

Plant Pathology Research and Demonstration Progress Reports: 1999 Field Season

Compiled by: Gary D. Franc, William L. Stump and Stephan C. Briere
University of Wyoming: Department of Plant Sciences
P.O. Box 3354
Laramie, WY 82071-3354

For a copy of this report contact:
G.D. Franc (307) 766-2397
>FrancG@uwyo.edu<

Table of Contents

Bean Rust Management with Foliar Fungicides, 1999	1
Potato Late Blight Management with Seedpiece Fungicide Treatments, 1999	4
Potato Pink Rot Management with Mefenoxam, 1999	9
Early Blight and Late Blight Disease Management in Potato with Foliar Fungicide Programs, 1999	13
Foliar Disease Management in Potatoes, 1999	19
Silver Scurf and Potato Tuber Disease Management with Foliar Fungicide Programs, 1999	25
Potato Psyllid and Aphid Management with In-furrow and Foliar Insecticides, 1999	30
Bacterial Ring Rot Symptom Development in Selected Potato Cultivars, 1999	33
Potato Vine Desiccation, 1999	39
Rhizoctonia Root and Crown Rot Management in Sugar Beet using Quadris, 1999	44
Quadris Combinations with Postemergence Herbicide Treatments in Sugar Beets, 1999	51
Cercospora Management in Sugar Beet with Foliar Fungicide Programs, 1999	60
AgriTin Rainfast Trial, 1999	65

Research Project**Bean Rust Management with Foliar Fungicides, 1999****Research Team**

Tel: 307-766-2397
FAX: 766-5549
francg@uwyo.edu

G.D. Franc, W.L. Stump, S.C. Briere
University of Wyoming, Dept. of Plant Sciences
P.O. Box 3354 (16th & Gibbon Streets)
Laramie, WY 82071-3354

Field Plot Location

Torrington Research & Extension Center @ Torrington, WY.
4104 ft MSL; sandy loam soil; overhead irrigation

Plot Design

RCBD with 4 replications; Treatment plots were 4 rows (30-inch centers) X 20 ft with a 5 ft in-row buffer. All treatments were made to, and all data were collected from, the center two rows; 4 rows of corn surrounded the field plot area.

Plot Management

Planting Date: 25 May.

Variety: Bill Z

Fertilizer: 50 lbs P₂O₅

Herbicide: Sonalan + Eptam (2 pt + 4.5 pt product/A) on 26 May.

Insecticide: Asana (4 fl oz/A) on 19 July for Mexican bean beetle.

Rust Development

Natural: Rust pustules were first noted on 4 August.

Artificial: Bean plants were inoculated in the greenhouse, pustules were allowed to develop, and then plants were transplanted into spreader rows on 5 August. One inoculated plant was transplanted per treatment plot.

Treatment Applications

Applications A, B, C, and D, were 4, 11, 18, and 25 August, respectively. Fungicides were applied with the aid of a portable (CO₂) sprayer in a total volume of 43 gal/A @ 30 psi boom pressure (four #8004 flat fan nozzles spaced @ 20 inches). Descriptions of the chemicals tested can be found in Appendix 1.

Rust Severity Ratings

Ten terminal leaflets were randomly selected from the middle canopy of each treatment plot on 4, 17, 26, and 31 August. The number of pustules per leaflet underside was counted and the treatment plot average was calculated. The percentage of foliage necrotic (combined effects of disease and senescence) was estimated on 8 September.

Harvest

The center 10 ft X two rows for each plot was harvested by hand (22 September) and then threshed with a small combine. Total yield was measured for each treatment plot plus a seed quality (size) rating was made by determining a 200-count seed weight.

Statistical Analysis

Data were analyzed by ANOVA and mean separations were done using Fisher's protected LSD ($P \leq 0.05$). For AUDPC determinations, data were transformed (\log_{10}) to correct for non-homogeneity prior to analysis; data prior to transformation are presented in Table 1.

Results and Discussion

All fungicide programs significantly reduced the number of rust pustules per leaflet by 31 August, compared to the nontreated check ($P \leq 0.05$). The AUDPC values revealed that spray programs that included Quadris and Bravo were superior to the EBDC and copper programs. Seed yields and quality were not affected by fungicide application ($P \leq 0.05$). However, bean rust pressure was light during 1999 and bean senescence occurred early. It also should be noted that early infection was not uniform across treatment plots and may have introduced variability into the data.

Table 1. The effects of foliar fungicide programs on bean rust development (G.D. Franc, et al., U of WY; 1999).

Treatment and Application Rate (lb a.i./ acre)	Application dates ¹	Number of rust pustules per terminal leaflet				AUDPC ²	% foliar necrosis
		4 Aug	17 Aug	26 Aug	31 Aug		
1. Nontreated Control	A-D	0.0 a ³	8.5 ab	99.4 a	228.3 a	1360 a	76.5 a
2. Maneb (1.5)	A-D	0.3 a	2.1 bc	42.3 abc	44.1 bc	431 b	55.0 a
3. Maneb + Cuprofix (1.5 + 1.2)	A-D	0.0 a	3.2 bc	11.6 bc	33.7 bc	200 bc	65.0 a
4. Maneb + Cuprofix (1.5 + 1.6)	A-D	0.3 a	2.7 bc	48.0 abc	66.7 bc	534 ab	69.0 a
5. Maneb + Cuprofix (1.5 + 0.8)	A-D	0.7 a	11.4 a	70.5 ab	83.7 b	833 ab	59.5 a
6. Quadris + LI700 (0.15 + 0.06 % v/v)	A, D	0.3 a	0.3 c	5.9 bc	20.2 bc	97 dc	64.0 a
6. Bravo Zn (1.8)	C						
7. Quadris + LI700 (0.2 + 0.06 % v/v)	A, D	0.0 a	0.1 c	1.5 c	2.5 c	18 e	55.0 a
7. Bravo Zn (1.8)	C						
8. Quadris + LI700 (0.25 + 0.06 % v/v)	A, D	0.3 a	0.3 c	3.7 c	8.6 c	53 de	59.5 a
8. Bravo Zn (1.8)	C						
9. Manex + Kocide 2000 (1.2 + 0.54)	A-D	0.0 a	1.8 bc	13.9 bc	32.9 bc	199 bc	59.5 a

¹ Application dates: A=8/4, B=8/11, C=8/18, and D=8/25.

² Area under the disease progress curve; decreased disease severity and/or later disease onset will contribute to a lower AUDPC value.

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 bean seed yield and quality (G.D. Franc, et al., U of WY; 1999).

Treatment and Application Rate (lb a.i./ acre)	Application dates ¹	Seed yield and Quality	
		Cwt/A	oz/200 seeds
1. Nontreated Control	A-D	27.9 a ²	2.77 a
2. Maneb (1.5)	A-D	25.7 a	2.76 a
3. Maneb + Cuprofix (1.5 + 1.2)	A-D	26.5 a	2.75 a
4. Maneb + Cuprofix (1.5 + 1.6).	A-D	25.6 a	2.78 a
5. Maneb + Cuprofix (1.5 + 0.8)	A-D	22.9 a	2.73 a
6. Quadris + LI700 (0.15 + 0.06 % v/v) . .	A, D	26.3 a	2.83 a
6. Bravo Zn (1.8)	C		
7. Quadris + LI700 (0.2 + 0.06 % v/v)	A, D	27.7 a	2.79 a
7. Bravo Zn (1.8)	C		
8. Quadris + LI700 (0.25 + 0.06 % v/v) . .	A, D	27.5 a	2.77 a
8. Bravo Zn (1.8)	C		
9. Manex + Kocide 2000 (1.2 + 0.54)	A-D	25.7 a	2.72 a

¹ Application dates: A=8/4, B=8/11, C=8/18, and D=8/25.

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

Appendix 1. List of chemicals tested.

<u>Product</u>	<u>Manufacturer</u>	<u>Composition</u>
Maneb 75 DF	Elf Atochem North America, Inc. 2000 Market Street Philadelphia, PA 19103-3222	75% Maneb
Cuprofix 20 WG Bravo Zn 4.17 F	Elf Atochem North America, Inc. Zeneca Inc. Agricultural Products 1800 Concord Pike Wilmington, DE 19897	Bordeaux mixture 38.5% Chlorothalonil
Quadris 2.08 SC Manex 4L	Zeneca Inc. Agricultural Products Griffin Corporation P.O. Box 1847 Valdosta, GA 31603-1847	22.9% Azoxystrobin 37% Maneb
Kocide 2000 LI 700	Griffin Corporation Loveland Industries, Inc. P.O. Box 1289 Greeley, CO 80623	53.8% copper hydroxide Surfactant Penetrant Acidifier

Research Project

Potato Late Blight Management with Seedpiece Fungicide Treatments, 1999

Research Team

Tel: 307-766-2397

FAX: 766-5549

francg@uwyo.edu

G.D. Franc, W.L. Stump, and S.C. Briere
University of Wyoming, Dept. of Plant Sciences
P.O. Box 3354 (16th & Gibbon Streets)
Laramie, WY 82071-3354

Field Plot Location

Site 1: Torrington Research & Extension Center @ Torrington, WY. 4104 ft MSL; sandy loam soil; overhead irrigation

Site 2: University of Wyoming @ Laramie, WY. 7200 ft MSL; sandy clay loam; overhead irrigation

Plot Design

RCBD with 4 replications; plots were 2 rows (36-in row centers) X 20 ft; treatment plots were separated by two nontreated buffer rows and a 5 ft in-row buffer. Four rows of corn surrounded the entire field plot area at the Torrington site.

Plot Management

Site 1:

Planting Date: 13 May.

Variety: Atlantic New Leaf

Fertilizer: 150 lbs N + 50 lbs P₂O₅

Herbicide: PPI, Dual II (1.5 pt/A) on 7 May.

Insecticide: Asana (4 fl oz) on 7 August for psyllid suppression

Fungicide: Bravo Weather Stik (1.5 pt/A) for foliar disease management on 17, 31 August, and 8 September.

Site 2:

Planting Date: 21 May

Variety: Atlantic New Leaf

Fertilizer: 150 lbs N + 50 lbs P₂O₅

Herbicide: PPI, Dual II (2.0 pt/A) on 19 May

Insecticide: Admire (3.75 fl oz) on 6 August for psyllid suppression

Disease Development

Seedpiece inoculation: Whole seed was inoculated by cutting with a contaminated knife. The knife was contaminated by cutting through source tubers previously inoculated with an US8 late blight strain.

Foliar and Stem late blight: Foliar late blight lesions were observed 11 August at site 1 in replications 1 and 2. Disease development was scattered and may have initiated from neighboring research plots. Stem lesions due to late blight were not detected at either site. Early blight development in Torrington was from natural inoculum and lesions were first observed on 15 July.

Treatment Applications

Seedpiece fungicide treatments were applied immediately after cutting and inoculation on 11 May. Cut seed was divided into eight equal piles and treated with fungicide. Treated seed was held at 45 F until planting. A description of chemicals tested can be found in Appendix 1.

Disease Ratings

Starting on 24 June and 8 July for sites 1 and 2 respectively, plots were inspected weekly for signs of stem and foliar lesions.

On 14 and 20 July for sites 1 and 2, respectively, five plants (five hills) were removed from each plot and the following determined; the number of stems per plant, severity of *Rhizoctonia solani* stem lesions, and the percentage of the seedpiece visually affected by dry-rot (presumptive *Fusarium* species) or soft-rot. Plots also were rated visually for vigor using a rating scale of 1-4 (1=poor and 4=good).

At harvest, daughter tubers were inspected for decay. A subsample of 20 healthy-appearing tubers from each plot was stored at approximately 45°F for one month, and then was evaluated for tuber decay a second time.

Harvest

Two rows X 10 ft were harvested on 29 and 25 September for sites 1 and 2, respectively. Tubers were sorted and weighed by grade.

Statistical Analysis

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

Results and Discussion

Addition of PGR to the mancozeb (treatments 7 and 8) significantly accelerated early emergence for both diseased and healthy seed compared with all other treatments ($P\#0.05$). Even though the time between planting and emergence was decreased, *Rhizoctonia* stem canker slightly increased for PGR treated plots. PGR also had a trend to increase the number of stems per plant and the yield of smaller tubers. PGR-treated plants may have outperformed non-PGR treated seed if additional growing season was available to permit additional tuber sizing. The effect of PGR is likely to be variety dependent and

growers may need to alter their seed spacing practices to accommodate the earlier emergence and increased stem numbers. Mancozeb + PGR provided protection against stand losses attributed to late blight inoculation.

Only the Torrington site had decayed tubers present at harvest, the incidence was low and not found to be associated with treatment ($P \geq 0.05$). After one month of storage, only one additional tuber (Torrington site, treatment 7), developed visible late blight symptoms.

Table 1. Potato seedpiece treatments and their effects on potato emergence and vigor. Data were combined over two field sites (Franc et al., U of WY; 1999).

Treatment and rate (product/cwt) ¹	Early Stand (max=20)	Final Stand (max=20)	AUEPC ²	Vigor 4=high 1=low
1. H + Tops MZ (12 oz)	4.4 b ³	19.8 ab	435.9 b	4.0 a
2. D + Nontreated	1.1 c	4.0 c	84.1 d	2.4 b
3. D + Tops MZ (12 oz)	3.8 b	19.8 ab	427.3 bc	3.9 a
4. D +Tops MZ-curzate (12 oz)	2.6 bc	19.1 ab	398.1 c	3.7 a
5. D + Mancozeb-curzate (12 oz)	4.5 b	19.6 ab	438.0 ab	4.0 a
6. D + LS214/1-99 (12 oz)	2.8 bc	19.9 a	427.8 bc	4.0 a
7. D + Mancozeb + PGR (8 oz)	7.4 a	18.9 b	436.9 ab	3.7 a
8. H + Mancozeb + PGR (8 oz)	8.5 a	19.5 ab	466.3 a	3.9 a

¹ Fungicide treatments were applied to seedpieces immediately after cutting and inoculation; H=healthy (noninoculated) seed and D=diseased (inoculated) seed.

