizoctonia solani* AG2-2 on 29 June, 2006 (14-20 leaf stage) immediately following fungicide application.

2 The fungicide application date was A = 29 June, and NA = not-applicable.

3 Because severe disease resulted in some treatments that had no or few beets to rate, no statistics were run on these data. NA = non-applicable. Plots were harvested 2 October, 2006.

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

Research Project	**Pelletized Seed Treatments for Sugar Beet Root Maggot and Insect Suppression in Sugar Beet, 2006**
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 Location	Field plots were located within a grower-cooperator's sugar beet field near Morrill, NE (4143 ft MSL). This field was planted in corn during 2005, and numerous volunteer corn were present in the field during 2006. This field site was selected because it had a history of chronic sugar beet root maggot (*Tetanops myopaeformis*) infestation. The soil was a sandy clay loam at pH 7.8 to 7.9. Irrigation water was applied as needed via center pivot.
Plot Design	The experimental design was a RCBD with 4 replications. Each plot was 4 rows wide (30-in row centers) by 30 ft long. A 5 ft in-row buffer remained between plots.
Plot Management	**Planting Date**: 28 April, 2006 at a target rate of 60,000 plants per acre. **Variety**:1653RZ (seed and encapsulation was provided by Syngenta) **Fertility:** 140 lb N + 75 lb P_2O_5 + 15 lb S **Herbicide:** A pre-emergence application of Nortron (6 pt product/A) was made prior to planting. Post-emergence applications of Betamix (24oz product/A) on 20, 27 May and Select (8 fl oz product/A) on 6 June. Labor crews also came in for hand weeding in mid August.
Insect Development	All insect development and infestation relied on natural infestations. This cropping area and particular field location had historical problems with sugar beet root maggot.
Treatment Applications	Seeds were pelletized with the various insecticide/fungicide treatments. The Counter (11.2 g ai/100 m row) was applied by hand in a 5-7 inch band over the row after planting and then lightly incorporated with a rake.
Crop Evaluations	Stand counts were determined on 17 May and 6 June for the two middle rows at a fixed position between five and 15 feet (two rows x 10 feet). Crop vigor ratings were made on 29 June and 6 July using a 0 to 10 scale (scale 0 = dead to 10 = most vigorous; all ratings relative to treatment 1 [no insecticide] = 5). Vigor ratings were influenced by plant size, uniformity and overall general appearance. On 29 August, plots were visually evaluated for the incidence of beet curly top virus symptoms.
Insect Treatment Ratings	Sweep-net counts were conducted for leaf hoppers on 6 and 12 July (five sweeps along the length of the plot). Leaf hoppers were not speciated. Sugar beet root maggot root injury ratings were done on 27 July and at the time of harvest on 28 September. On 27 July, the first five beets encountered in the first row of the plot were hand dug, the roots brushed

free of soil and visually rated for injury. The rating scale (0-5) was that of Blickenstaff *et al* **(**Blickenstaff, C.C., R.E. Peckenpaugh and R.E. Mahrt. 1977. Rating sugarbeets for damage by the sugarbeet root maggot. J. Am. Soc. Sugar Beet Technol. 19(3): 188-191.) This rating scale also is summarized in Appendix 1. On 28 September, five roots were selected at random from the 30 ft of row that had been lifted for harvest, and roots were rated in the same manner as on 27 July.

Harvest On 28 September plants in one randomly selected middle row was topped by hand and lifted with a one-row beet lifter. Because of the uneven stands that resulted from hail damage early in the season, ten beets were selected at random for weight and quality measurements. Beet quality was determined at Western Sugar Tare lab located in Gering, NE.

Statistical Analysis ANOVA with four replications. Mean separations were done using Fisher's protected LSD ($P \leq 0.05$).

Results and Discussion

Field plots during early- to mid-May were exposed to hail events and cold temperatures, and plant stands were affected. Treatments had no relative effect on plant stand and crop vigor on any evaluation date (Table 1: P=0.05). No incidence of curly top virus was detected during the growing season. Phytotoxicity was not observed during the growing season.

Treatment effects on leaf hopper populations, root maggot injury ratings and curly top incidence are summarized in Table 2. Leaf hopper populations were low, however there was a treatment effect detected on 12 July ($P \leq 0.05$). Treatments effects on sugar beet root maggot injury to roots were not significant (P=0.05). However trends in the data reveal that all insecticide treatments reduced sugar beet root maggot injury relative to treatment 1 (no insecticide). The overall infestation of sugar beet root maggot was low in the variety (1653RZ) planted in the field plots.

Treatment effects on root yield, percentage of sucrose and sucrose quality were not significant (Table 3: P=0.05).

Table 1. Effects of pelletized insecticide seed treatments on sugar beet plant stand establishment and general crop vigor (G.D. Franc and W.L. Stump, U of WY; 2006).

Treatment and rate: (fl oz product per cwt seed, unless noted otherwise)	Application dates[1]	Plant stand (10 row ft)		Plant vigor (trt 1=5)	
		17 May	6 June	29 June	6 July
1. Apron XL 3LS (0.33)	A	8.0 a[2]	14.8 a	5.0 a	5.0 a
1. Maxim 4FS (0.08)	A				
2. Apron XL 3LS (0.33)	A	10.0 a	17.5 a	5.3 a	5.0 a
2. Maxim 4FS (0.08)	A				
2. Cruiser 5FS (0.51)	A				
3. Apron XL 3LS (0.33)	A	8.5 a	15.8 a	5.0 a	5.3 a
3. Maxim 4FS (0.08)	A				
3. Cruiser 5FS (1.02)					
4. Apron XL 3LS (0.33)	A	8.1 a	15.0 a	5.0 a	5.0 a
4. Maxim 4FS (0.08)	A				
4. Cruiser 5FS (1.53)					
5. Apron XL 3LS (0.33)	A	6.5 a	12.4 a	4.8 a	5.0 a
5. Maxim 4FS (0.08)	A				
5. Cruiser 5FS (2.04)	A				
6. Allegiance-LS (1.18)	A	8.1 a	14.0 a	5.0 a	5.0 a
6. Thiram 42-S (4.0)	A				
6. Poncho 600 5SC (1.53)	A				
7. Apron XL 3LS (0.33)	A	10.8 a	17.1 a	5.0 a	5.3 a
7. Maxim 4FS (0.08)	A				
7. Counter 20G (11.2 g ai/100m row)	B				
8. Apron XL 3LS (0.33)	A	7.8 a	12.4 a	5.0 a	5.3 a
8. Maxim 4FS (0.08)	A				
8. Cruiser 5FS (2.04)	A				
8. Counter 20G (11.2 g ai/100m row)	B				

[1] Field plots were planted on 28 April, 2006 with variety 1653RZ, and roots were harvested on 28 September. Insecticide application dates were: A = pelletized seed treatment, B = banded over furrow with shallow incorporation immediately after planting. Field plots were located near Morrill, NE.

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

Table 2. Effects of pelletized insecticide seed treatments on leaf hopper populations, sugar beet root maggot root injury, and beet curly top virus incidence (G.D. Franc and W.L. Stump, U of WY; 2006).