² The area under the emergence progress curve. Delayed emergence and/or decreased final stands will contribute to a lower AUEPC.

³ Means followed by the same letter in the column do not differ significantly (Fisher's Protected LSD, $P \leq 0.05$).

Table 2. Potato seedpiece treatments and their effects on plant growth and yield. Data were combined over two field sites (Franc et al., U of WY; 1999).

Treatment and rate (product/cwt) ¹	14-20 July		Yield/plant (g)	Total Yield (kg/6.1 m row)
	height (cm)	stem #		
1. H + Tops MZ (12 oz)	44.8 a ²	3.0 bc	220.7 a	4.4 ab
2. D + Nontreated	31.7 b	1.2 e	104.5 b	0.4 c
3. D + Tops MZ (12 oz)	44.3 a	2.5 cd	201.7 a	4.0 ab
4. D +Tops MZ-curzate (12 oz)	41.3 a	2.7 bcd	179.3 ab	3.4 b
5. D + Mancozeb-curzate (12 oz)	43.8 a	2.6 bcd	234.5 a	4.6 ab
6. D + LS214/1-99 (12 oz)	45.9 a	2.2 d	257.4 a	5.1 a
7. D + Mancozeb + PGR (8 oz)	43.0 a	3.2 ab	209.0 a	3.9 ab
8. H + Mancozeb + PGR (8 oz)	41.2 a	3.9 a	209.5 a	4.0 ab

¹ Fungicide treatments were applied to seedpieces immediately after cutting and inoculation; H=healthy (noninoculated) seed and D=diseased (inoculated) seed.

² Means followed by the same letter in the column do not differ significantly (Fisher's Protected LSD, $P=0.05$).

Table 3. Potato seedpiece treatments and their effects on disease. Data were combined over two field sites (Franc et al., U of WY; 1999).

Treatment and rate (product/cwt) ¹	Seed decay (%)	Rhizoctonia ²	Foliar late blight	No. of Tubers decayed at harvest ₃
		Stem S.A. cankered (%)	(# reps pos.) 11 Aug	
1. H + Tops MZ (12 oz)	12.4 d ⁴	0.3 c	+1/4	0.5 a
2. D + Nontreated	N.A.	N.A.	+1/4	0.5 a
3. D + Tops MZ (12 oz)	27.4 cd	0.7 bc	+1/4	0.5 a
4. D +Tops MZ-curzate (12 oz)	62.4 a	0.8 bc	+2/4	0.3 a
5. D + Mancozeb-curzate (12 oz)	53.9 ab	1.9 ab	+1/4	0.5 a
6. D + LS214/1-99 (12 oz)	22.8 cd	0.0 c	+2/4	0.8 a
7. D + Mancozeb + PGR (8 oz)	38.6 bc	3.0 a	+1/4	1.0 a
8. H + Mancozeb + PGR (8 oz)	54.6 ab	3.0 a	+1/4	1.0 a

¹ Fungicide treatments were applied to seedpieces immediately after cutting and inoculation; H=healthy (noninoculated) seed and D=diseased (inoculated) seed.

² Percentage (disease severity) data for Rhizoctonia canker symptoms (20 July) were converted from Horsfall-Barratt ratings (0-11 scale).

³ Data from Torrington only, (no tuber decay found in Laramie). Decay organisms were not identified, however, late blight symptoms were present.

⁴ Means followed by the same letter in the column do not differ significantly (Fisher's Protected LSD, $P=0.05$).

Table 4. Potato seedpiece treatments and their effects on tuber yield and quality. Data is for the Torrington field site ¹ (Franc et al., U of WY; 1999).

Treatment and rate (product/cwt) ²	Tuber Yield and Grade: kg per 6.1 m row				
	US#1	US#2	Grade B	Culls	Total
1. H + Tops MZ (12 oz)	4.67 ab ³	0.20 a	2.81 abc	0.14 a	7.67 ab
2. D + Nontreated	0.32 c	0.05 a	0.41 e	0.05 a	0.77 c
3. D + Tops MZ (12 oz)	3.90 b	0.14 a	2.63 bc	0.09 a	6.71 ab
4. D +Tops MZ-curzate (12 oz)	4.44 ab	0.05 a	1.59 d	0.18 a	6.17 b
5. D + Mancozeb-curzate (12 oz)	5.81 a	0.00 a	2.27 cd	0.27 a	8.35 ab
6. D + LS214/1-99 (12 oz)	6.08 a	0.14 a	2.36 cd	0.14 a	8.85 a
7. D + Mancozeb + PGR (8 oz)	3.45 b	0.14 a	3.45 a	0.14 a	7.12 ab
8. H + Mancozeb + PGR (8 oz)	3.67 b	0.14 a	3.31 ab	0.18 a	7.21 ab

¹ Tuber quality for all Laramie treatment plots was poor due to psyllid feeding injury; Laramie data were not included.

² Fungicide treatments were applied to seedpieces immediately after cutting and inoculation;

H=healthy (noninoculated) seed and D=diseased (inoculated) seed.

³ Means followed by the same letter in the column do not differ significantly (Fisher's Protected LSD, $P=0.05$).

Appendix 1. Chemicals tested.

<u>Product</u>	<u>Manufacturer</u>	<u>Composition</u>
Tops MZ	Gustafson, Inc. 1400 Preston Rd., Suite 400 Plano, TX 75093	2.5 % Thiophanate-methyl 6 % zinc ion and manganese bisdithiocarbamate ethylene
Tops MZ-curzate	Gustafson, Inc.	Information not provided
Mancozeb-curzate	Gustafson, Inc.	Information not provided
LS214/1-99	Gustafson, Inc.	Information not provided
Mancozeb + PGR	Griffin Corporation	8% mancozeb + 3.5% Early Harvest
TST	P.O. Box 1847 Valdosta, GA 31603-1847	

Research Project

Potato Pink Rot Management with Mefenoxam, 1999

Research Team

Tel: 307-766-2397
FAX: 766-5549
francg@uwyo.edu

G.D. Franc, W.L. Stump, and S.C. Briere
University of Wyoming, Dept. of Plant Sciences
P.O. Box 3354 (16th & Gibbon Streets)
Laramie, WY 82071-3354

Field Plot Location

Site 1: Torrington Research & Extension Center @ Torrington, WY. 4104 ft MSL; sandy loam soil; overhead irrigation
Site 2: University of Wyoming @ Laramie, WY. 7200 ft MSL; sandy clay loam; overhead irrigation

Plot Design

RCBD with 4 replications; plots were 2 rows (36-in row centers) X 20 ft (10 ft in Laramie); treated plots were separated by two nontreated buffer rows and a 5 ft in-row buffer.

Plot Management

Site 1:
Planting Date: 13 May.
Variety: Red Norland
Fertilizer: 150 lbs N + 50 lbs P₂O₅
Herbicide: PPI, Dual II (1.5 pt/A) on 7 May.
Insecticide: Asana (4 fl oz) on 2, and 12 July for psyllid.
Fungicide: Bravo Weather Stik (1.5 pt/A) for foliar disease management on 5 August.

Site 2:
Planting Date: 24 May.
Variety: Atlantic New Leaf
Fertilizer: 150 lbs N + 50 lbs P₂O₅
Herbicide: PPI, Dual II (2.0 pt/A) on 19 May.

Disease Development

Natural: No tuber pink rot infection was observed at harvest.
Artificial: A subsample of 20 tubers was challenge-inoculated with Pink Rot inoculum (*Phytophthora erythroseptica*).

Treatment Applications

In-furrow treatments were made to an open furrow after seed placement (over-seed application), or prior to seed placement (under-seed application) with the aid of a portable (CO₂) sprayer in 1.1 gal/1000 row-ft (8 in band) @ 40 psi boom pressure (one #8002 flat fan nozzle). Furrows were immediately filled with soil following treatment. Treatment dates were 13 and 24 May for sites 1 and 2, respectively.

Foliar treatment (site 1 only) was made on 7 July (tubers ca. 1 in diameter) and 21 July. Ridomil Gold + Weather Stik was co-applied with the aid of a portable (CO₂) sprayer in 43 gal/A @ 30 psi boom pressure (four #8004 flat fan nozzles spaced @ 20 inches). A description of chemicals tested can be found in Appendix 1.

Disease Ratings

Plots were periodically observed for phytotoxicity and tubers were inspected for decay during harvest. Twenty healthy-appearing tubers from each plot were forwarded to Gary Secor @ NDSU for standardized pink rot challenge inoculations to determine efficacy of the mefenoxam residual.

Harvest

Plots (2 rows X 20 ft, site 1; 2 rows X 10 ft, site 2) were harvested on 22 and 25 September, respectively. Tubers were sorted and weighed by grade. A 30 tuber subsample from each plot was stored for pink rot evaluations and challenge inoculations.

Statistical Analysis

ANOVA with four replications. Mean separations were done using Fisher's protected LSD (P=0.05). The percentage of tubers decayed following inoculation with *P. erythroseptica* was analyzed.

Results and Discussion

Phytotoxicity was not observed at either field site. Mefenoxam treatments had no significant effect on plant emergence, vigor, tuber yield and tuber grade (P#0.05). Pink rot symptoms were not observed in tubers during harvest. The challenge inoculation of tubers harvested from plots revealed trends that residual mefenoxam was present and suppressed infection by *P. erythroseptica*.

Foliar late blight was observed in neighboring research plots at both field sites. Symptoms were difficult to detect at the Laramie field site and were readily observed at the Torrington field site. However, foliar and tuber late blight symptoms were not detected in treatment plots for the study described in this report. Psyllid Yellows was present in all plots during 1999. Psyllid Yellows results from the feeding of *Paratrioza cockerelli* on potato leaves. The toxin released into plants during feeding causes plant stunting, leafrolling and yellowing of foliage. Tubers are often smaller, distorted and have irregular dormancy.

Table 1. In-furrow and foliar effects of mefenoxam on potato stand, vigor and disease. (Franc et al., Torrington, site 1, U of WY; 1999)

Treatment and rate (product)	Final Stand (max=40)	Vigor (check=7)	Pink Rot incidence (%) ¹
1. Nontreated Check	36.3 a ²	7.0 a	37.50 a
2. Ridomil Gold (0.42 fl oz/1000 row ft) ³	37.8 a	6.5 a	17.50 ab
3. Ridomil Gold + Bravo Weather Stik (0.2 pt/A + 1.5 pt/A) ⁴	39.0 a	6.9 a	22.50 ab
4. Ultra Flourish (0.84 fl oz/ 1000 row ft) ⁵	38.0 a	6.8 a	18.75 ab
5. Ultra Flourish (0.84 fl oz/ 1000 row ft) ³	36.3 a	6.8 a	6.25 b

- ¹ Twenty tubers per plot were challenge-inoculated with *P. erythroseptica*; data and analysis provided by NDSU.
- ² Means followed by the same letter in the column do not differ significantly (Fisher's Protected LSD, $P=0.05$).
- ³ Treatments were applied at planting to an open furrow directly over the top of seedpieces. Furrows were immediately filled with soil.
- ⁴ The treatment was applied as a mixture to duplicate the Ridomil Prepak formulation. The broadcast was made on 7 and 21 July.
- ⁵ The treatment was applied at planting to an open blank furrow. Following application, seedpieces were placed and immediately covered with soil.

Table 2. In-furrow and foliar effects of mefenoxam on tuber yield and grade. (Franc et al., Torrington, site 1, U of WY; 1999).

Treatment and rate (product)	Yield (lb per 30 row-ft)				
	US#1	US#2	Grade B	Cull	Total
1. Nontreated Check	30.8 a ¹	0.3 a	8.4 a	1.0 a	40.5 a
2. Ridomil Gold (0.42 fl oz/1000 row ft) ²	32.5 a	0.2 a	7.0 a	1.9 a	41.5 a
3. Ridomil Gold + Bravo Weather Stik (0.2 pt/A + 1.5 pt/A) ³	31.8 a	0.5 a	9.2 a	1.6 a	43.2 a
4. Ultra Flourish (0.84 fl oz/ 1000 row ft) ⁴	29.3 a	0.3 a	9.4 a	1.7 a	40.4 a
5. Ultra Flourish (0.84 fl oz/ 1000 row ft) ²	25.5 a	0.1 a	8.5 a	1.3 a	35.5 a

- ¹ Means followed by the same letter in the column do not differ significantly (Fisher's Protected LSD, $P=0.05$).
- ² Treatments were applied at planting to an open furrow directly over the top of seedpieces. Furrows were immediately filled with soil.
- ³ The treatment was applied as a mixture to duplicate the Ridomil Prepak formulation. The broadcast was made on 7 and 21 July.
- ⁴ The treatment was applied at planting to an open blank furrow. Following application, seedpieces were placed and immediately covered with soil.

Table 3. In-furrow and foliar effects of mefenoxam on potato stand, vigor and pink rot tuber decay (Franc et al., Laramie, site 2, U of WY; 1999).

Treatment and rate (product)	Final Stand (max=20)	AUEPC ¹	Vigor (check=7)	Pink Rot incidence (%) ²
1. Nontreated Check	17.5 a ³	355 a	7.0 a	6.3 a
2. Ultra Flourish (0.84 fl oz/ 1000 row ft) ⁴	16.8 a	345 a	6.8 a	0.0 a
3. Ultra Flourish (0.84 fl oz/ 1000 row ft) ⁵	16.3 a	329 a	7.0 a	0.0 a

¹ The area under the emergence progress curve. Delayed emergence and/or decreased final stands will contribute to a lower AUEPC.

² Twenty tubers per plot were challenge inoculated with pink rot; data provided by NDSU.

³ Means followed by the same letter in the column do not differ significantly (Fisher's Protected LSD, $P=0.05$).

⁴ Treatments were applied at planting to the open, blank furrow. Following application, seedpieces were placed and immediately covered with soil.

⁵ Treatments were applied at planting to an open furrow directly over the seedpiece. Seedpieces were immediately covered with soil.

Table 4. In-furrow and foliar effects of mefenoxam on tuber yield and grade (Franc et al., Laramie, site 2, U of WY; 1999).

Treatment and rate (product)	Yield (lb per 20 row-ft)		
	US#1	Grade B	Total
1. Nontreated Check	0.0 a ¹	2.9 a	2.9 a
2. Ultra Flourish (0.84 fl oz/ 1000 row ft) ²	0.1 a	3.0 a	3.1 a
3. Ultra Flourish (0.84 fl oz/ 1000 row ft) ³	0.3 a	3.6 a	3.9 a

¹ Means followed by the same letter in the column do not differ significantly (Fisher's Protected LSD, $P=0.05$).

² Treatments were applied at planting to the open, blank furrow. Following application, seedpieces were placed and immediately covered with soil.

³ Treatments were applied at planting to an open furrow directly over the seedpiece. Seedpieces were immediately covered with soil.

Appendix 1. List of chemicals tested

<u>Product</u>	<u>Manufacturer</u>	<u>Composition</u>
Ridomil Gold 4EC	Novartis Crop Protection, Inc. P.O. Box 18300 Greensboro, NC 27419	47.6% Mefenoxam
Bravo Weather Stik 6F	Zeneca Inc. Agricultural Products 1800 Concord Pike Wilmington, DE 19897	54% Chlorothalonil
Ultra Flourish	Agtrol International 7322 S.W. Freeway, Suite 1400 Houston, TX 77074	25.1% Mefenoxam

Research Project**Early Blight and Late Blight Disease Management in Potato with Foliar Fungicide Programs, 1999****Research Team**

Tel: 307-766-2397

FAX: 766-5549

francg@uwyo.edu

G.D. Franc and W.L. Stump

University of Wyoming, Dept. of Plant Sciences

P.O. Box 3354 (16th & Gibbon Streets)

Laramie, WY 82071-3354

Field Plot Location

Torrington Research & Extension Center @ Torrington, WY.
4104 ft MSL; sandy loam soil; overhead irrigation

Plot Design

RCBD with 4 replications; plots were 4 rows (36-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.

Plot Management

Planting Date: 13 May.

Variety: Atlantic New Leaf

Fertilizer: 150 lbs N + 50 lbs P₂O₅

Herbicide: PPI, Dual II (1.5 pt/A) on 7 May.

Insecticide: Asana (4 fl oz) on 7 August for psyllid.

Disease Development

Early blight development was from natural inoculum and the first lesions were observed on 15 July. Late blight lesions were observed on 11 August and development was slow.

Treatment Applications

Foliar treatments consisted of spray programs that began on 22 July (329 P-days). The actual application dates are indicated in the Tables. Fungicides were applied with the aid of a portable (CO₂) sprayer in a total volume of 43 gal/A @ 30 psi boom pressure (four #8004 flat fan nozzles spaced @ 20 inches). A description of chemicals tested can be found in Appendix 1.

Disease Ratings

Early blight disease severity was measured by calculating the average number of lesions per leaflet for leaves collected on 21, 28 July, and 4, 11, and 24 August. Nine leaves were randomly selected from each treatment plot (three leaves each from the top, middle, and bottom third of the canopy) and the number of early blight lesions, on up to seven leaflets from each leaf, was counted.

Plots were visually rated using the Horsfall-Barratt scale (0-11) to estimate the percentage of foliar necrosis (combined effects of early blight, late blight and senescence) on 26, 31 August, and 8 September.

Harvest

Two rows X 15 ft were dug on 29 September, and then sorted and weighed by grade on 30 September.

Statistical Analysis

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

Results and Discussion

Initial disease development was slow and disease pressure remained light to moderate. All fungicide programs reduced the number of early blight lesions per leaflet and the early blight AUDPC compared to the two nontreated controls. During late August, both early and late blight lesions were readily evident in the two nontreated control plots and to varying degrees in the fungicide treated plots. Although late blight lesions were present in the plots, they did not interfere with early blight lesion counts. Late blight US8 was recovered from the plot area. Necrosis ratings taken during the late growing season estimated effects from both early and late blight. All fungicide programs significantly reduced the AUNPC compared to the two nontreated controls ($P \leq 0.05$). Total yields were generally greater in the plots receiving fungicide, when compared to the nontreated control.

The field plot area experienced a moderate to severe psyllid infestation that resulted in widespread plant chlorosis and reduced yields. Tuber size and uniformity were reduced. Psyllid Yellows symptoms were generally uniform throughout the plot area.

Table 1. Fungicide program effects on early blight disease progression (G.D. Franc and W.L. Stump, U of WY; 1999).

Treatment and Application Rate (lb a.i./ acre)	Application dates ¹	Early blight lesions per leaflet			AUDPC ²
		4 Aug	11 Aug	24 Aug	
1. Nontreated Check	A-G	0.05 a ³	0.57 a	3.57 a	29.3 a
2. Penncozeb + Bravo Weather Stik (0.94 + 0.56)	A-F	0.11 a	0.21 a	1.21 cd	10.8 cd
3. Penncozeb (1.5)	B, D, F	0.01 a	0.51 a	1.68 bcd	16.2 a
3. Bravo Weather Stik (1.125)	A, C, E				
4. Bravo Weather Stik (1.125)	A, B	0.12 a	0.21 a	1.68 bcd	14.2 bcd
4. Penncozeb + Bravo Weather Stik (0.94 + 0.56)	C, E				
4. Penncozeb + Super Tin (1.5 + 0.19) . . .	D, F				
5. Penncozeb (1.5)	A-F	0.07 a	0.30 a	1.50 cd	13.2 cd
6. Penncozeb + Bravo Weather Stik (0.94 + 0.56)	A, C, E	0.01 a	0.25 a	0.94 cd	9.3 cd
6. Penncozeb + Super Tin (1.5 + 0.15) . . .	B, D, F				
7. Bravo Weather Stik (1.125)	A	0.18 a	0.17 a	1.24 cd	12.2 cd
7. Penncozeb + Super Tin (1.5 + 0.15). . . .	B-E				
7. Penncozeb (1.5)	F, G				
8. Penncozeb (1.5)	A, C, E	0.00 a	0.12 a	0.77 d	6.3 d
8. Quadris (0.203)	B, D, F				
9. Flint (0.63)	A-C	0.06 a	0.20 a	1.28 cd	10.8 cd
9. Bravo Weather Stik (1.125)	D-F				
10. Flint (0.63)	A, C, E	0.04 a	0.14 a	1.91 bc	14.3 bcd
10. Bravo Weather Stik (1.125)	B, D, F				
11. Quadris (0.103)	A, C, E	0.01 a	0.06 a	1.31 cd	9.5 cd
11. Bravo Weather Stik (1.125)	B, D, F				
12. Nontreated Check	A-G	0.01 a	0.56 a	2.76 ab	23.8 ab
13. Agri Tin (0.125)	A, C, E	0.07 a	0.28 a	1.65 bcd	14.5 bcd
13. Dithane DF NT (0.75)	B, D, F				

¹ Application dates: A=7/22, B=7/29, C=8/5, D=8/11, E=8/18, F=8/25, and G=8/31.

² Area under the disease progress curve for data collected 21 Jul through 24 Aug.

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

Table 2. Fungicide program effects on the progression of foliar necrosis due to combined effects of early and late blight (G.D. Franc and W.L. Stump, U of WY; 1999).

Treatment and Application Rate (lb a.i./ acre)	Application dates ¹	% Foliar Necrosis ²			AUNPC ³
		26 Aug	31 Aug	8 Sep	
1. Nontreated Check	A-G	31.0 a ⁴	59.5 a	94.0 a	90.8 a
2. Penncozeb + Bravo Weather Stik (0.94 + 0.56)	A-F	6.0 cd	15.0 bc	40.5 cd	48.1 cd
3. Penncozeb (1.5)	B, D, F	8.5 cd	15.0 bc	37.0 cde	48.9 cd
3. Bravo Weather Stik (1.125)	A, C, E				
4. Bravo Weather Stik (1.125)	A, B	5.0 d	10.5 c	21.5 ef	40.0 d
4. Penncozeb + Bravo Weather Stik (0.94 + 0.56)	C, E				
4. Penncozeb + Super Tin (1.5 + 0.19) . . .	D, F				
5. Penncozeb (1.5)	A-F	6.0 cd	17.0 bc	46.0 bc	50.8 c
6. Penncozeb + Bravo Weather Stik (0.94 + 0.56)	A, C, E	7.5 cd	12.0 c	23.5 ef	43.4 cd
6. Penncozeb + Super Tin (1.5 + 0.15) . . .	B, D, F				
7. Bravo Weather Stik (1.125)	A	8.5 cd	15.0 bc	28.0 def	46.9 cd
7. Penncozeb + Super Tin (1.5 + 0.15). . . .	B-E				
7. Penncozeb (1.5)	F, G				
8. Penncozeb (1.5)	A, C, E	6.0 cd	15.0 bc	17.0 f	42.1 cd
8. Quadris (0.203)	B, D, F				
9. Flint (0.63)	A-C	8.5 cd	15.0 bc	31.0 cde	47.9 cd
9. Bravo Weather Stik (1.125)	D-F				
10. Flint (0.63)	A, C, E	6.0 cd	15.0 bc	31.0 cde	46.1 cd
10. Bravo Weather Stik (1.125)	B, D, F				
11. Quadris (0.103)	A, C, E	8.5 cd	12.0 c	31.0 cde	46.3 cd
11. Bravo Weather Stik (1.125)	B, D, F				
12. Nontreated Check	A-G	21.0 ab	50.0 a	94.0 a	84.9 a
13. Agri Tin (0.125)	A, C, E	12.0 bc	23.5 b	59.5 b	60.5 b
13. Dithane DF NT (0.75)	B, D, F				

¹ Application dates: A=7/22, B=7/29, C=8/5, D=8/11, E=8/18, F=8/25, and G=8/31.

² Data presented were converted to percentages from Horsfall-Barratt scale (0-11) data.

³ Area under the necrosis progress curve.

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

Table 3. The effects of foliar fungicide programs on potato yield and grade (G.D. Franc and W.L. Stump, U of WY; 1999).

Treatment and Application Rate (lb a.i./ acre)	Application dates ¹	Yield expressed (lb per 30 row-ft)				
		US#1 (<10 oz)	US#2	Grade B	Cull	Total
1. Nontreated Check	A-G	22.0 cd ²	1.0 a	12.1 a	1.1 a	36.3 a
2. Penncozeb + Bravo Weather Stik (0.94 + 0.56)	A-F	27.7 a-d	0.8 a	12.6 a	1.2 a	42.2 a
3. Penncozeb (1.5)	B, D, F	29.4 abc	0.9 a	10.3 a	1.1 a	41.8 a
3. Bravo Weather Stik (1.125)	A, C, E					
4. Bravo Weather Stik (1.125)	A, B	30.3 ab	0.9 a	13.3 a	2.0 a	46.5 a
4. Penncozeb + Bravo Weather Stik (0.94 + 0.56)	C, E					
4. Penncozeb + Super Tin (1.5 + 0.19) . . .	D, F					
5. Penncozeb (1.5)	A-F	23.5 bcd	0.9 a	13.7 a	0.9 a	39.0 a
6. Penncozeb + Bravo Weather Stik (0.94 + 0.56)	A, C, E	20.8 d	1.4 a	14.9 a	1.9 a	38.9 a
6. Penncozeb + Super Tin (1.5 + 0.15) . . .	B, D, F					
7. Bravo Weather Stik (1.125)	A	24.9 bcd	0.8 a	11.1 a	1.4 a	38.1 a
7. Penncozeb + Super Tin (1.5 + 0.15). . . .	B-E					
7. Penncozeb (1.5)	F, G					
8. Penncozeb (1.5)	A, C, E	27.9 a-d	0.9 a	12.1 a	1.8 a	42.7 a
8. Quadris (0.203)	B, D, F					
9. Flint (0.63)	A-C	25.5 bcd	0.9 a	10.3 a	1.1 a	37.9 a
9. Bravo Weather Stik (1.125)	D-F					
10. Flint (0.63)	A, C, E	22.9 bcd	1.0 a	11.9 a	1.8 a	37.6 a
10. Bravo Weather Stik (1.125)	B, D, F					
11. Quadris (0.103)	A, C, E	24.2 bcd	0.8 a	11.6 a	1.8 a	38.4 a
11. Bravo Weather Stik (1.125)	B, D, F					
12. Nontreated Check	A-G	23.6 bcd	0.9 a	11.9 a	1.4 a	37.8 a
13. Agri Tin (0.125)	A, C, E	34.9 a	0.9 a	10.7 a	2.3 a	48.7 a
13. Dithane DF NT (0.75)	B, D, F					

¹ Application dates: A=7/22, B=7/29, C=8/5, D=8/11, E=8/18, F=8/25, and G=8/31.

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

Appendix 1. List of chemicals tested.