Treatment and rate; (fl oz product per cwt seed, unless noted otherwise)	Application dates[1]	Leaf hopper populations (5 Sweeps)		Sugar beet root maggot root injury rate (0-5)[2]		Curly top incidence (4 rows X 30 ft)
		6 Jul	12 Jul	27 Jul	28 Sep	29 Aug
1. Apron XL 3LS (0.33)	A	0.0 a[3]	0.3 b	0.6 a	0.4 a	0.0 a
1. Maxim 4FS (0.08)	A					
2. Apron XL 3LS (0.33)	A	0.0 a	0.0 b	0.1 a	0.1 a	0.0 a
2. Maxim 4FS (0.08)	A					
2. Cruiser 5FS (0.51)	A					
3. Apron XL 3LS (0.33)	A	0.0 a	0.0 b	0.3 a	0.1 a	0.0 a
3. Maxim 4FS (0.08)	A					
3. Cruiser 5FS (1.02)						
4. Apron XL 3LS (0.33)	A	0.0 a	0.0 b	0.1 a	0.0 a	0.0 a
4. Maxim 4FS (0.08)	A					
4. Cruiser 5FS (1.53)						
5. Apron XL 3LS (0.33)	A	0.3 a	0.8 ab	0.1 a	0.2 a	0.0 a
5. Maxim 4FS (0.08)	A					
5. Cruiser 5FS (2.04)	A					
6. Allegiance-LS (1.18)	A	0.0 a	0.5 b	0.3 a	0.1 a	0.0 a
6. Thiram 42-S (4.0)	A					
6. Poncho 600 5SC (1.53)	A					
7. Apron XL 3LS (0.33)	A	0.0 a	1.8 a	0.1 a	0.2 a	0.0 a
7. Maxim 4FS (0.08)	A					
7. Counter 20G (11.2 g ai/100m row)	B					
8. Apron XL 3LS (0.33)	A	0.3 a	0.3 b	0.1 a	0.0 a	0.0 a
8. Maxim 4FS (0.08)	A					
8. Cruiser 5FS (2.04)	A					
8. Counter 20G (11.2 g ai/100m row)	B					

[1] Field plots were planted on 28 April, 2006 with variety 1653RZ, and roots were harvested on 28 September. Insecticide application dates were: A = pelletized seed treatment, B = banded over furrow with shallow incorporation immediately after planting. Field plots were located near Morrill, NE.

[2] Values in the Table are a average of five root ratings. The rating scale used was; 0 = no scars, 1 = 1-4 small (pinhead size) scars, 2 = 5-10 small scars, up to 4 large scars, 3 = more than 3 large scars, 4 = 1/2 to 3/4 root blackened by scars and 5 = >3/4 root blackened by scars.

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

Table 3. Effects of pelletized insecticide seed treatments on beet root yield and quality (G.D. Franc and W.L. Stump, U of WY; 2006).

Treatment and rate (fl oz product per cwt seed, unless noted otherwise)	Application dates[1]	Sugar beet root yield and quality		
		Yield for 10 beet roots (lbs)	% total sucrose	% sugar lost to molasses
1. Apron XL 3LS (0.33)	A	28.9 a[2]	14.2 a	1.5 a
1. Maxim 4FS (0.08)	A			
2. Apron XL 3LS (0.33)	A	29.6 a	14.3 a	1.5 a
2. Maxim 4FS (0.08)	A			
2. Cruiser 5FS (0.51)	A			
3. Apron XL 3LS (0.33)	A	28.9 a	14.0 a	1.5 a
3. Maxim 4FS (0.08)	A			
3. Cruiser 5FS (1.02)				
4. Apron XL 3LS (0.33)	A	27.8 a	14.3 a	1.5 a
4. Maxim 4FS (0.08)	A			
4. Cruiser 5FS (1.53)				
5. Apron XL 3LS (0.33)	A	30.9 a	14.5 a	1.5 a
5. Maxim 4FS (0.08)	A			
5. Cruiser 5FS (2.04)	A			
6. Allegiance-LS (1.18)	A	29.4 a	14.5 a	1.5 a
6. Thiram 42-S (4.0)	A			
6. Poncho 600 5SC (1.53)	A			
7. Apron XL 3LS (0.33)	A	29.6 a	14.3 a	1.5 a
7. Maxim 4FS (0.08)	A			
7. Counter 20G (11.2 g ai/100m row)	B			
8. Apron XL 3LS (0.33)	A	29.8 a	14.3 a	1.4 a
8. Maxim 4FS (0.08)	A			
8. Cruiser 5FS (2.04)	A			
8. Counter 20G (11.2 g ai/100m row)	B			

[1] Field plots were planted on 28 April, 2006 with variety 1653RZ, and roots were harvested on 28 September. Insecticide application dates were: A = pelletized seed treatment, B = banded over furrow with shallow incorporation immediately after planting. Field plots were located near Morrill, NE.

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

Appendix 1. Rating scale for sugar beet root maggot damage (G.D. Franc and W.L. Stump, U of WY; 2006).

Rating scale from Blickenstaff http://www.ag.ndsu.edu/pubs/plantsci/rowcrops/e1165w.htm

0 = no scars
1 = 1-4 small (pin head size) scars
2 = 5-10 small scars, up to 3 large scars
3 = more than 3 large scars
4 = 25% to 75% of the root are blackened by scars
5 = More than 75% of root area blackened, an obviously heavily damaged or dead beet
Size: 2 mm, small scar; 5 mm, medium scar; 10 mm, large scar

Research Project	**Management of Sugar Beet Root Maggot with In-Furrow Applications of Vydate C-LV, 2006**
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 Location	Field plots were located within a grower-cooperator's sugar beet field near Morrill, NE (4143 ft MSL). This field was planted in corn during 2005, and numerous volunteer corn were present in the field during 2006. This field site was selected because it had a history of chronic sugar beet root maggot (*Tetanops myopaeformis*) infestation. The soil was a sandy clay loam at pH 7.8 to 7.9. Irrigation water was applied as needed via center pivot.
Plot Design	The experimental design was a RCBD with 4 replications. Each plot was 4 rows wide (30-in row centers) by 30 ft long. A 2.5 ft in-row buffer remained between plots.
Plot Management	**Planting Date**: 28 April, 2006; 60,000 plants per acre planting rate. **Variety**: Beta 1344N **Fertility:** 140 lb N + 75 lb P_2O_5 + 15 lb S **Herbicide:** Preemergence application (all rates in product/A) of Nortron (6 pt) prior to planting. Post-emergence applications of Betamix (24oz) on 20, 27 May and Select (8 fl oz) on 6 June. Labor crews also came in for hand weeding in Mid August.
Insect Development	All insect development and infestation relied on natural infestations. This cropping area had historical problems with sugar beet root maggot.
Treatment Applications	All seed was pelletized. Treatment 5 was pelletized in the same manner but with Poncho insecticide added. Counter treatments were applied by hand in a 5-7 inch band over the row immediately after planting and lightly incorporated with a rake. In-furrow insecticide applications were made in a 7-inch band directed over the planted row. Insecticide was applied with the aid of a portable (CO_2) sprayer in a total volume of 1.0 gal/1000 row-ft at 46 psi boom pressure. The boom was equipped with a single #8002 flat fan nozzle. Three Vydate application timings were used: at planting, seven days prior to peak based on the fly peak model and at peak based on the fly peak model. The fly peak-date was estimated based on historical fly occurrences and was confirmed with the grower cooperator and Gary Hein (University of Nebraska Panhandle R/E Center, Scottsbluff, NE). The application dates are indicated in the Tables.
Crop Evaluations	Stand counts were determined on 6 June and 6 July for the two middle rows at a fixed position between five and 15 feet (two rows x 10 feet). A crop vigor rating was made on 6 July using a 0 to 10 scale (scale 0 = dead

to 10 = most vigorous; all ratings relative to the untreated check [treatment 1] = 5). Vigor ratings were influenced by plant size, uniformity and overall general appearance.