<u>Product</u>	<u>Manufacturer</u>	<u>Composition</u>
Penncozeb 75DF	Elf Atochem North America, Inc. 2000 Market Street Philadelphia, PA 19103-3222	75 % Mancozeb
Bravo Weather Stik 6F	Zeneca Inc. Agricultural Products 1800 Concord Pike Wilmington, DE 19897	54% Chlorothalonil
Quadris 2.08SC Super Tin 80WP	Zeneca Inc. Agricultural Products Griffin Corporation P.O. Box 1847 Valdosta, GA 31603-1847	22.9% Azoxystrobin 80% Triphenyltin Hydroxide
Flint 50WG	Novartis Crop Protection, Inc. P.O. Box 18300 Greensboro, NC 27419	50% CGA-279202
Dithane 75DF NT	Rohm and Haas Co. 100 Independence Mall West Philadelphia, PA 19106-2399	75% Mancozeb
Agri Tin 80WP	Agtrol International 7322 S.W. Freeway, Suite 1400 Houston, TX 77074	80% Triphenyltin Hydroxide

Research Project**Foliar Disease Management in Potatoes, 1999****Research Team**

Tel: 307-766-2397
FAX: 766-5549
francg@uwyo.edu

G.D. Franc, W.L. Stump, and S.C. Briere
University of Wyoming, Dept. of Plant Sciences
P.O. Box 3354 (16th & Gibbon Streets)
Laramie, WY 82071-3354

Field Plot Location

Torrington Research & Extension Center @ Torrington, WY.
4104 ft MSL; sandy loam soil; overhead irrigation

Plot Design

RCBD with 4 replications; plots were 4 rows (36-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; four rows of corn surrounded the field plot area.

Plot Management

Planting Date: 13 May.
Variety: Atlantic New Leaf
Fertilizer: 150 lbs N + 50 lbs P₂O₅
Herbicide: PPI, Dual II (1.5 pt/A) on 7 May.
Insecticide: Asana (4 fl oz) on 7 August for psyllid.

Disease Development

Late blight inoculum was introduced via infected seedpieces planted in neighboring experimental plots. Late blight lesions were first observed on 11 August. Disease development was slow even though environmental conditions were favorable during late July and early August. Early blight development resulted from natural inoculum and lesions were first observed on 28 July.

Treatment Applications

Foliar spray programs were initiated on 29 July. Fungicides were applied with the aid of a portable (CO₂) sprayer in a total volume of 43 gal/A @ 30 psi boom pressure (four #8004 flat fan nozzles spaced @ 20 inches). The application dates are summarized in the Tables. A description of chemicals used can be found in Appendix 1.

Disease Ratings

Early blight disease severity was measured by calculating the average number of lesions per leaflet for leaves collected on 28 July, and 4, 17, August, and 1 September. Nine leaves were randomly selected from each treatment plot (three leaves each from the top, middle, and bottom third of the canopy) and the number of early blight lesions, on up to seven leaflets from each leaf, was counted. In addition, plots were visually rated using the Horsfall-Barratt scale (0-11) to estimate the percentage of foliar necrosis (combined effects of early blight and late blight) on 26, 31 August, and 8 September.

Harvest

Two rows X 15 ft were harvested on 29 September, and then were sorted and weighed by grade on 30 September.

Statistical Analysis

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

Results and Discussion

Initial late blight and early blight disease development was slow and disease pressure remained light to moderate. During late August, both early and late blight lesions were readily evident in the nontreated control plot and to varying degrees in the fungicide-treated plots. Although late blight lesions were present in the plots, they did not interfere with early blight lesion counts. However, necrosis ratings taken during the late growing season estimated effects from both early and late blight and did not separate effects from the two diseases. The late blight fungus (US8) was recovered from the plot area. Although not significantly different, total yields and yields of US#1 were greater in the plots receiving fungicide, compared to the nontreated control ($P \leq 0.05$).

The field plot area experienced a moderate to severe psyllid infestation that resulted in widespread plant chlorosis and reduced yields. Tuber size and uniformity were reduced. Psyllid Yellows symptoms were generally uniform throughout the plot area.

Table 1. Fungicide program effects on Early Blight disease progression (G.D. Franc, et al., U of WY; 1999).

Treatment and Application Rate (lb a.i./ acre)	Application dates ¹	Early Blight (# lesions per leaflet)			AUDPC ²
		4 Aug	17 Aug	1 Sep	
1. Nontreated Check	A-G	0.02 a ³	0.85 a	5.57 a	53.9 a
2. IFK-916 (0.036) + Silwet L-77 (42.9% v:v)	A, B, D, E, F	0.03 a	0.66 a	3.26 cd	34.1 b-f
3. IFK-916 (0.054) + Silwet L-77 (42.9% v:v)	A, B, D, E, F	0.04 a	1.28 a	4.79 ab	54.3 a
4. IFK-916 (0.071) + Silwet L-77 (42.9% v:v)	A, B, D, E, F	0.08 a	0.50 a	4.04 bcd	38.2 a-d
5. IFK-916 (0.089) + Silwet L-77 (42.9% v:v)	A, B, D, E, F	0.04 a	0.86 a	4.52 abc	46.4 ab
6. IFK-916 (0.071) + Silwet L-77 (42.9% v:v)	A, C, E, G	0.14 a	1.49 a	3.73 bcd	50.2 ab
7. IFK-916 (0.089) + Silwet L-77 (42.9% v:v)	A, C, E, G	0.01 a	1.32 a	3.45 bcd	44.5 abc
8. Super Tin + Curzate (0.125 + 0.113)	A, B, D, E, F	0.02 a	0.99 a	1.61 ef	26.1 c-g
9. Super Tin + Manzate (0.125 + 1.125) . . .	A, B, D, E, F	0.02 a	0.82 a	0.89 f	18.4 efg
10. Dithane DF NT (0.75)	A	0.05 a	1.04 a	2.57 de	34.5 b-e
10. RH-141457 (1.5)	B, D, E, F				
11. RH-141457 (1.5)	A, D, F	0.03 a	0.57 a	0.24 f	10.1 g
11. Quadris (0.1)	B, E				
12. Dithane DF NT (1.5)	A, D, F	0.06 a	0.58 a	0.41 f	11.8 g
12. Quadris (0.1)	B, E				
13. Dithane DF NT + RH-7281 (1.2 + 0.2) . .	A, B, D, E, F	0.02 a	0.56 a	1.01 f	15.6 fg
14. RH-7281 + Quadris (0.2 + 0.1)	A, B, D, E, F	0.04 a	0.54 a	1.02 f	15.7 fg
15. RH-7281 + Bravo Weather Stik (0.17 + 0.75)	A, B, D, E, F	0.05 a	0.54 a	1.55 ef	19.8 e-g

¹ Application dates: A=7/29, B=8/5, C=8/9, D=8/11, E=8/18, F=8/25, and G=8/26.

² Area under the disease progress curve for data collected 28 July through 1 September.

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

Table 2. Fungicide programs and their effects on combined Late Blight and Early Blight disease progression (G.D. Franc, et al., U of WY; 1999).

Treatment and Application Rate (lb a.i./ acre)	Application Dates ¹	Foliar Necrosis (%) ²			AUNPC ³
		26 Aug	31 Aug	8 Sep	
1. Nontreated Check	A-G	17.0 a ⁴	33.0 abc	83.5 a	72.3 a
2. IFK-916 (0.036) + Silwet L-77 (42.9% v:v)	A, B, D, E, F	15.0 a	36.0 ab	76.5 ab	70.3 a
3. IFK-916 (0.054) + Silwet L-77 (42.9% v:v)	A, B, D, E, F	12.0 a	27.2 a-d	80.5 ab	68.9 a
4. IFK-916 (0.071) + Silwet L-77 (42.9% v:v)	A, B, D, E, F	15.0 a	20.2 cde	69.0 ab	61.8 abc
5. IFK-916 (0.089) + Silwet L-77 (42.9% v:v)	A, B, D, E, F	12.0 a	23.5 b-e	65.0 b	61.5 abc
6. IFK-916 (0.071) + Silwet L-77 (42.9% v:v)	A, C, E, G	15.0 a	42.0 a	73.5 ab	71.7 a
7. IFK-916 (0.089) + Silwet L-77 (42.9% v:v)	A, C, E, G	12.0 a	27.2 a-d	69.0 ab	64.1 ab
8. Super Tin + Curzate (0.125 + 0.113)	A, B, D, E, F	12.0 a	18.8 de	31.0 cd	52.1 cde
9. Super Tin + Manzate (0.125 + 1.125)	A, B, D, E, F	12.0 a	17.0 de	23.5 cd	49.3 de
10. Dithane DF NT (0.75)	A	10.5 a	20.2 cde	37.0 c	53.0 bcd
10. RH-141457 (1.5)	B, D, E, F				
11. RH-141457 (1.5)	A, D, F	6.0 a	13.3 e	17.0 d	41.3 e
11. Quadris (0.1)	B, E				
12. Dithane DF NT (1.5)	A, D, F	10.5 a	14.5 e	23.5 cd	46.8 de
12. Quadris (0.1)	B, E				
13. Dithane DF NT + RH-7281 (1.2 + 0.2)	A, B, D, E, F	12.0 a	23.5 b-e	37.0 c	55.5 bcd
14. RH-7281 + Quadris (0.2 + 0.1)	A, B, D, E, F	8.5 a	13.3 e	28.0 cd	46.1 de
15. RH-7281 + Bravo Weather Stik (0.17 + 0.75)	A, B, D, E, F	8.5 a	21.8 b-e	40.5 c	53.9 bcd

¹ Application dates: A=7/29, B=8/5, C=8/9, D=8/11, E=8/18, F=8/25, and G=8/26.

² Foliar necrosis attributed to early and late blight combined. Data presented were converted to percentages from Horsfall-Barratt scale (0-11) data.

³ Area under the necrosis progress curve.

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

Table 3. The effects of foliar fungicide programs on potato tuber yield and grade (G.D. Franc, et al., U of WY; 1999).

Treatment and Application Rate (lb a.i./ acre)	Application Dates ¹	Yield (lb per 30 row-ft)				
		US#1 (<10 oz)	US#2	Grade B	Cull	Total
1. Nontreated Check	A-G	17.2 a ²	0.5 a	10.0 a	1.2 a	28.9 a
2. IFK-916 (0.036) + Silwet L-77 (42.9% v:v)	A, B, D, E, F	21.5 a	0.5 a	10.2 a	1.9 a	34.1 a
3. IFK-916 (0.054) + Silwet L-77 (42.9% v:v)	A, B, D, E, F	20.6 a	0.3 a	12.4 a	1.6 a	34.9 a
4. IFK-916 (0.071) + Silwet L-77 (42.9% v:v)	A, B, D, E, F	22.5 a	0.5 a	9.7 a	2.0 a	34.7 a
5. IFK-916 (0.089) + Silwet L-77 (42.9% v:v)	A, B, D, E, F	22.5 a	0.4 a	11.1 a	1.3 a	35.3 a
6. IFK-916 (0.071) + Silwet L-77 (42.9% v:v)	A, C, E, G	24.2 a	0.6 a	10.0 a	1.6 a	36.3 a
7. IFK-916 (0.089) + Silwet L-77 (42.9% v:v)	A, C, E, G	24.2 a	0.3 a	12.2 a	1.2 a	37.8 a
8. Super Tin + Curzate (0.125 + 0.113)	A, B, D, E, F	24.9 a	0.6 a	11.8 a	1.3 a	38.7 a
9. Super Tin + Manzate (0.125 + 1.125) . . .	A, B, D, E, F	21.6 a	0.1 a	10.8 a	1.4 a	33.9 a
10. Dithane DF NT (0.75)	A	21.4 a	0.3 a	11.5 a	0.9 a	34.1 a
10. RH-141457 (1.5)	B, D, E, F					
11. RH-141457 (1.5)	A, D, F	20.2 a	0.3 a	10.2 a	1.2 a	31.9 a
11. Quadris (0.1)	B, E					
12. Dithane DF NT (1.5)	A, D, F	20.6 a	0.2 a	10.7 a	1.1 a	32.6 a
12. Quadris (0.1)	B, E					
13. Dithane DF NT + RH-7281 (1.2 + 0.2) .	A, B, D, E, F	20.6 a	0.2 a	9.4 a	1.2 a	31.2 a
14. RH-7281 + Quadris (0.2 + 0.1)	A, B, D, E, F	19.7 a	0.3 a	10.0 a	1.6 a	31.6 a
15. RH-7281 + Bravo Weather Stik (0.17 + 0.75)	A, B, D, E, F	23.7 a	0.3 a	9.8 a	1.6 a	35.4 a

¹ Application dates: A=7/29, B=8/5, C=8/9, D=8/11, E=8/18, F=8/25, and G=8/26.

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

Appendix 1. List of chemicals used.

<u>Product</u>	<u>Manufacturer</u>	<u>Composition</u>
IFK-916 3.33SC	ISK Biotech Corp. 5966 Heisley Rd Mentor, OH 44061	Not provided
Super Tin 80WP	Griffin Corporation P.O. Box 1847 Valdosta, GA 31603-1847	80% Triphenyltin Hydroxide
Manzate 75DF	Griffin Corporation	75% Mancozeb
Dithane 75DF NT	Rohm and Haas Co. 100 Independence Mall West Philadelphia, PA 19106-2399	75% Mancozeb
RH-7281 80W	Rohm and Haas Co.	80% RH-117,281
RH-141457 75DF	Rohm and Haas Co.	66-69% Mancozeb + 6-9% RH-117,281
Bravo Weather Stik 6 F	Zeneca Inc. Agricultural Products 1800 Concord Pike Wilmington, DE 19897	54% Chlorothalonil
Quadris 2.08 SC	Zeneca Inc. Agricultural Products	22.9% Azoxystrobin
Curzate 60DF	Dupont Agricultural products Wilmington, DE 19898	60% Cymoxanil
Silwet L-77	Loveland Industries, Inc. P.O. Box 1289 Greeley, CO 80623	Surfactant

Research Project	Silver Scurf and Potato Tuber Disease Management with Foliar Fungicide Programs, 1999
Research Team Tel: 307-766-2397 FAX: 766-5549 francg@uwyo.edu	G.D. Franc, W.L. Stump, and S.C. Briere University of Wyoming, Dept. of Plant Sciences P.O. Box 3354 (16 th & Gibbon Streets) Laramie, WY 82071-3354
Field Plot Location	Torrington Research & Extension Center @ Torrington, WY. 4104 ft MSL; sandy loam soil; overhead irrigation
Plot Design	RCBD with 4 replications; plots were 4 rows (36-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.
Plot Management	Planting Date: 13 May. Variety: Red Norland, with Silver Scurf symptoms Fertilizer: 150 lbs N + 50 lbs P ₂ O ₅ Herbicide: PPI, Dual II (1.5 pt/A) on 7 May. PRE, Roundup RT (3 qt/A) on 28 May. Insecticide: Asana (4 fl oz) on 2, 7 July and 7 August for Colorado potato beetle and psyllid.
Disease Development	Seed used in the study was naturally infested with the Silver Scurf fungus.
Treatment Applications	Maxim (treatment 9) was applied to cut seed on 11 May. Seedpiece fungicides were not applied to the other treatments. Foliar treatments consisted of fungicide spray programs that began with Bravo Weather Stik then rotated to either Quadris or Fluazinam at various stages in the phenology of the potato plant (see Table 3). Actual spray dates are indicated in Tables 1 and 2. Foliar 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). A description of chemicals tested can be found in Appendix 1.
Data Collection	Plants (one plant per plot) were rated for phenology at flowering, 14 DAF (days after flowering), and 28 DAF on 7, 21 July, and 4 August, respectively.
Disease Ratings	Rhizoctonia stem canker was rated (all stems from one plant per plot) on 7, 21 July, and 4 August. Tuber color and Silver Scurf disease ratings (30 tubers/plot) were made on 20 October.

Harvest Two rows X 15 ft were harvested and graded on 22 September. A subsample of 30 randomly selected (US#1) tubers per plot were bagged and held at 45 F for tuber disease ratings.

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

Results and Discussion

The severity of *Rhizoctonia* stem canker development was not significant ($P \leq 0.05$). Although all treatments reduced Silver Scurf severity, none of the treatments were significant ($P \leq 0.05$). The Bravo Weather Stik/Quadris program (Quadris starting at flowering) significantly improved tuber color and appearance compared to the nontreated check ($P \leq 0.05$). Treatments had no effect on tuber yield and grade ($P \leq 0.05$).

Table 1. The effects of different fungicide programs on tuber disease development (G.D. Franc, et al., U of WY; 1999).

Treatment and Application Rate (lb a.i./ acre)	Application dates ¹	Tuber ratings (30 tuber subsample)		
		Silver Scurf Severity (%) ²	Tuber Surface Defects (%) ³	Tuber Quality ⁴ 1= good 3= poor
1. Nontreated Check	A-I	4.5 a ⁵	4.5 a	2.5 ab
2. Bravo Weather Stik (1.03)	A-I	3.5 a	4.0 a	3.0 a
3. Bravo Weather Stik (1.03)	A, B, D, F, H	3.0 a	3.5 a	1.5 c
3. Quadris (0.21)	C, E, G, I			
4. Bravo Weather Stik (1.03)	A-D, F, H	2.5 a	3.0 a	2.5 ab
4. Quadris (0.21)	E, G, I			
5. Bravo Weather Stik (1.03)	A-F, H	2.5 a	3.0 a	2.0 bc
5. Quadris (0.21)	G, I			
6. Bravo Weather Stik (1.03)	A, B, D, F, H	2.0 a	2.5 a	2.8 ab
6. Fluazinam (0.51)	C, E, G, I			
7. Bravo Weather Stik (1.03)	A-D, F, H	1.2 a	1.4 a	2.3 abc
7. Fluazinam (0.51)	E, G, I			
8. Bravo Weather Stik (1.03)	A-F, H	4.0 a	4.1 a	2.5 ab
8. Fluazinam (0.51)	G, I			
9. Maxim (8 oz per cwt.)		1.6 a	1.8 a	2.3 abc
9. Bravo Weather Stik (1.03)	E-I			

¹ Application dates: Maxim was applied to seed on 5/11; A=6/23, B=6/30, C=7/7, D=7/14, E=7/21, F=7/28, G=8/4, H=8/11, and I=8/18.

² The percentage of tuber surface area with Silver Scurf symptoms was estimated using the Horsfall-Barratt scale (0-11).

³ The percentage of tuber surface area with defects (Silver Scurf, Black Scurf, Scab) estimated using the Horsfall-Barratt

scale (0-11).

4 Tuber quality was rated visually and evaluated tuber color and uniformity of appearance.

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

Table 2. The effects of fungicide programs on tuber yield and grade (G.D. Franc, et al., U of WY; 1999).

Treatment and Application Rate (lb a.i. per acre)	Application dates ¹	Potato yield (lb per 30 ft)				
		US#1 (<10oz)	US#2	Grade B	Cull	Total
1. Nontreated Check	A-I	32.5 a ²	0.9 a	7.8 a	0.8 a	42.1 a
2. Bravo Weather Stik (1.03)	A-I	32.8 a	0.4 a	8.6 a	1.0 a	42.3 a
3. Bravo Weather Stik (1.03)	A, B, D, F, H	31.8 a	1.6 a	6.8 a	1.0 a	41.2 a
3. Quadris (0.21)	C, E, G, I					
4. Bravo Weather Stik (1.03)	A-D, F, H	32.6 a	1.1 a	7.2 a	1.6 a	42.5 a
4. Quadris (0.21)	E, G, I					
5. Bravo Weather Stik (1.03)	A-F, H	28.4 a	0.7 a	6.4 a	0.8 a	36.4 a
5. Quadris (0.21)	G, I					
6. Bravo Weather Stik (1.03)	A, B, D, F, H	29.3 a	1.9 a	6.5 a	1.3 a	38.9 a
6. Fluazinam (0.51)	C, E, G, I					
7. Bravo Weather Stik (1.03)	A-D, F, H	33.6 a	1.1 a	6.9 a	1.4 a	43.0 a
7. Fluazinam (0.51)	E, G, I					
8. Bravo Weather Stik (1.03)	A-F, H	32.4 a	1.0 a	5.5 a	0.7 a	39.6 a
8. Fluazinam (0.51)	G, I					
9. Maxim (8 oz per cwt)		36.9 a	0.9 a	8.7 a	0.9 a	47.4 a
9. Bravo Weather Stik (1.03)	E-I					

¹ Application dates: Maxim was applied to seed on 5/11; A=6/23, B=6/30, C=7/7, D=7/14, E=7/21, F=7/28, G=8/4, H=8/11, and I=8/18.

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

Table 3. Plant phenology at three sample dates during the growing season (G.D. Franc, et al., U of WY; 1999).

Treatment and Application Rate (lb a.i./ acre) ¹	7 July			21 July			4 August		
	Stem number	Tuber number	Tuber weight (g)	Stem number	Tuber number	Tuber weight (g)	Stem number	Tuber number	Tuber weight (g)
1. Nontreated Check	4.8	7.0	231.6	4.8	11.0	477.3	4.5	17.0	992.6
2. Bravo Weather Stik (1.03)	4.3	8.5	195.6	5.0	12.0	462.4	3.8	12.3	775.2
3. Bravo Weather Stik (1.03)	5.3	9.3	250.6	2.8	7.8	251.3	4.5	13.3	868.8
3. Quadris (0.21)									
4. Bravo Weather Stik (1.03)	3.8	6.5	182.9	4.3	12.5	613.4	3.8	8.8	312.0
4. Quadris (0.21)									
5. Bravo Weather Stik (1.03)	5.0	6.0	191.9	6.0	9.8	531.5	5.3	18.5	581.3
5. Quadris (0.21)									
6. Bravo Weather Stik (1.03)	4.8	9.3	255.4	4.3	13.5	580.8	4.3	11.0	832.2
6. Fluazinam (0.51)									
7. Bravo Weather Stik (1.03)	4.5	6.3	134.9	4.8	11.3	426.3	3.8	10.8	662.1
7. Fluazinam (0.51)									
8. Bravo Weather Stik (1.03)	4.0	6.8	175.2	4.3	10.5	545.3	3.3	13.0	657.2
8. Fluazinam (0.51)									
9. Maxim (8 oz per cwt)	4.5	7.8	257.9	3.0	8.5	534.1	4.5	17.0	612.9
9. Bravo Weather Stik (1.03)									
Mean	4.6	7.5	208.4	4.4	10.8	491.4	4.2	13.5	699.4

¹ See Tables 1 and 2 for treatment application dates.

Appendix 1. List of chemicals tested.

<u>Product</u>	<u>Manufacturer</u>	<u>Composition</u>
Bravo Weather Stik 6F	Zeneca Inc. Agricultural Products 1800 Concord Pike Wilmington, DE 19897	54% Chlorothalonil
Quadris 2.08SC	Zeneca Inc. Agricultural Products	22.9% Azoxystrobin
Fluazinam 4.17F	Zeneca Inc. Agricultural Products	Fluazinam
Maxim 5D	Novartis Crop Protection, Inc. P.O. Box 18300 Greensboro, NC 27419	0.5% Fludioxonil

Research Project**Potato Psyllid and Aphid Management with In-furrow and Foliar Insecticides, 1999****Research Team**

Tel: 307-766-2397

FAX: 766-5549

francg@uwyo.edu

G.D. Franc and W.L. Stump

University of Wyoming, Dept. of Plant Sciences

P.O. Box 3354 (16th & Gibbon Streets)

Laramie, WY 82071-3354

Field Plot Location

Torrington Research & Extension Center @ Torrington, WY.

4104 ft MSL; sandy loam soil; overhead irrigation

Plot Design

RCBD with 3 replications; plots were 4 rows (36-in row centers) X 20 ft. All treatments were made to, and all data were collected from, the center two rows.

Plot Management

Planting Date: 13 May.

Variety: Atlantic NL (constitutive Bt toxin) in the center (treated) rows and standard Atlantic was planted in buffer rows.

Fertilizer: 150 lbs N + 50 lbs P₂O₅

Herbicide: PPI, Dual II (1.5 pt/A) on 7 May.

Fungicide: Bravo Weather Stik (1.5 pt/A) for foliar disease management on 21 July.

Insect Development

Psyllid pressure was moderate to severe with populations peaking during early August. Psyllid Yellows was evident in the plot area at this time. Aphids were present, but in low numbers.

Treatment Applications

In-furrow treatments were made to the open furrow prior to seed placement (13 May) with the aid of a portable (CO₂) sprayer in a total volume of 1.43 gal per 1000 ft of row (8 in band) @ 40 psi boom pressure (one #8002 flat fan nozzle). Seedpieces were planted by hand and then covered with soil.

Foliar broadcast applications were made on 5 August in a total volume of 43 gal/A @ 30 psi boom pressure (four #8004 flat fan nozzles spaced @ 20 inches).

Insect Ratings

Plots were rated for the percentage of potato plant foliage affected by psyllid toxin (Psyllid Yellows) on 4 August. The average number of psyllids (nymphs) and aphids (species not identified) were determined for 10 leaves/plot on 5, 11, and 19 August.

Statistical Analysis

ANOVA with three replications. Mean separations were done using Fisher's protected LSD ($P=0.05$). Psyllid count data for 5 August were transformed (square root) to correct for non-homogeneity prior to analysis. Data prior to transformation are presented in Table 1.

Results and Discussion

Psyllid Yellows results from the feeding of *Paratrioza cockerelli* on potato leaves. The toxin released into the plant during feeding causes plant stunting, leafrolling and yellowing of foliage. Tubers are often small, distorted and have irregular dormancy. Psyllid Yellows can be a severe problem in the irrigated High Plains. The insect migrates northward during the early growing season, and infestations are difficult to predict. We do not have reliable insecticides for psyllid suppression.

In-furrow Platinum and Admire treatments protected plants from the development of Psyllid Yellows for at least the first half of the growing season ($P\#0.05$). Admire also significantly reduced the number of psyllid nymphs present on leaves during early August ($P\#0.05$). Psyllid and aphid populations were not significantly affected by treatment later in the growing season ($P\#0.05$). Broadcast treatments had no effect on psyllid and aphid populations ($P\#0.05$). Yields were not taken.

Table 1. The effects of in-furrow and foliar insecticide applications on psyllid populations and Psyllid Yellows development in potato (Franc and Stump, U of WY; 1999).

Treatment and rate (product amount)	Psyllid (nymphs) counts per leaf			% of Potato foliage exhibiting Psyllid Yellows
	5 Aug	11 Aug	19 Aug	4 Aug
1. Nontreated Check	1.8 ab ³	0.2 a	0.3 a	98.0 a
2. Platinum (0.45 fl oz/1000 ft) ¹	1.2 ab	0.5 a	0.2 a	7.5 b
3. Actara (1.5 oz/A) ²	2.8 a	0.2 a	0.3 a	98.5 a
4. Fulfill (2.75 oz/A) ²	2.9 a	0.7 a	0.3 a	95.5 a
5. Admire (1.17 fl oz/1000 ft) ¹	0.2 c	0.2 a	0.1 a	10.0 b

¹ In-furrow treatments were applied (1.43 gal/1000 row-ft, 8 inch band) immediately before planting on 13 May.

² Broadcast applications were made on 5 Aug.

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

Table 2. The effects of in-furrow and foliar insecticide applications on aphid suppression (Franc and

Stump, U of WY; 1999).

Treatment and rate (product amount)	Aphid (species not identified) counts per leaf		
	5 Aug	11 Aug	19 Aug
1. Nontreated Check	0.40 a ³	0.23 a	0.17 a
2. Platinum (0.45 fl oz/1000 ft) ¹	0.13 a	0.23 a	0.00 a
3. Actara (1.5 oz/A) ²	0.33 a	0.10 a	0.13 a
4. Fulfill (2.75 oz/A) ²	0.13 a	0.27 a	0.03 a
5. Admire (1.17 fl oz/1000 ft) ¹	0.37 a	0.03 a	0.00 a

¹ In-furrow treatments were applied (1.43 gal/1000 row-ft, 8 inch band) immediately before planting on 13 May.

² Broadcast applications were made on 5 Aug.