Insect Treatment Ratings

Sweep-net counts were conducted for leaf hoppers on 12 July (five sweeps along the length of the plot). Leaf hoppers were not speciated. Sugar beet root maggot root injury ratings were done on 27 July and at the time of harvest on 28 September. On 27 July, the first five beets encountered in the first row of the plot were hand dug, the roots brushed free of soil and visually rated for injury. The rating scale (0-5) was that of Blickenstaff *et al* **(**Blickenstaff, C.C., R.E. Peckenpaugh and R.E. Mahrt. 1977. Rating sugarbeets for damage by the sugarbeet root maggot. J. Am. Soc. Sugar Beet Technol. 19(3): 188-191). Scale is described in Appendix 1. On 28 September, five roots were selected at random from the 30 ft of row that had been lifted for harvest, and roots were rated in the same manner as on 27 July.

Harvest

On 28 September plants in one randomly selected middle row was topped by hand and lifted with a one-row beet lifter. Because of the uneven stands that resulted from hail damage early in the season, ten beets were selected at random for weight and quality measurements. Beet quality was determined at Western Sugar Tare lab located in Gering, NE.

Statistical Analysis

ANOVA with four replications. Mean separations were done using Fisher's protected LSD ($P \leq 0.05$).

Results and Discussion

Field plots during early- to mid-May were exposed to hail events and cold temperatures, and plant stands were affected by these adverse environmental conditions. Treatments had no significant effect on plant stands for either rating date (P=0.05). All Vydate treatments except treatment 3 (intermediate response) had improved vigor compared to the untreated check and counter (treatment 6: $P \leq 0.05$). Phytotoxicity was not observed during the growing season.

Leaf hopper populations were generally low and treatments had no effect on infestation levels (P=0.05). Sugar beet root maggot injury was scattered throughout the plot. However, treatments had no significant effect on root injury attributed the sugar beet maggot (P=0.05). It is not known what effect treatment timings had on insect suppression. Treatment effects on root weight, percentage of sucrose or the percentage of sugar lost to molasses (sugar quality) was not significant (Table 3, P=0.05).

Table 1. Effects of in-furrow applications of Vydate on the sugar beet stands and plant vigor (G.D. Franc and W.L. Stump, U of WY; 2006).

Treatment and rate (lbs ai/A)	Application dates[1]	Plant stand (10 row ft)		Plant vigor (trt 1=5)
		6 Jun	6 Jul	6 Jul
1. Untreated check	NA	11.3 a[2]	13.5 a	5.0 b
2. Vydate C-LV 3.77SL (1.0)	A	14.6 a	12.6 a	5.8 a
2. Vydate C-LV 3.77SL (1.0)	B			
2. Vydate C-LV 3.77SL (1.0)	C			
3. Vydate C-LV 3.77SL (2.0)	A	12.9 a	13.5 a	5.3 ab
3. Vydate C-LV 3.77SL (1.0)	B			
3. Vydate C-LV 3.77SL (1.0)	C			
4. Vydate C-LV 3.77SL (2.0)	A	14.8 a	17.0 a	5.8 a
4. Vydate C-LV 3.77SL (1.0)	B			
4. Asana XL 0.66EC (0.03)	B			
4. Vydate C-LV 3.77SL (1.0)	C			
4. Asana XL 0.66EC (0.03)	C			
5. Poncho (seed treatment)	NA	15.8 a	16.3 a	5.8 a
5. Vydate C-LV 3.77SL (1.0)	B			
5. Vydate C-LV 3.77SL (1.0)	C			
6. Counter 15G (2.0)	A	11.4 a	13.1 a	5.0 b

[1] The planting date was 28 April, 2006 with variety Beta Seed 1344N. Insecticide application dates were: A = banded over furrow, shallow incorporation after planting on 28 April, B=before fly peak (estimated) 25 May, C=6 June fly peak (historical) and NA = non-applicable.

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

Table 2. Effects of in-furrow applications of Vydate on leaf hopper populations and sugar beet root maggot root injury (G.D. Franc and W.L. Stump, U of WY; 2006).

Treatment and rate (lbs ai/A)	Application dates[1]	Leaf hopper populations (5 Sweeps)	Sugar beet root maggot root injury rate (0-5)[2]	
		12 Jul	27 Jul	28 Sep
1. Untreated check	NA	0.8 a[3]	1.4 a	0.8 a
2. Vydate C-LV 3.77SL (1.0)	A	1.0 a	1.6 a	0.6 a
2. Vydate C-LV 3.77SL (1.0)	B			
2. Vydate C-LV 3.77SL (1.0)	C			
3. Vydate C-LV 3.77SL (2.0)	A	1.8 a	1.0 a	0.5 a
3. Vydate C-LV 3.77SL (1.0)	B			
3. Vydate C-LV 3.77SL (1.0)	C			
4. Vydate C-LV 3.77SL (2.0)	A	0.5 a	2.1 a	1.0 a
4. Vydate C-LV 3.77SL (1.0)	B			
4. Asana XL 0.66EC (0.03)	B			
4. Vydate C-LV 3.77SL (1.0)	C			
4. Asana XL 0.66EC (0.03)	C			
5. Poncho (seed treatment)	NA	1.5 a	1.2 a	1.4 a
5. Vydate C-LV 3.77SL (1.0)	B			
5. Vydate C-LV 3.77SL (1.0)	C			
6. Counter 15G (2.0)	A	0.0 a	1.2 a	1.4 a

[1] The planting date was 28 April, 2006 with variety Beta Seed 1344N. Insecticide application dates were: A = banded over furrow, shallow incorporation after planting on 28 April, B=before fly peak (estimated) 25 May, C=6 June fly peak (historical) and NA = non-applicable.

[2] Rating scale; 0 = no scars, 1 = 1-4 small (pinhead size) scars, 2 = 5-10 small scars, up to 4 large scars, 3 = more than 3 large scars, 4 = 1/2 to 3/4 root blackened by scars and 5 = > 3/4 root blackened by scars.

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

Table 3. Effects of in-furrow applications of Vydate on beet root yield and quality (G.D. Franc and W.L. Stump, U of WY; 2006).

Treatment and rate (lbs ai/A)	Application dates[1]	Sugar beet root yield and quality		
		Yield for 10 beet roots (lbs)	% total sucrose	% sugar lost to molasses
1. Untreated check	NA	28.5 a[2]	12.6 a	1.8 a
2. Vydate C-LV 3.77SL (1.0)	A	31.2 a	13.0 a	1.8 a
2. Vydate C-LV 3.77SL (1.0)	B			
2. Vydate C-LV 3.77SL (1.0)	C			
3. Vydate C-LV 3.77SL (2.0)	A	29.1 a	12.7 a	1.7 a
3. Vydate C-LV 3.77SL (1.0)	B			
3. Vydate C-LV 3.77SL (1.0)	C			
4. Vydate C-LV 3.77SL (2.0)	A	26.1 a	12.9 a	1.7 a
4. Vydate C-LV 3.77SL (1.0)	B			
4. Asana XL 0.66EC (0.03)	B			
4. Vydate C-LV 3.77SL (1.0)	C			
4. Asana XL 0.66EC (0.03)	C			
5. Poncho (seed treatment)	NA	24.8 a	13.9 a	1.6 a
5. Vydate C-LV 3.77SL (1.0)	B			
5. Vydate C-LV 3.77SL (1.0)	C			
6. Counter 15G (2.0)	A	27.8 a	12.8 a	1.7 a

[1] The planting date was 28 April, 2006 with variety Beta Seed 1344N, harvest was 28 September. Insecticide application dates were: A = banded over furrow, shallow incorporation after planting on 28 April, B=before fly peak (estimated) 25 May, C=6 June fly peak (historical) and NA = non-applicable.

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

Appendix 1. Rating scale for sugar beet root maggot damage.