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

Research Project

Bacterial Ring Rot Symptom Development in Selected Potato Cultivars, 1999

Research Team

Tel: 307-766-2397

FAX: 766-5549

francg@uwyo.edu

G.D. Franc, W.L. Stump, S.C. Briere, and G. Leever*

U. of Wyoming, Dept. of Plant Sciences

P.O. Box 3354 (16th & Gibbon Streets)

Laramie, WY 82071-3354

*Potato Certification Association of Nebraska

P.O. Box 339

Alliance, NE 69301

Field Plot Location

Site 1: Torrington Research & Extension Center at Torrington, WY. 4104 ft MSL; sandy loam soil; overhead irrigation

Site 2: University of Wyoming at Laramie, WY. 7200 ft MSL; sandy clay loam; overhead irrigation

Plot Design

The experimental design was a split-plot design with eight potato cultivars as main plots and four replicates. Main plots were split with non-inoculated (A) or ring rot-inoculated (B) seed treatments. Main plots were one row X 20 ft and planted to Umatilla, Legend, Russet Burbank, Russet Burbank NL, Russet Burbank NL+, Superior, Superior NL, and Yukon Gold.

Plot Management

Site 1:

Planting Date: 13 May.

Fertilizer: 150 lbs N + 50 lbs P₂O₅

Herbicide: PPI, Dual II (1.5 pt/A) on 7 May.

Insecticide: Asana (4 fl oz) on 2, 12, 29 July, 4 and 7 August for psslid.

Fungicide: Bravo Weather Stik (1.5 pt/A) for foliar disease management on 22 July, 4,11,17, and 25 August.

Site 2:

Planting Date: 20 May.

Fertilizer: 150 lbs N + 50 lbs P₂O₅

Herbicide: PPI, Dual II (2.0 pt/A) on 1 June.

Insecticide: Admire (3.75 fl oz) on 6 August for psslid.

Fungicide: Bravo Weather Stik on 10 August for foliar disease management.

Inoculation

All seed tubers were cut by hand and inoculated on 10 May, 1999. Cut seed was immediately dipped into either sterile water (non-inoculated) or sterile water to which macerated tubers infected with *Clavibacter michiganensis* subsp. *sepedonicus* (CMS) were added (inoculated). The source of CMS (rifampicin marker) was symptomatic tubers stored from the 1998 growing season. All non-inoculated treatments were completed prior to inoculated treatments, to minimize the risk of cross contamination. After treatment, seedpieces were held at 45° F until planting

Disease Ratings

Stand counts for Torrington were taken on 2, 4, 8, 15, 23, 29 June; and in Laramie on 8, 10, 14, 18, 21, 25, 28 June, and 6 July. Plant height (vine length) for the first three plants per subplot was measured in Torrington on 29 June and 21 July, and in Laramie on 6 and 20 July. Plant vigor was estimated (0 worst to 10 best, treatment A=7) in Torrington on 21, 28 July, and 4 August, and in Laramie on 3 August. Foliar symptom expression was rated in Torrington on 15, 21, 28 July, and 4, 12, 19 August, and in Laramie on 3, 10, and 27 August. On 16 September in Torrington, and on 25 September in Laramie, up to four stems from each subplot were selected and subjected to a stem squeeze test for signs of bacterial ring rot.

Harvest

Plots were hand harvested in Torrington on 8 October and on 25 September in Laramie. Thirty externally sound (healthy appearing) tubers were randomly selected from each subplot, placed in paper bags, and stored at room temperature. On 20 October ten tubers from each subplot were cut and evaluated for the presence of typical ring rot symptoms. The remaining tubers will be rated after ca. 3 and 7 months storage at 45°F. If 30 tubers were not present at harvest, all sound tubers were stored and one third will be examined on each evaluation date.

Statistical Analysis

Data were analyzed as a split-plot ANOVA with four replicates and eight cultivars by two treatment levels. Main effect means were separated using Fisher's protected LSD (P=0.05). For between cultivar comparisons on vigor, plant and tuber symptoms, analysis was done on the inoculated treatments only, and was analyzed as a standard ANOVA. These means were separated using Fisher's protected LSD (P=0.05). For all analyses each location was analyzed separately.

Results and Discussion

Inoculation with CMS had no effect on emergence rates and final stands for the Torrington and Laramie sites (Table 1, P#0.05). Vine length was not affected by CMS inoculation at either site (Table 2, P#0.05). There was a reduction in vigor following inoculation with CMS for cultivars Superior and Superior NL (both sites), and for Russet Burbank NL when compared to their corresponding noninoculated treatment (Torrington only) (data not shown, P#0.05). Vigor comparisons between the inoculated cultivars are shown in Tables 3 and 4.

Foliar ring rot symptom development was greatest at the Laramie site compared to the Torrington site. At Laramie, the percentage of plants expressing foliar symptom development differed significantly among several cultivars (Table 4, P#0.05). Superior, Superior NL, and Umatilla exhibited the most foliar symptoms (Table 4, P#0.05). For the Laramie site, Superior had the greatest percentage of tubers expressing symptoms, followed by Superior NL, Umatilla, and Russet Burbank (Table 4, P#0.05). Symptomatic tubers were not detected for Legend and Yukon Gold harvested at either field site.

Psyllid feeding pressure was high in Torrington and many plants exhibited psyllid yellows which interfered with evaluating ring rot foliar symptom development. Superior was especially sensitive to psyllid feeding injury followed by Superior NL and Legend.

Table 1. Plant emergence and stand following seedpiece inoculation with *Clavibacter michiganensis* subsp. *sepedonicus* (CMS) (G.D. Franc, et al., University of Wyoming, 1999).¹

Cultivar Tested	Torrington				Laramie			
	Final stand (29 Jun) ²		AUEPC ³		Final stand (6 Jul) ²		AUEPC ³	
	<u>water only</u>	<u>water + CMS</u>	<u>water only</u>	<u>water + CMS</u>	<u>water only</u>	<u>water + CMS</u>	<u>water only</u>	<u>water + CMS</u>
1. Umatilla	7.0	6.3	148	135	6.8	6.5	108	114
2. Legend	7.0	7.0	166	167	6.8	6.5	133	147
3. Russet Burbank	7.0	7.0	172	185	6.8	7.0	148	151
4. Russet Burbank NL	7.0	7.0	171	168	7.0	7.0	136	143
5. Russet Burbank NL +	7.0	7.0	171	172	7.0	6.8	156	139
6. Superior	6.8	7.0	181	187	7.0	7.0	156	158
7. Superior NL	7.0	7.0	194	190	6.8	6.8	153	160
8. Yukon Gold	7.0	6.3	180	172	7.0	7.0	127	148

¹ Effects of inoculation, cultivar, and their interactions were not significant (P=0.05).

² Exactly seven seedpieces were planted per treatment subplot.

³ Area under the emergence progress curve for data collected 2 through 29 Jun; 8 Jun through 6 Jul for Torrington and Laramie respectively.

Delayed
emergence
and/or
decreased
final
stands
will
contribute
to a
lower
AUEPC.

Table 2. Potato growth response following seedpiece inoculation with the ring rot bacterium *Clavibacter michiganensis* subsp. *sepedonicus* (CMS) (G.D. Franc, et al., University of Wyoming, 1999).*

Cultivar Tested	Torrington Vine length (cm)				Laramie Vine length (cm)			
	29 Jun		21 Jul		6 Jul		20 Jul	
	<u>water only</u>	<u>water + CMS</u>	<u>water only</u>	<u>water + CMS</u>	<u>water only</u>	<u>water + CMS</u>	<u>water only</u>	<u>water + CMS</u>
1. Umatilla	34.9	36.3	53.8	52.6	20.7	20.9	33.3	34.4
2. Legend	36.1	36.7	55.8	59.8	20.8	21.6	35.7	36.8
3. Russet Burbank	45.9	43.8	68.2	65.1	27.2	26.2	42.5	41.0
4. Russet Burbank NL	46.0	40.4	68.1	62.9	26.0	27.5	44.5	43.2
5. Russet Burbank NL +	45.1	42.9	65.3	60.9	27.3	23.3	42.8	39.0
6. Superior	44.9	43.8	56.8	59.3	24.7	24.1	39.4	38.8
7. Superior NL	39.8	33.3	59.7	51.4	23.3	22.9	38.2	35.3
8. Yukon Gold	45.6	46.0	65.7	67.8	29.0	31.6	48.0	47.7

* Effects of inoculation, and inoculation x cultivar were not significant (P=0.05), mean separations between cultivars not shown.

Table 3. Vigor response and ring rot detection at Torrington, WY following seedpiece inoculation with *Clavibacter michiganensis* subsp. *sepedonicus* (G.D. Franc, et al., University of Wyoming, 1999).

Torrington Site Cultivar Tested	Average plant vigor non-inoculated =7 ¹	Percentage of plants with foliar symptoms	Range of visual symptoms observed ²	Stem Squeeze	
				16 Sep	Percentage of tubers expressing symptoms 20 Oct
1. Umatilla	6.9 ab ³	35.6 a	IVC, MN, LR, N, W	-	0.0 a
2. Legend	6.8 ab	10.7 a	IVC, LR, N, W	-	0.0 a
3. Russet Burbank	7.0 ab	21.5 a	IVC, LR, N, W	+	13.5 a
4. Russet Burbank NL	6.4 bc	14.9 a	ED, IVC, LR, MN, W	+	2.5 a
5. Russet Burbank NL +	6.8 ab	21.5 a	ED, IVC, LR, MN, N, W	-	2.5 a
6. Superior	6.4 bc	28.0 a	IVC, IVN, LR, MN, N, W	+	12.5 a
7. Superior NL	5.9 c	18.3 a	IVC, LR, MN, N, W	+	12.5 a
8. Yukon Gold	7.2 a	14.3 a	IVC, IVN, N	-	0.0 a
Site average	6.7	20.6			5.4

¹Vigor values presented represents the average of vigor ratings taken on 21, 28 Jul, and 4 Aug.

²Symptom code: ED= early dwarfing, IVC= interveinal chlorosis, IVN= interveinal necrosis, MN= marginal necrosis, LR= leaf roll, N= necrosis, C= chlorosis, W= wilt, S= stunting.

³ Mean comparisons between cultivars were based on analysis of the inoculated data set only. Treatment means followed by different letters differ significantly (Fisher's protected LSD, $P=0.05$).

Table 4. Vigor response and ring rot detection at Laramie, WY following seedpiece inoculation with *Clavibacter michiganensis* subsp. *sepedonicus* (CMS) (G.D. Franc, et al., University of Wyoming, 1999).

Laramie Site	Plant vigor non-inoculated =7	Percentage of plants with foliar symptoms	Range of visual symptoms observed*	Stem Squeeze	Percentage of tubers expressing symptoms
Cultivar Tested	3 Aug			23 Sep	20 Oct
1. Umatilla	7.0 a**	41.7 ab	IVC, MN, LR, W	+	15.7 bc
2. Legend	6.5 ab	3.6 d	IVC, S, W	+	0.0 d
3. Russet Burbank	7.0 a	10.7 d	ED, LR, MN	+	10.3 bcd
4. Russet Burbank NL	7.0 a	25.0 cd	ED, IVC, LR, MN, W	-	2.5 cd
5. Russet Burbank NL +	7.0 a	25.6 cd	ED, IVC, LR, MN	+	2.5 cd
6. Superior	5.8 b	78.6 a	IVC, IVN, LR, MN, N, C, W	+	47.5 a
7. Superior NL	6.0 b	63.7 ab	IVC, IVN, LR, MN, W	+	20.6 b
8. Yukon Gold	7.0 a	3.6 d	IVC	+	0.0 d
Site average	6.7	31.6			12.4

*Symptom code: ED= early dwarfing, IVC= interveinal chlorosis, IVN= interveinal necrosis, MN= marginal necrosis, LR= leaf roll, N= necrosis, C= chlorosis, W= wilt, S= stunting.

**Mean comparisons between cultivars were based on analysis of the inoculated data set only. Treatment means followed by different letters differ significantly (Fisher's protected LSD, $P=0.05$).

Research Project**Potato Vine Desiccation, 1999****Research Team**

Tel: 307-766-2397
FAX: 766-5549
francg@uwyo.edu

G.D. Franc and W.L. Stump
University of Wyoming, Dept. of Plant Sciences
P.O. Box 3354 (16th & Gibbon Streets)
Laramie, WY 82071-3354

Field Plot Location

Torrington Research & Extension Center @ Torrington, WY. 4104 ft MSL; sandy loam soil; overhead irrigation

Plot Design

RCBD with 4 replications; plots were 4 rows (36-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.

Plot Management

Planting Date: 12 May
Variety: Atlantic New Leaf
Fertilizer: 150 lbs N + 50 lbs P₂O₅
Herbicide: PPI, Dual II (1.5 pt/A) on 7 May
Insecticide: Asana (4 fl oz) on 7 August for Pysllid
Fungicide: Bravo Weather Stik (1.5 pt/A) for foliar disease management on 22 July.

Treatment Applications

Vine desiccation applications were initiated on 24 August, foliage at that time was 10% necrotic and stems were approximately 0.5% necrotic. Subsequent applications of Diquat were made on 31 August (for treatments 3 and 4). Treatments were applied with the aid of a portable (CO₂) sprayer in a total volume of 43 gal/A @ 30 psi boom pressure (four #8004 flat fan nozzles spaced @ 20 in).

Desiccation Ratings

Desiccation was estimated by visually rating vines for percent foliar and stem necrosis using the Horsfall-Barratt scale (0-11). Foliar necrosis was rated on 24, 25, 26, 31 August and 8 September. Stem necrosis was rated on 24, 31 August and 8 September. For overall measures of necrosis, an area under the desiccation progress curve (AUDPC) was computed for both foliar and stem necrosis.