Rating scale from Blickenstaff http://www.ag.ndsu.edu/pubs/plantsci/rowcrops/e1165w.htm

Sugarbeet Root Maggot 0-5 Damage Rating Scale

0 = no scars
1 = 1-4 small (pin head size) scars
2 = 5-10 small scars, up to 3 large scars
3 = more than 3 large scars
4 = 25% to 75% of the root are blackened by scars
5 = More than 75% of root area blackened, an obviously heavily damaged or dead beet

- 2 mm, small scar
-- 5 mm, medium scar
--- 10 mm, large scar

Research Project	**Assessment of a Dry Bean "Plant Health" Response to Headline Fungicide at Lingle, WY (SAREC), 2006**
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Field Plot Location	Field plots were placed at the Sustainable Agricultural Research & Extension Center (SAREC) located near Lingle, WY. The elevation of SAREC is placed at 4,165 ft MSL, and the soil type at the plot location was a Mitchell clay loam soil at pH = 7.9. Overhead sprinkler irrigation was applied as needed.
Plot Design	RCBD with six replications; plots were 4 rows (30-in row centers) X 20 ft; 5 ft in-row buffer. All treatments were made to, and all data were collected from, the center two rows. Note: two extra replications (six replications total) were included to increase the degrees of freedom for statistical analysis.
Plot Management	**Planting Date**: 31 May, 2006. **Variety**: Othello **Fertilizer:** 30 lb N + 35 lb P_2O_5 + 20 lb S **Herbicide:** Eptam 7EC (4 pt product) + Sonalan 3EC (3 pt product) pre-plant incorporated.
Treatment Applications	Treatment timings were based on crop development as described in Table 1. Headline treatments 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).
Plant Health Evaluations	A visual plant vigor assessment (scale 0 = dead, 10 = maximum vigor, nontreated check vigor = 5) was made on 11 and 22 August. Plants were inspected periodically thoughout the growing season for appearance of disease, especially the appearance of rust. Vigor ratings take into account overall plant appearance, plant size, as well as overall plot uniformity.
Harvest	On 29 September, five feet of the middle two rows were harvested (total 10 row-feet per plot), with a small mechanical plot harvester. One hundred seeds were randomly selected and weighed as a measure of seed quality. Seed quality data were converted to ounces per 200 seeds for presentation in the Table. Additionally, the number of damaged and discolored seeds were evaluated from this one hundred seed sample.
Statistical Analysis	ANOVA with six replications. Mean separations were done using Fisher's protected LSD ($P \leq 0.05$).

Results and Discussion

Application of strobilurin fungicide has been reported to cause a favorable "plant health" response following foliar application that includes, but is not limited to increased plant size, improved yield, and/or improved color that may indicate delayed senescence. This benefit to the plant is reported to exceed the benefit that resulted from concomitant disease suppression alone.

The potential for plant health response following application of the strobilurin fungicide pyraclostrobin (Headline, BASF) was measured in dry bean (cv. Othello) planted at the SAREC field plot location. Pyraclostrobin applications were made at several different stages of plant growth, that started at the fourth trifoliolate and ended at 14 days after early pod set. The timing of the pyraclostrobin applications and all associated data are summarized in Table 1.

All pyraclostrobin treatments had no significant affect on crop vigor, crop (seed) yield and seed quality (seed size; P=0.05). Total yields relative to the non-treated check (treatment 1) ranged from a 12.3 percent decrease (treatment 6) to a four percent increase (treatment 4), while the 200 seed-weight varied ± 3.6 percent. No significant disease development occurred in the field plots at any time during the 2006 growing season. Therefore, any plant responses measured during 2006 were independent of any obvious disease suppression afforded by fungicide application.

Table 1. Effects of timed Headline (pyraclostrobin) fungicide application on dry bean plant vigor, total seed yield and seed quality (G.D. Franc, W.L. Stump, and J.T. Cecil, SAREC; University of WY, 2006).

Treatment and rate (product /A)	Crop stage[1]	Application dates[2] (mm/dd)	Crop vigor		Yield (cwt/A)	Seed quality[3]		
			11 Aug	22 Aug		200 seed weight (oz)	% damaged	% discolored
1. Nontreated check	NA	NA	5.0 a[4]	5.0 a	37.5 a	2.8 a	0.5 a	2.8 a
2. Headline 2.08EC (6.0 fl oz)	4th-trifoliolate	A (07/06)	5.0 a	5.0 a	35.2 a	2.8 a	1.3 a	3.7 a
3. Headline 2.08EC (6.0 fl oz)	R1	B (07/12)	5.0 a	5.0 a	33.7 a	2.8 a	0.8 a	1.5 a
4. Headline 2.08EC (6.0 fl oz)	R2	C (07/20)	5.0 a	5.0 a	39.0 a	2.9 a	0.3 a	2.8 a
5. Headline 2.08EC (6.0 fl oz)	R3	D (07/25)	4.7 a	5.0 a	33.7 a	2.7 a	1.2 a	3.3 a
6. Headline 2.08EC (6.0 fl oz) ..... 6. Headline 2.08EC (6.0 fl oz)	R1 + 14 days	B (07/12) D (07/25)	5.0 a	5.0 a	32.9 a	2.7 a	0.7 a	1.8 a
7. Headline 2.08EC (6.0 fl oz) ..... 7. Headline 2.08EC (6.0 fl oz)	R3 + 14 days	D (07/25) E (08/08)	5.0 a	5.0 a	36.7 a	2.9 a	0.2 a	1.0 a

[1] Plots were planted on 31 May, 2006 (Othello) and harvested on 29 September. Crop stages are; R1 = beginning bloom, R2 = full bloom (ca. 1 flower per plant), R3 = pod initiation, "+ 14 days" = re-application made 14 days later, and NA = not-applicable.

[2] Treatment application dates were: A = 6 July, B = 12 July, C=20 July, D = 25 July, E = 8 August and NA = not applicable.

[3] Seed quality measurements were based on evaluating 100 seeds.

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

Research Project	**Russian Wheat Aphid Management in Small Grains, 2006**

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Field Plot Details

The field plot was located at the Sustainable Agricultural Research & Extension Center (SAREC) near Lingle, WY at an elevation of 4165 ft MSL. The soil type was a Mitchell silt loam soil at pH = 7.9. No irrigation water was applied and plant growth relied on stored soil-water and natural rainfall (dryland wheat).

Plot Design

The plot design was a randomized complete block design with four replications. Each plots was 10 ft wide by 20 ft long with a 5 ft in-row buffer. All treatments were made to, and all data were collected from, the center 6.7 ft (width) by 20 ft length of plot area.

Plot Management

Planting Date: 1 September, 2005.
Variety: Goodstreak (winter wheat)
Fertilizer: 30 lbs N + 35 lb P_2O_5 + 10 lb S
Herbicide: Post application of Harmony Extra + 2,4-D LV6 (0.4 oz + 4 fl oz product) on 11 May, 2006.

Treatment Applications

The insecticide treatments were applied on 7 and 12 June, corresponding to wheat stages "wheat in late flower" and "wheat berries in milk stage," respectively. The winter wheat became drought stressed by mid-June, as was typical for the High Plains production area.

Insect Development

All insect population development relied on natural infestations. Regional surveys revealed that Russian wheat aphid populations were established in fields throughout southeastern Wyoming. Scouting in the field plot area revealed that Russian wheat aphid populations were clumped and not uniformly distributed. The buffer rows were left untreated to improve the potential for greater insect pest pressure.

Insect Treatment Evaluations

Initial Russian wheat aphid populations were determined on 7 June. Six tillers were selected at random from each of the four replicate blocks (24 tillers total), aphids were enumerated and the average number of aphids per tiller was calculated. On each evaluation date, except for 12 June (when five tillers per plot were collected), ten wheat tillers were selected at random from each plot and the number of Russian wheat aphids was enumerated.

Statistical Analysis ANOVA with four replications. Mean separations were done using Fisher's protected LSD ($P \leq 0.05$).

Harvest Winter wheat yields were not determined.

Results and Discussion

Regional surveys revealed that Russian wheat aphid (RWA) populations were established throughout southeastern Wyoming. Winter wheat in most dryland production fields was suffering from moisture stress due to the continuing drought. In the field plot area, RWA was present in all plots and tended to be clumped in distribution. The location of blocks in the field plot area was arranged to compensate for the uneven RWA distribution. At the time when the first insecticide applications were made (7 June, late flowering), an estimated 42 percent of the tillers were found to be infested with RWA. The second insecticide application was made on 12 June (wheat berries in milk stage).

Treatment effects on RWA populations are summarized in Tables 1 and 2. There were no significant treatment effects on RWA incidence (percentage of tillers infested) or populations (average number of RWA per tiller) until the 15 June rating ($P \leq 0.05$). By 15 June, Lorsban (treatment 2) and Warrior (treatment 4) treatments significantly reduced the percentage of infested tillers from 67.5 percent (nontreated check) to 27.5 percent and 40.0 percent, respectively. The number of RWAs per tiller was reduced from 7.3 (nontreated check) to 1.7 (Lorsban) and 3.0 (Warrior) RWAs per tiller. On the last evaluation date (19 June), only Lorsban significantly reduced the percentage of tiller infested and RWA populations compared to the nontreated check ($P \leq 0.05$).

Table 1. Effects of foliar insecticide treatments on Russian wheat aphid incidence (G.D.Franc and W.L. Stump, Univ. of WY; 2006).

Treatment (product/A)[1]	Russian wheat aphid incidence (% of tillers infested)				
	Initial 7 June[2]	9 June[3]	12 June[4]	15 June[3]	19 June[3]
1. Nontreated check	42.0 a[5]	65.0 a	50.0 a	67.5 a	70.0 a
2. Lorsban 4EC (12 fl oz)	42.0 a	35.0 a	45.0 a	27.5 b	25.0 b
3. Lannate LV 2.4SL (1.5 pt)	42.0 a	40.0 a	70.0 a	67.5 a	72.5 a
4. Warrior (3.84 fl oz)	42.0 a	60.0 a	60.0 a	40.0 b	45.0 ab

1 Treatments were foliar applied on 7, and 12 June.
2 Average initial populations prior to first insecticide applications, based on 24 tillers.
3 A total of ten tillers were randomly selected from each plot during evaluations.
4 A total of five tillers were randomly selected from each plot during evaluation.
5 Treatment means followed by different letters differ significantly (Fisher's protected LSD, $P \leq 0.05$).

Table 2. Effects of foliar insecticide treatments on Russian wheat aphid populations (G.D.Franc and W.L. Stump, Univ. of WY; 2006).

Treatment (product/A)[1]	Average number of Russian wheat aphid per tiller				
	Initial 7 June[2]	9 June[3]	12 June[4]	15 June[3]	19 June[3]
1. Nontreated check	4.6 a[5]	7.6 a	9.3 a	7.3 a	6.3 a
2. Lorsban 4EC (12 fl oz)	4.6 a	3.4 a	6.1 a	1.7 b	1.2 b
3. Lannate LV 2.4SL (1.5 pt)	4.6 a	8.3 a	20.5 a	7.3 a	11.1 a
4. Warrior (3.84 fl oz)	4.6 a	13.1 a	16.7 a	3.0 b	6.8 ab

1 Treatments were foliar applied on 7, and 12 June.
2 Average initial populations prior to first insecticide applications, based on 24 tillers.
3 A total of ten tillers were randomly selected from each plot during evaluations.
4 A total of five tillers were randomly selected from each plot during evaluation.
5 Treatment means followed by different letters differ significantly (Fisher's protected LSD, $P \leq 0.05$).

2006 Southeastern Wyoming and Western Nebraska Winter Wheat Survey-

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Forty-eight field sites were visited on May 24 thru May 26, 2006 (Figure 1). Crop specialists from the University of Nebraska-Lincoln and the University of Wyoming participated in the survey. University of Wyoming participants were Gary Franc (extension plant pathologist), William Stump (research scientist), and Jack Cecil (research scientist). UNL participants were Stephen Wegulo (extension plant pathologist), Gary Hein (entomologist), Drew Lyon (extension dryland cropping specialist), Robert Harveson (plant pathologist), William Booker (extension educator), and Karen DeBoer (extension educator),

NW Nebraska (Seventeen fields visited on May 24-25, 2006):

In NW Nebraska near Alliance we observed considerable tan spot and wheat streak mosaic virus. Although widespread, only one field had disease progression up the plant as far as the penultimate leaf, and this field would have probably benefitted from a fungicide application earlier in the season and is likely to show some yield loss. In general, tan spot control in most fields is not economically justified because the boost in dryland wheat yield that results from disease control typically will not offset the cost of the fungicide. Some Russian wheat aphid and green bugs were observed, as well. The wheat stands were generally good and most wheat was in the late boot stage to fully emerged and heading out. The wheat crop is at the critical stage where timely rain is essential for achieving average yields.

The wheat crop north of Sidney, generally appeared good with adequate stands. Wheat streak mosaic virus and tan spot were routinely observed in the fields. Similar to NW Nebraska, timely rain in the next 10 days will be needed for decent yields to be achieved.

Wyoming (Thirty-one fields visited on May 25-26, 2006):

Evidence of prior frost was evident in most Wyoming fields with tips of some lower leaves dead. Furthermore, drought stress effects were showing up on the plants as considerable leaf death low in the canopy around the base of the stems. There was a lack of tillering and tillers that already formed were drying up and turning brown, because the plants were in the process of re-directing water to the heads and (hopefully) eventual grain-fill.

Pine Bluffs-Albin-Hawk Springs-Lingle: The crop in this general area was heading out and showing signs of drought stress. The growth stage of the crop will now require timely rains in order to even approach average yields. Tan spot and wheat streak mosaic virus were only found on the occasional plant, in contrast to Nebraska fields where wheat streak mosaic and tan spot were much more commonly observed. In contrast, evidence of Russian wheat aphid was much more common in Wyoming than in Nebraska.

Russian wheat aphid was common in some fields, and several producers west of Hawk Springs had already sprayed earlier in May. One of the fields sprayed earlier with insecticide still had living aphids evident, and living aphids were occasionally found in high numbers scattered along the edges of other fields in the area.

Chugwater Bench: The crop was approximately 1 week behind that in the SE corner of Wyoming. Russian wheat aphid evidence was common in some fields and, once again, only a few plants were observed with tan spot or wheat streak mosaic virus. The exception was a single field with extensive widespread symptoms of viral infection that looked somewhat like wheat streak mosaic virus. Plant samples from this field will be tested to determine if another virus is possibly involved. As with most fields visited during the survey, rain in the next two weeks is critical if decent yields are to be obtained. By the way...we saw one too many rattlesnakes!

Wyoming Summary: In summary for Wyoming, water availability (lack of timely and sufficient rain) will limit production this year, with relatively little yield effects due to disease or other pests.