Harvest

The middle 2 rows were dug with a single-row mechanical harvester on 16 September, and 25 sound, whole tubers were bagged for post-harvest skin-set and tuber quality evaluations.

Tuber Evaluations

A skin slip test was performed on 17 September; five tubers were used to measure skin-set (skin shear-strength, oz/in²) with a modified torque-wrench as developed by Halderson and Henning (1993). The modified torque-wrench was placed on each tuber with a 17-lb force applied to a 0.60 in diameter rubber stopper (#1 size) and then twisted until the skin “slipped.” Each tuber was tested at three positions along the equatorial region and an average reading was calculated.

To simulate harvest-related injury, on 4 October, the remaining 20 tubers were tumbled from a height of 18.5 in down a 59-in wooden ramp. This procedure was repeated once. The tubers were dipped into a catechol solution (56 g per gal) and ten tubers were rated for skinning, and 5 tubers rated for the incidence of shatter bruise (slight, medium and severe). The remaining 5 tubers were rated on 5 October for the level of occurrence of “alligator hide”, pit scab, and stem end discoloration using a scale of 1-3 (1=slight, 2=moderate and 3=severe occurrence).

Statistical Analysis

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

Results and Discussion

Most treatments increased foliar and stem necrosis compared to the nontreated control (P#0.05). Treatments had no effect on skinning, bruising, skin-slip measurements, and other tuber-skin characteristics (P=0.05). The lack of treatment effects on tuber characteristics may be attributed to the small differences in the time interval between chemical induced desiccation and natural senescence in the nontreated control. The addition of Superquick to Desicate II did accelerate the rate of foliar desiccation immediately after treatment. This would be a more favorable treatment effect for growers experiencing late blight in their crop, a situation where rapid vine-kill destroys host tissue and opening of the canopy is needed to quickly reduce humidity.

Table 1. The effect of vine desiccation treatments on potato (cv. Atlantic NL) foliar necrosis (Franc and Stump, U of WY; 1999).

Treatment and rate (lb ai/A) ¹	Percentage of foliage necrotic ²				AUDPC ³
	25 Aug	26 Aug	31 Aug	8 Sep	
1. Nontreated Control	10.3 d ⁴	10.3 e	33.0 c	88.0 bc	77.6 c
2. Desiccate II (1.0) + LI700 + AMS	31.0 ab	40.5 ab	59.5 ab	93.0 ab	97.6 a
3. Desiccate II (1.0) + LI700 + AMS	31.0 ab	36.0 bc	59.5 ab	95.2 a	98.1 a
3. Diquat (0.25) + LI700 ⁵					
4. Desiccate II (0.5) + LI700 + AMS	31.0 ab	27.2 c	58.0 ab	93.0 a	94.9 ab
4. Diquat (0.25) + LI700 ⁵					
5. Desiccate II (0.75) + Superquick	50.0 a	50.0 a	69.0 a	85.5 c	99.4 a
6. Desiccate II (1.0) + Choice (4.0)	27.2 bc	17.0 d	50.0 abc	94.0 a	91.0 ab
7. Desiccate II (1.0) + LI700 + Choice (2.0)	23.5 bc	17.0 d	50.0 abc	93.0 ab	89.4 ab
8. Desiccate II (1.0) + LI700 + Choice (4.0)	14.5 cd	14.5 de	45.0 bc	93.0 ab	85.9 bc

¹ Use amounts for; LI700= 1 pt product per 100 gal spray, AMS (ammonium sulfate)= 5 lb/A, and Superquick= 5 gal product/A.

² Data presented were converted to percentages from Horsfall-Barratt scale (0-11) data. Applications were initiated on 24 August; approximately 10% of the foliage was necrotic at this time.

³ Area under the (foliar) desiccation progress curve. Delayed foliar desiccation rates and/or decreased total foliar necrosis will contribute to a lower AUDPC.

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

⁵ The sequential application of Diquat + LI700 was made 7 days later.

Table 2. The effect of vine desiccation treatments on potato (cv. Atlantic NL) stem necrosis (Franc and Stump, U of WY; 1999).

Treatment and rate (lb ai/A) ¹	<u>Percentage of stems necrotic</u> ²		AUDPC ³
	31 Aug	8 Sep	
1. Nontreated Control	4.0 c ⁴	23.5 c	28.4 b
2. Desiccate II (1.0) + LI700 + AMS	20.2 a	40.5 a	49.3 a
3. Desiccate II (1.0) + LI700 + AMS	14.5 a	40.5 a	45.5 a
3. Diquat (0.25) + LI700 ⁵			
4. Desiccate II (0.5) + LI700 + AMS	12.0 a	40.5 a	44.8 a
4. Diquat (0.25) + LI700 ⁵			
5. Desiccate II (0.75) + Superquick	14.5 a	40.5 a	44.4 a
6. Desiccate II (1.0) + Choice (4.0)	14.5 a	31.0 b	44.6 a
7. Desiccate II (1.0) + LI700 + Choice (2.0)	12.0 ab	31.0 b	41.6 a
8. Desiccate II (1.0) + LI700 + Choice (4.0)	7.3 bc	27.2 bc	33.9 b

¹ Use amounts for; LI700= 1 pt product per 100 gal spray, AMS (ammonium sulfate)= 5 lbs/A, and Superquick= 5 gal product/A.

² Data presented were converted to percentages from Horsfall-Barratt scale (0-11) data. Applications were initiated on 24 August; approximately 0.5% of the stems were necrotic at this time.

³ Area under the (stem) desiccation progress curve. Delayed stem desiccation rates and/or decreased total stem necrosis will contribute to a lower AUDPC.

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

⁵ The sequential application of Diquat + LI700 was made 7 days later.

Table 3. The effect of vine desiccation treatments on post-harvest potato (cv. Atlantic NL) tuber characteristics (Franc and Stump, U of WY; 1999).

Treatment and rate (product/A) ¹	Tuber skinning (%) ³	Tuber bruise severity and incidence (average no. per tuber) ²			Tuber-skin characteristics ²			
		<u>Slight</u>	<u>Medium</u>	<u>Total</u>	Skin-set (shear) ⁴	Alligator hide severity ⁵	Stem-end discoloration ⁵	Pit scab severity ⁵
1. Nontreated Control	0.9 a ⁶	9.0 a	1.2 a	10.1 a	36.5 a	1.3 a	0.8 a	0.4 a
2. Desiccate II (1.0) + LI700 + AMS	1.6 a	9.8 a	1.4 a	11.2 a	36.6 a	1.8 a	1.0 a	0.3 a
3. Desiccate II (1.0) + LI700 + AMS	0.9 a	7.7 a	1.6 a	9.3 a	35.9 a	1.8 a	0.8 a	0.3 a
3. Diquat (0.25) + LI700 ⁷ .								
4. Desiccate II (0.5) + LI700 + AMS	0.9 a	7.6 a	1.4 a	9.0 a	36.6 a	2.0 a	0.9 a	0.4 a
4. Diquat (0.25) + LI700 ⁷ .								
5. Desiccate II (0.75) + Superquick	1.1 a	9.1 a	1.5 a	10.6 a	38.4 a	2.0 a	1.0 a	0.6 a
6. Desiccate II (1.0) + Choice (4.0)	0.7 a	10.9 a	1.2 a	12.1 a	36.7 a	1.4 a	1.2 a	0.6 a
7. Desiccate II (1.0) + LI700 + Choice (2.0)	0.7 a	8.9 a	1.9 a	10.8 a	36.8 a	2.0 a	1.0 a	0.3 a
8. Desiccate II (1.0) + LI700 + Choice (4.0)	1.1 a	6.3 a	0.8 a	7.0 a	35.5 a	1.8 a	0.7 a	0.4 a

¹ Use amounts for; LI700= 1 pt product per 100 gal spray, AMS (ammonium sulfate)= 5 lb/A, and Superquick= 5 gal product/A.

² All data are based on a subsample of five tubers.

³ All data are based on a subsample of ten tubers.

⁴ Skin-set results were based on 3 torque readings per tuber (oz per in²).

⁵ Ratings were: 1=slight, 2=moderate and 3=severe occurrence.

⁶ Means followed by the same letter in the column do not differ significantly (Fisher's Protected LSD, $P=0.05$).

⁷ The sequential application of Diquat + LI700 was made 7 days later.

Research Project**Rhizoctonia Root and Crown Rot Management in Sugar Beet using Quadris, 1999****Research Team**

Tel: 307-766-2397
FAX: 307-766-5549
francg@uwyo.edu

G.D. Franc, W.L. Stump, S.C. Briere
University of Wyoming, Dept. of Plant Sciences
P.O. Box 3354 (16th & Gibbon Streets)
Laramie, WY 82071-3354

Field Plot Location

Torrington Research & Extension Center @ Torrington, WY.
4104 ft MSL; sandy loam soil; overhead irrigation

Plot Design

RCBD with 4 replications; plots were 4 rows (30-in row centers) X 20 ft; 5 ft in-row buffer. Quadris treatments were made to, and all data were collected from, the center two rows of each plot. Rhizoctonia-inoculated and non-inoculated (natural inoculum) rows were paired within each plot.

Plot Management

Planting Date: 6 May.
Variety: Monohikori
Fertilizer: 150 lbs N + 50 lbs P₂O₅
Herbicide: Post emergence applications of Betamix + Upbeet (32 + 0.5 oz product) on 25 May.

Disease Development

On 29 June, Rhizoctonia inoculum was applied to each plant in one of the two center rows of each plot; ¼ tsp (0.8 g) of inoculum was applied to the crown of each plant. Immediately after inoculation, plots were watered twice during an 8 hr period to favor infection. [Inoculum was prepared by culturing several *Rhizoctonia solani* isolates on winter wheat, followed by air-drying and grinding.] Rhizoctonia development in the non-inoculated row relied upon naturally occurring inoculum. Cercospora development resulted from naturally occurring inoculum, as well.

Treatment Applications

In-furrow treatments were applied on 6 May with a hand-spray bottle in a total volume of 250 ml per 160 ft of row, incorporated with a hoe and then seed was placed with a commercial planter into the treated soil.

Band applications (6 inch width) were made on 9 June with a single-nozzle (730077 flat fan tip) in a total volume of 500 ml per 160 ft of row. Sugar beets were in the 4-6 leaf stage.

Broadcast applications were applied on 7 July using a backpack sprayer in a total spray volume of 43 gal/A at 30 psi boom pressure. The boom was equipped with four #8004 flat fan nozzles spaced at 20 in. The sugar beet canopy was closed within the row but not between rows. A description of chemicals tested can be found in Appendix 1.

Data Collection

Stand counts (2 rows X 10 ft) were taken on 26 May (7 days after emergence=DAE) and 8 June (20 DAE).

Disease Ratings

Rhizoctonia severity ratings were based on 5 plants/plot (destructive sampling) collected on 24 June. The percentage of surface-area decayed was estimated.

Rhizoctonia incidence was rated separately for the inoculated and non-inoculated rows (20 ft) on 9 August.

Cercospora severity (average number of lesions per leaf) was determined for 10 leaves collected 16 September.

At harvest, Rhizoctonia severity and incidence was rated separately for the inoculated and non-inoculated rows (5 ft) on 1 October.

Harvest

Beet harvest was from 5 ft of row for the inoculated and non-inoculated rows, harvested separately, on 1 October. Sucrose (%) and nitrate levels were measured by the Holly Sugar lab.

Statistical Analysis

Data were analyzed via ANOVA. Because natural infection was slight, analysis on final Rhizoctonia ratings, beet yield and quality were done on data from the inoculated row and non-inoculated rows separately. Mean separations were done using Fisher's protected LSD (P=0.05).

Results and Discussion

Early season in-furrow and band applications of Quadris had no significant effect (Table 1) on seedling emergence and root decay as measured by stand counts and the 24 June root-rot ratings ($P \neq 0.05$). However, natural Rhizoctonia disease development was low. Following artificial inoculation of beet crowns on 29 June, substantial crown rot developed. Data for inoculated rows (Table 2) revealed that both Quadris broadcast treatments significantly reduced crown rot disease incidence (8 Aug) and

severity (1 Oct) ($P \leq 0.05$). This effect was easily measured, even though all broadcast treatments were made 8 days after plants were inoculated. Total root yields for broadcast treatments were significantly increased ($P \leq 0.05$) compared to the nontreated control; broadcast treatment yields exceeded that of the nontreated control by 72%.

Banded applications made to the crown of sugar beet plants may be as effective as the broadcast treatments, if properly timed. Direct comparisons of banded and broadcast applications were not made during 1999 and should be made during the 2000 growing season. A properly timed Quadris application made only to the crown of the plant may help reduce costs associated with Rhizoctonia management by reducing total chemical usage.

As expected, there was no detectable residual effect of Quadris applications on subsequent Cercospora lesion development during the later portion of the growing season ($P \leq 0.05$). During 1999, Cercospora development started almost 30 days after the last Quadris broadcast treatment was applied. No additional fungicide was applied to the foliage following the 7 July Quadris broadcast.

Table 1. Effects of Quadris treatments on sugar beet stand establishment and late season Cercospora development (Franc et al., U of WY; 1999).

Treatment	Timing and Application Rate (ai) ¹	Stand counts (per 20 row ft)		Rhizoctonia severity SA rotted (%) ²	Cercospora # of lesions per leaf
		26 May	8 Jun	24 Jun	16 Sep
1. Nontreated Control		48.0 a ³	49.3 a	1.0 a	187 a
2. Quadris	in-furrow (0.075 oz /1000 ft)	52.0 a	50.5 a	1.2 a	234 a
3. Quadris	in-furrow (0.15 oz /1000 ft)	48.5 a	49.0 a	1.3 a	264 a
4. Quadris	banded (0.075 oz /1000 ft)	52.5 a	52.8 a	1.0 a	219 a
5. Quadris	banded (0.15 oz /1000 ft)	46.3 a	48.5 a	1.2 a	204 a
6. Quadris	in-furrow (0.075 oz /1000 ft)	49.5 a	50.8 a	1.0 a	190 a
6. Quadris	broadcast (0.15 lb/A)				
7. Quadris	banded (0.075 oz /1000 ft)	54.8 a	56.0 a	0.8 a	152 a
7. Quadris	broadcast (0.15 lb/A)				

¹ In-furrow applications were made immediately prior to planting on 6 May. Banded applications were made on 9 June; beets were in the 4-6 leaf stage. Broadcast treatments were made on 7 July; the beet canopy was closed within the row. Plants (one paired-row per plot) were inoculated with Rhizoctonia on 29 June.