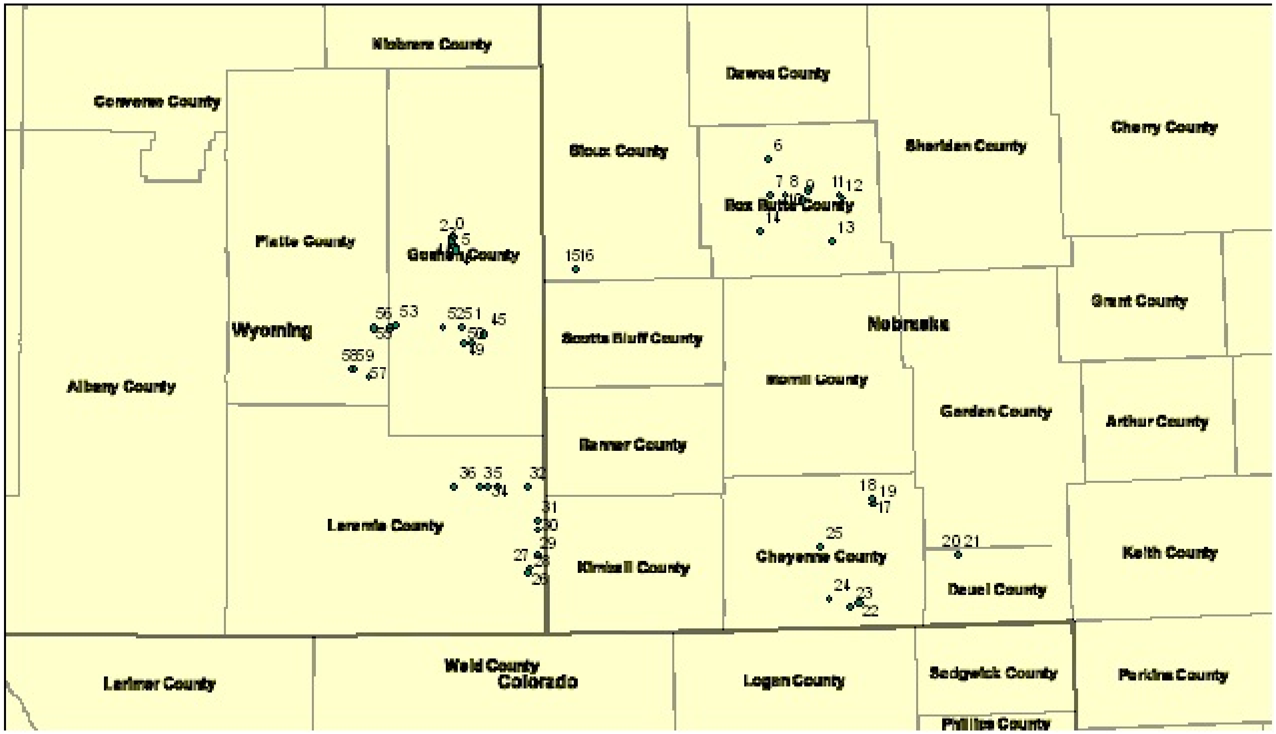
Other crops visited:

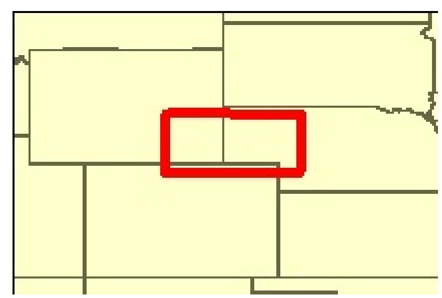
Garbanzo Beans (near Alliance Nebraska): The crop was just emerging and had been planted into heavy mulch and corn stubble. Although under center pivot, the surface mulch was reported to greatly reduce (at least 50%) the water requirement in this particular field because surface evaporation was greatly reduced.

Canola (near Alliance, Nebraska and near Lingle, Wyoming): The crop was in flower and generally looked good. No apparent disease problems were observed in these fields.

Alfalfa (west of Hawk Springs, Wyoming): Alfalfa weevil was evident, and the crop suffered greatly from lack of water. Even the weeds were dying! Hopefully irrigation water will become available soon.

Figure 1. Wheat survey sample sites, May 24-26, 2006





2006 Survey Results: Fungicide Sensitivity Characteristics of *Cercospora beticola* Isolates Recovered from Infected Sugarbeet in the High Plains of Colorado, Montana, Nebraska, and Wyoming

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Abstract

The 2006 Cercospora leaf spot survey tested the fungicide reaction of 200 *Cercospora beticola* isolates recovered from 39 fields: 11 fields from CO, 2 fields from MT, 25 from NE, and one field from WY. All isolates were tested for sensitivity to benzimidazole (Benlate®, Topsin®), triphenyltin hydroxide (Super Tin®, Agritin®), tetraconazole (Eminent®), propiconazole (Tilt®), azoxystrobin (Quadris®), trifloxystrobin (Gem®) and pyraclostrobin (Headline®). No appreciable insensitivity was observed for these fungicides, except benzimidazole; 62 percent of the fields surveyed had detectable levels of benzimidazole insensitivity. Historical trends for High Plains surveys initiated in 1998 revealed that fields with benzimidazole insensitivity increased from 26 percent in 1998 to 80 percent in 2003, followed by a three year decline to 45 percent in 2005. Results consistently reveal that benzimidazole insensitivity is widespread in High Plains sugar beet fields. Therefore, reliance on benzimidazole or thiophanate-methyl for Cercospora leaf spot suppression is not advised. Isolate reaction to diethofencarb in 2004-2006 revealed that all isolates insensitive to benzimidazole were sensitive to diethofencarb (negative cross resistance), indicating the likely presence of a single (and previously described) mutation conferring benzimidazole resistance. However, data for 2006 reveal for the first time that isolates (21 isolates representing 11 fields) had intermediate responses (21-74% inhibition) in the presence of benzimidazole. The growth of these isolates was suppressed by diethofencarb, possibly indicating the emergence of a second mutation in the fungal population. The presence of negative cross resistance in the fungal population suggests that diethofencarb plus benzimidazole be used as a tank mix to suppress the spectrum of isolates present in the field. However, this approach had limited success in other production regions because insensitivity to both fungicides resulted. A concerning trend is that decreased sensitivity to asoxystrobin is appearing in the fungal population, although growth suppression is considered effective. In summary, the 2006 survey revealed that, with the exception of benzimidazole, our fungicide chemistries remain effective for Cercospora leaf spot suppression and that fungicide resistance management must be practiced by growers to maintain long-term efficacy of our fungicide chemistries.

Materials and Methods

Cercospora leaf spot samples were collected from commercial sugar beet fields during the late growing season by the Western Sugar cooperative personnel and one sample collection was made in Wyoming by UW personnel. The 2006 survey consisted of leaf samples collected from 42 fields throughout the High Plains growing region: 13 fields from Colorado, 2 fields from Montana, 26 fields from Nebraska, and one field from Wyoming. Leaf samples were air-dried and stored for approximately two months prior to recovery attempts. Up to several recovery attempts were made for each sample so that each field was represented by at least one fungal isolate, with up to 12 isolates was tested from a field. Cercospora isolates (200 isolates) were successfully recovered from 39 of the 42 fields; 11 fields from CO, 2 fields from MT, 25 from NE, and one field from WY.

Fungicide sensitivity tests:

The media for testing the strobilurin fungicides azoxystrobin (Quadris®), trifloxystrobin (Gem®) and pyraclostrobin (Headline®) was made by amending glycerol medium and all other fungicides were added to potato dextrose agar (PDA). Diethofencarb, a fungicide with activity against certain benzimidazole-resistant fungi, also was tested. Media was autoclaved and cooled to approximately 50˚C. Stock suspensions of 500 ppm benzimidazole (Benlate®), triphenyltin hydroxide (Super Tin®, Agritin®), tetraconazole (Eminent®), propiconazole (Tilt®), azoxystrobin (Quadris®), trifloxystrobin (Gem®) and pyraclostrobin (Headline®) were prepared in sterile distilled water. 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; 14 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 5 ppm, triphenyltin hydroxide 1 ppm, tetraconazole 1 ppm, propiconazole 1 ppm, azoxystrobin 1 ppm, trifloxystrobin 1 ppm, pyraclostrobin 1 ppm, and diethofencarb 5 ppm.

Each isolate recovered from infected leaves was cultured onto a SBLEA (sugar beet leaf extract) source plate, incubated for 12 to 14 days at 23˚C with a 12 hr photoperiod and the colony was allowed to desiccate prior to use for plate inoculations. 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 eight amended plates plus glycerol and PDA non-amended control plates. All ten plates for a given isolate were sleeved together for incubation, two isolate series per sleeve. Known *Cercospora beticola* strains sensitive and insensitive to benzimidazole were included as controls. Inoculated plates were incubated at 23˚C with a 12 hr photoperiod.

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 percentage of inhibition of radial growth for each test isolate grown on fungicide-amended media was compared to its growth on non-amended media. 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 calculating growth inhibition. The percent inhibition for each isolate was then calculated with the following equation, [(non-amended control – amended)/non-amended control X 100]. Although isolates that had colony growth greater than 3 mm after 7 days had measurable "insensitivity" to the fungicide present in the amended medium, only isolates that exhibited 20% or less inhibition (80% or more growth) were considered insensitive.

Results and Discussion

A total of 200 isolates were recovered in 2006 from 39 sugar beet fields with symptoms of Cercospora leaf spot. For three of the fields we failed to recover *C. beticola* due to lack of sufficient lesions or the presence of other organisms. Each isolate represented a single separate foliar lesion. All isolates were tested for growth on the ten different media plates. Known benzimidazole sensitive and insensitive *C. beticola* isolates from prior surveys were tested and reacted consistently on the test media. Due to poor or no growth on the check plates, approximately 23 isolates were retested. After the retests, a total of 195 isolates provided results for the glycerol based medium (azoxystrobin, trifloxystrobin and pyraclostrobin) and a total of 199 isolates provided results for the remaining fungicide treatments.

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. Insensitivity to triphenyltin hydroxide, tetraconazole, propiconazole, azoxystrobin, trifloxystrobin or pyraclostrobin was not detected. A total of 62 isolates (31%) were found to be insensitive to benzimidazole at 5 ppm. Nebraska had the greatest percentage of insensitive isolates (40%) followed by Montana (31%), Colorado (12%), and Wyoming (80%, only one field).

The number of **fields** in which at least one benzimidazole insensitive isolate was detected are shown in Table 2. Overall, 62 percent of the fields tested in the High Plains region had detectable benzimidazole insensitivity in 2006. Colorado had 73% benzimidazole resistant fields represented (8/11) in the survey; 4 of these 8 fields had mixed populations of sensitive and insensitive isolates. In Nebraska, 56 percent (14/25) of the fields had benzimidazole resistance; 9 of these 14 fields had mixed populations. Montana had 50 percent (½) of the fields with an insensitive isolate detected (also a mixed population). Wyoming had one field tested with 4 of the 5 isolates being insensitive. 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, trifloxystrobin and pyraclostrobin fungicides are shown in Table 3. In general, isolates had greater inhibition of growth in the presence with pyraclostrobin compared to azoxystrobin and trifloxystrobin, similar to field trials that revealed pyraclostrobin suppressed Cercospora leaf spot more effectively than did azoxystrobin. All the isolates tested in the survey were considered sensitive because all were inhibited in their growth by greater than 20 percent. However, for one isolate from Colorado, growth was only inhibited 24 percent on azoxystrobin. From this same field, another isolate was inhibited only 38 percent on trifloxystrobin. Additionally, compared to past surveys, percent inhibition levels have been decreasing for azoxystrobin and trifloxystrobin.

Isolate inhibition in the presence of 1 ppm tetraconazole and propiconazole fungicides are summarized in Table 4. In the presence of tetraconazole all of the isolates had 100 percent growth inhibition (none of the isolates grew in the presence of these fungicides) and propiconazole inhibited the majority of isolate growth.

Isolate inhibition in the presence of triphenyltin hydroxide at 1 ppm are summarized in Table 5. All of the isolates were inhibited 100 percent at 1 ppm.

Isolate inhibition in the presence of benzimidazole at 5 ppm are summarized in Table 6. Contrary to past surveys, where isolates either were completely inhibited or not inhibited at all (<9% inhibition), 21 isolates exhibited inhibition levels between 21 and 74 percent. About one half of the intermediate isolates were retested to confirm this reaction. Of these, 78 percent of the retested isolates still exhibited an intermediate reaction on benzimidazole. The final 21 intermediate isolates reported herein is a combination of the original test result data and the retest data (isolate retest results replaced original results). Fifty-eight of the 199 isolates were inhibited less than 9 percent (91% or greater growth) in the presence of benzimidazole. 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). The 21 intermediate insensitive isolates mentioned above were also sensitive to diethofencarb.

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 a high of 80 percent in 2003, followed by a three year decline to 45 percent in 2005, then increased to 62 percent in 2006. Results reveal the consistent trend that benzimidazole insensitivity is widespread in High Plains sugar beet fields. Although the field fungicide-use data is incomplete, no fields sampled in 2006 indicated the use of benzimidazole for the 2006 field season. Additionally, 46 percent of the fields considered to be insensitive to benzimidazole also had at least one sensitive isolate recovered from the same field (up from 32% in 2005). This increase of mixed populations in addition to the appearance of the intermediate growth inhibitions in the presence of benzimidazole, indicates a possible shift in *Cercospora beticola* populations.

Tests with diethofencarb reveal that all isolates insensitive or with an intermediate insensitive reaction 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. More importantly, the consistent correlation of benzimidazole insensitivity to diethofencarb sensitivity suggests the presence of a single mutation that conferred benzimidazole insensitivity to all isolates recovered during 2004-2006 surveys. The presence of intermediate benzimidazole reactions may indicate the presence of a second mutation. In summary, the 2006 survey reveals that our fungicide chemistries, except for benzimidazoles, remain effective and that fungicide resistance management must be practiced by growers to preserve the useful life of our fungicide chemistries.

Table 1. The number of insensitive *Cercospora beticola* isolates (20% or less growth inhibition in the presence of the indicated fungicide) recovered in 2006 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
Trifloxystrobin (1)	1	0	0	0	0
Tetraconazole (1)	0	0	0	0	0
Propiconazole (1)	0	0	0	0	0
Triphenyltin (1)	0	0	0	0	0
Benzimidazole (5)	8	4	46	4	62
Total isolates tested	67	13	114	5	199

* Azoxystrobin, trifloxystrobin and pyraclostrobin utilized a glycerol based medium, while all other fungicides were tested utilizing potato dextrose agar.

** Percent inhibition: Mean colony diameter was first computed for both the amended and non-amended control for each isolate (three replications) 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% or less inhibition) present. Isolates were recovered in 2006 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 (5)	8	1	14	1	24
Total fields tested	11	2	25	1	39

* Azoxystrobin, trifloxystrobin and pyraclostrobin utilized a glycerol based medium, while all other fungicides were tested utilizing potato dextrose agar.

** Percent inhibition: Mean colony diameter was first computed for both the amended and non-amended control for each isolate (three replications) 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), trifloxystrobin (Gem) and pyraclostrobin (Headline) fungicides. Isolates were recovered from symptomatic leaves collected in 2006 from Colorado, Nebraska, Montana, and Wyoming sugar beet fields.

% inhibition*	Number of isolates within a category														
	Azoxystrobin 1 ppm					Trifloxystrobin 1 ppm					Pyraclostrobin 1 ppm				
	CO**	MT	NE	WY	Total	CO	MT	NE	WY	Total	CO	MT	NE	WY	Total
0-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10-19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20-29	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0
30-39	0	0	1	0	1	1	0	2	0	3	0	0	0	0	0
40-49	2	2	5	0	9	6	3	5	0	14	0	0	0	0	0
50-59	9	2	10	0	21	9	2	5	1	17	0	0	0	0	0
60-69	12	2	13	0	27	7	1	13	0	21	0	0	0	0	0
70-79	14	1	10	1	26	11	1	13	0	25	0	2	2	0	4
80-89	10	1	7	1	19	15	0	11	1	27	7	1	5	0	13
90-99	7	1	8	1	17	7	3	12	0	22	20	3	19	0	42
100	11	4	57	2	74	10	3	50	3	66	39	7	85	5	136
Total tested	66	13	111	5	195	66	13	111	5	195	66	13	111	5	195

* 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 2006 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	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	1	0	0	0	1
100	67	13	114	5	199	66	13	114	5	198
Total tested	67	13	114	5	199	67	13	114	5	199

* 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 2006 from Colorado, Nebraska, Montana, and Wyoming sugar beet fields.

Percent inhibition*	Number of isolates within a category				
	Triphenyltin hydroxide (1 ppm)				
	CO**	MT	NE	WY	Total
0-9	0	0	0	0	0
10-19	0	0	0	0	0
20-29	0	0	0	0	0
30-39	0	0	0	0	0
40-49	0	0	0	0	0
50-59	0	0	0	0	0
60-69	0	0	0	0	0
70-79	0	0	0	0	0
80-89	0	0	0	0	0
90-99	0	0	0	0	0
100	67	13	114	5	199
Total tested	67	13	114	5	199

* 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 2006 from Colorado, Nebraska, Montana, and Wyoming sugar beet fields.

Percent inhibition*	Number of isolates within a category				
	benzimidazole (5 ppm)				
	CO**	MT	NE	WY	Total
0-9	12	1	42	3	58
10-19	4	2	4	0	10
20-29	1	2	2	2	7
30-39	4	0	5	0	9
40-49	2	1	1	0	4
50-59	1	0	1	0	2
60-69	0	0	0	0	0
70-79	0	0	1	0	1
80-89	0	0	0	0	0
90-99	0	0	0	0	0
100	43	7	58	5	108
Total tested	67	13	114	5	199

* 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 (1998-2006) 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	2005	2006
Colorado	19/36 53%	14/29 48%	9/23 39%	18/29 62%	3/5 60%	17/21 81%	9/12 75%	5/10 50%	8/11 73%
Montana	0/19 0%	1/5 20%	3/5 60%	6/11 55%	0/1 0%	3/5 60%	2/6 33%	1/10 10%	½ 50%
Nebraska	4/33 12%	8/39 21%	8/32 25%	7/29 24%	21/27 78%	13/16 81%	16/20 80%	19/35 54%	14/25 56%
Wyoming	NT*	0/1 0%	0/1 0%	NT	1/1 100%	3/3 100%	0/2 0%	0/1 0%	1/1 100%
Total	23/88 26%	23/74 31%	20/61 33%	31/69 45%	25/34 74%	36/45 80%	27/40 68%	25/56 45%	24/39 62%

* NT=Not tested.

Products Tested in 2006 Field Research Studies

Product	Class*	Manufacturer	Composition
Allegiance-LS	F	Bayer Corp.	17.7% Metalaxyl
Apron XL 3LS	F	Syngenta Crop Protection, Inc.	3.46% Mefenoxam
Asana XL 0.66 EC	I	Dupont Agricultural Products Wilmington, DE 19880-0402	8.4% Esfenvalerate
Bravo Weather Stik 6F	F	Syngenta Crop Protection, Inc. P.O. Box 18300 Greensboro, NC 27419	54% Chlorothalonil
Counter 20G	I	BASF Corp. 26 Davis Dr. Research Triangle Park, NC 27709	20% Tebufos
Cruiser 5SC	I	Syngenta Crop Protection, Inc.	47.6% Thiamethoxam
Dyne-Amic	S	Helena Chemical Co. 225 Schilling Blvd., Suite 300 Collierville, TN 38017	Nonionic organosilicone surfactant
Echo ZN 4.17F	F	Sipcam Agro USA, Inc. 70 Mansell Ct., Suite 230 Roswell, GA 30076	38.5% Chlorothalonil
Eminent 125SL	F	Sipcam Agro USA, Inc.	11.6% Tetraconazole
Endura 70WP	F	BASF Corp.	70% Boscalid
Garlic GP 1SC	F	Garlic GP LTD Co. San Antonio, TX 78218	98.2% Garlic juice
Gem 4.17SC	F	Bayer Corp.	38.5% Trifloxystrobin
Gramoxone 3SC	H	Syngenta Crop Protection, Inc.	43.8% Paraquat dichloride
Headline 2.08EC	F	BASF Corp.	22.9% Pyraclostrobin
Induce	S	Helena Chemical Co.	Nonionic surfactant mixture
Kocide 2000 35WP	F	Dupont	53.8% Copper hydroxide
Lannate LV 2.4SC	I	Dupont	29% Methomyl
LEM17 50WP	F	Dupont	Information not provided
LEM17 1.67SC	F	Dupont	Information not provided
Lorsban 4EC	I	Dow AgroSciences LLC 9330 Zionsville Road Indianapolis, IN 46268	44.9% Chlorpyrifos
ManKocide 61.1WG	F	Griffin Corp PO Box 1847, Rocky Ford Rd Valdosta, GA 31603-1847	46% Copper hydroxide 15% Mancozeb 3% Zinc oxide
Manzate Pro-Stick 75DF	F	Dupont	75% Mancozeb
Maxim 4FS	F	Syngenta Crop Protection, Inc.	40.3% Fludioxonil

Moncut 70DF	F	Gowan Co. PO Box 5569 Yuma, AZ 85366-5569	70% Flutolanil
Numbered compound	F	Bayer Corp.	Information not provided
Numbered compound	I	Dupont	Information not provided
Penncozeb 75DF	F	Cerexagri, Inc. 900 First Ave. King of Prussia, PA 19406	75% Mancozeb
Poncho 600 5SC	I	Bayer Corp.	48% Clothianidin
Proline 4EC	F	Bayer Corp.	41% Prothioconazole
Punch 3.3EC	F	Dupont	37.8% Flusilazole
Quadris 2.08SC	F	Syngenta Crop Protection, Inc.	22.9% Azoxystrobin
Reglone 3.73SC	H	Syngenta Crop Protection, Inc.	37.3% Diquat dibromide
Super Tin 80WP	F	Dupont	80% Triphenyltin hydroxide
Telone II	SF	Dow AgriSciences LLC	97.5% 1, 3-dichloropropene
Thiram 42-S	R	Bayer Corp.	42% Thiram
Topsin M 70WP	F	Cerexagri, Inc.	70% Thiophanate-methyl
Vydate C-LV	I	Dupont	42% Oxamyl
Warrior with Zeon Technology	I	Syngenta Crop Protection, Inc.	11.4% Lambda-cyhalothrin
X77	S	Loveland Industries, Inc. P.O. Box 1289 Greeley, CO 80632-1289	Nonionic surfactant

* F = fungicide, I = insecticide, H = herbicide, R = repellant, S = surfactant, SF = soil fumigant