² Data are expressed as the percentage of the root surface-area decayed by Rhizoctonia. Data were converted from Horsfall-Barratt ratings (0-11).

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

Table 2. Effects of Quadris treatments on Rhizoctonia Crown Rot of sugar beet (Franc et al., U of WY; 1999).

Treatment	Timing and Application Rate (ai) ¹	Rhizoctonia incidence and severity ²					
		Number of beets with rot per 20 row ft 9 Aug		Number of beets with rot per 5 row ft 1 Oct		SA root affected by rot (%) ³ 1 Oct	
		I	N	I	N	I	N
1. Nontreated Control		16.5 a ⁴	0.0 a	8.0 ab	0.3 a	88.0 a	0.5 a
2. Quadris	in-furrow (0.075 oz /1000 ft)	14.5 a	0.0 a	9.3 a	0.0 a	83.0 a	0.0 a
3. Quadris	in-furrow (0.15 oz /1000 ft)	17.3 a	0.0 a	8.8 ab	0.0 a	85.5 a	0.0 a
4. Quadris	banded (0.075 oz /1000 ft)	15.3 a	0.8 a	10.3 a	1.0 a	85.5 a	4.0 a
5. Quadris	banded (0.15 oz /1000 ft)	16.3 a	0.0 a	9.8 a	0.0 a	89.8 a	0.0 a
6. Quadris	in-furrow (0.075 oz /1000 ft)	2.5 b	0.0 a	3.8 c	0.0 a	20.3 b	0.0 a
6. Quadris	broadcast (0.15 lb/A)						
7. Quadris	banded (0.075 oz /1000 ft)	5.8 b	0.0 a	5.3 bc	0.0 a	23.5 b	0.0 a
7. Quadris	broadcast (0.15 lb/A)						

¹ In-furrow applications were made immediately prior to planting on 6 May. Banded applications were made on 9 June; beets were in the 4-6 leaf stage. Broadcast treatments were made on 7 July; the beet canopy was closed within the row. Plants (one paired-row per plot) were inoculated with Rhizoctonia on 29 June.

² Ratings were taken on inoculated (I) and noninoculated (N) rows separately.

³ Percentage data for Rhizoctonia symptoms were converted from Horsfall-Barratt ratings (0-11).

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

Table 3. Effects of Rhizoctonia and Quadris treatments on sugar beet yield (Franc et al., U of WY; 1999).

Treatment	Timing and Application Rate (ai) ¹	<u>Beet number (5 row ft)²</u>		<u>Beet yield (lbs 5 row ft)²</u>	
		I	N	I	N
1. Nontreated Control .		8.8 a ³	13.0 a	7.9 b	14.9 a
2. Quadris	in-furrow (0.075 oz /1000 ft)	9.8 a	12.3 a	6.2 b	13.8 a
3. Quadris	in-furrow (0.15 oz /1000 ft)	9.5 a	12.5 a	6.4 b	15.0 a
4. Quadris	banded (0.075 oz /1000 ft)	10.8 a	11.3 a	9.6 ab	13.9 a
5. Quadris	banded (0.15 oz /1000 ft)	10.0 a	12.8 a	6.5 b	15.6 a
6. Quadris	in-furrow (0.075 oz /1000 ft)	12.3 a	12.0 a	13.8 a	12.9 a
6. Quadris	broadcast (0.15 lb/A)				
7. Quadris	banded (0.075 oz /1000 ft)	13.5 a	13.0 a	13.4 a	14.5 a
7. Quadris	broadcast (0.15 lb/A)				

¹ In-furrow applications were made immediately prior to planting on 6 May. Banded applications were made on 9 June; beets were in the 4-6 leaf stage. Broadcast treatments were made on 7 July; the beet canopy was closed within the row. Plants (one paired-row per plot) were inoculated with Rhizoctonia on 29 June.

² All data were taken on inoculated (I) and noninoculated (N) rows separately.

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

Table 4. Effects of Rhizoctonia and Quadris treatments on sugar quality (Franc et al., U of WY; 1999).

Treatment	Timing and Application Rate (ai) ¹	<u>% total sucrose</u> ²		<u>Nitrate (ppm)</u> ²	
		I	N	I	N
1. Nontreated Control .		10.3 ab ³	16.4 a	116 b	125 a
2. Quadris	in-furrow (0.075 oz /1000 ft)	7.1 b	16.7 a	129 b	116 a
3. Quadris	in-furrow (0.15 oz /1000 ft)	7.3 b	16.2 a	161 ab	83 a
4. Quadris	banded (0.075 oz /1000 ft)	8.3 b	15.4 a	167 ab	112 a
5. Quadris	banded (0.15 oz /1000 ft)	5.8 b	16.3 a	250 a	129 a
6. Quadris	in-furrow (0.075 oz /1000 ft)	14.4 a	17.2 a	70 bc	79 a
6. Quadris	broadcast (0.15 lb/A)				
7. Quadris	banded (0.075 oz /1000 ft)	14.4 a	17.0 a	120 b	73 a
7. Quadris	broadcast (0.15 lb/A)				

¹ In-furrow applications were made immediately prior to planting on 6 May. Banded applications were made on 9 June; beets were in the 4-6 leaf stage. Broadcast treatments were made on 7 July; the beet canopy was closed within the row. Plants (one paired-row per plot) were inoculated with Rhizoctonia on 29 June.

² All data were taken on inoculated (I) and noninoculated (N) rows separately.

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

Appendix 1. Chemical tested.

<u>Product</u>	<u>Manufacturer</u>	<u>Composition</u>
Quadris 2.08SC	Zeneca Inc. Agricultural Products 1800 Concord Pike Wilmington, DE 19897	22.9 % Azoxystrobin

Research Project**Quadris Combinations with Postemergence Herbicide Treatments in Sugar Beets, 1999****Research Team**

Tel: 307-766-2397
FAX: 307-766-5549
francg@uwyo.edu

S. Miller, G.D. Franc, W.L. Stump, S.C. Briere
University of Wyoming, Dept. of Plant Sciences
P.O. Box 3354 (16th & Gibbon Streets)
Laramie, WY 82071-3354

Field Plot Location

Torrington Research & Extension Center @ Torrington, WY.
4104 ft MSL; sandy loam soil; overhead irrigation

Plot Design

RCBD with 3 replications; plots were 4 rows (30-in row centers) X 30 ft. Herbicide and Quadris treatments were made to, and all data were collected from, the center two rows of each plot. Rhizoctonia-inoculated and non-inoculated (natural inoculum) rows were paired within each plot.

Plot Management

Planting Date: 21 May.
Variety: MK71
Fertilizer: 150 lbs N + 50 lbs P₂O₅

Disease Development

On June 29, Rhizoctonia inoculum was applied to each plant in one of the two center rows of each plot; ¼ tsp (0.8 g) of inoculum was applied to the crown of each plant. Immediately after inoculation, plots were watered twice during an 8 hr period to favor infection. [Inoculum was prepared by culturing several *Rhizoctonia solani* isolates on winter wheat, followed by air-drying and grinding.] Rhizoctonia development in the non-inoculated row relied upon naturally occurring inoculum.

Treatment Applications

Herbicide and fungicide treatments were applied with a CO₂ pressurized 6-nozzle knapsack sprayer delivering 20 gpa at 40 psi June 9 (air temp. 66°F, relative humidity 30%, wind NW at 5 mph, sky clear and soil temp. - 0 inch 84°F, 2 inch 65°F and 4 inch 66°F) to cotyledonary beets and 0.5 inch weeds, June 16 (air temp. 65°F, relative humidity 65%, wind SE at 5 mph, sky partly cloudy and soil temp. - 0 inch 72°F, 2 inch 66 °F and 4 inch 64°F) to 2-leaf beets and 0.5 to 1.5 inch weeds and June 23, 1999 (air temp. 70°F, relative humidity 25% wind calm, sky clear and soil temp. - 0 inch 82°F, 2 inch 74°F and 4 inch 70°F) to 4-leaf beets and 0.5 to 3.0 inch weeds. Information on the herbicides tested can be found in Appendix 1.

Data Collection

Weed counts, crop stand counts and visual crop injury ratings were made July 8 and plots harvested October 1, 1999. Green foxtail (SETVI) infestations were heavy (102 plants/10 ft. row), common lambsquarters (CHEAL) and redroot pigweed (AMARE) infestations were heavy (21 to 39 plants/10 ft. row) and kochia (KCHSC) and erect knotweed (POLER) infestations moderate (5 to 6 plants/10 ft. row) and uniform throughout the experimental site.

Disease Ratings

At harvest, *Rhizoctonia* severity and incidence was rated separately for beets from the inoculated and non-inoculated rows (5 ft) on October 1.

Harvest

Beet harvest was from 5 ft of row for the inoculated and non-inoculated rows, harvested separately, on October 1. Sucrose (%) and nitrate levels were measured by the Holly Sugar lab.

Statistical Analysis

Data were analyzed via ANOVA. Analysis on stand, yield, sugar, and weed control was done on inoculated and non-inoculated rows separately. Analysis on final *Rhizoctonia* ratings were done on data from the inoculated row and non-inoculated rows combined. Mean separations were done using Fisher's protected LSD ($P=0.05$). Linear contrasts were done on treatments that contained Quadris (treatments 3-8) vs. treatments that did not (treatments 1, 2, 9, 10) and early Quadris treatments (treatments 3, 5, 7) vs. later Quadris treatments (treatments 4, 6, 8).

Results and Discussion

No herbicide treatment reduced sugar beet stands and only slight injury (3%) was evident with the conventional treatments ($P\#0.05$). Sugar beet stands were 40 to 50% lower at harvest compared to initial counts and were generally not different in *Rhizoctonia* inoculated or non-inoculated rows ($P\#0.05$). Weed control was better with the conventional compared to the micro-rate treatments and neither were influenced by Quadris at either timing ($P\#0.05$). Sugar beet yields were similar in hand weeded or herbicide treated plots and both out yielded the weedy check plots by 5.6 to 7.9 T/A ($P\#0.05$). Sugar beet yields, final beet numbers, and *Rhizoctonia* incidence were similar in *Rhizoctonia* inoculated or non-inoculated rows ($P\#0.05$). However, the severity of *Rhizoctonia* beet rot at harvest was greater in the inoculated (6.5%) vs. the non-inoculated rows (1.8%) ($P\#0.05$). Overall, treatments containing Quadris reduced both incidence and severity of *Rhizoctonia* on harvested beets compared to treatments that did not contain Quadris (linear contrast, $P\#0.05$). Timing of Quadris applications had no effect on beet number, number of beets rotted, and rot severity (linear contrast, $P\#0.05$).

Table 1. Sugar beet response to postemergence herbicide treatments applied with and without Quadris. Torrington Research and Extension Center, 1999.

Treatment*	Rate lb/A	Application	Sugar beets**					
			Stand		Injury	Yield	Sucrose	
			Initial	Harvest				---
<u>Non-infested</u>								
1.	Desmedipham-phenmedipaham(dp)+ triflurosulfuron(trif)/dp+clopyralid(clop)/ dp+sethoxydim(seth)	0.25+0.016/ 0.25+0.09/ 0.25+0.19	CO/ 7D/ 14D	29.6	18.1	3	18.4	15.86
2.	Dp+trif+clop+MS/dp+trif+clop+MS/ dp+trif+clop+seth+MS	0.08+0.004+0.023/0.08+0.004 +0.023/0.08+0.004+0.023+0.19	CO/7D/ 14D	31.4	18.0	0	16.1	15.32
3.	Hand weeded check+Quadris(Quad)	0.1	7D	31.4	16.3	0	18.6	15.19
4.	Hand weeded Check+Quadris	0.1	14D	29.6	16.3	0	18.3	15.06
5.	Dp+trif/dp+clop+Quadris/ dp+seth	0.25+0.016/0.25+0.09+ 0.1/0.25+0.19	CO/7D/ 14D	30.2	18.1	3	18.6	15.39
6.	Dp+trif/dp+clop/ dp+seth+Quadris	0.25+0.016/0.25+0.09/ 0.25+0.19+0.1	CO/7D/ 14D	30.2	18.1	0	19.3	15.89
7.	Dp+trif+clop+MS/dp+trif+clop+Quad+MS/ dp+trif+clop+seth+MS	0.08+0.004+0.023/0.08+0.004 +0.023+0.1/0.08+0.004+0.023+0.19	CO/7D/ 14D	30.8	18.1	0	16.2	15.38
8.	Dp+trif+clop+MS/dp+trif+clop+MS/ dp+trif+clop+seth+Quad+MS	0.08+0.004+0.23/0.08+0.004 +0.023/0.08+0.004+0.023+0.19+0.1	CO/7D/ 14D	32.5	18.1	0	16.2	15.84
9.	Hand weeded check	-----	7D/21D/28D	28.5	18.1	0	19.1	15.04
10.	Weedy Check	-----	-----	15.1	8.1	0	10.6	14.63
<u>Infested</u>								
1.	Desmedipham-phenmedipaham(dp)+ triflurosulfuron(trif)/dp+clopyralid(clop)/ dp+sethoxydim(seth)	0.25+0.016/ 0.25+0.09/ 0.25+0.19	CO/7D/ 14D CO/7D/	30.7	16.3	3	15.8	14.82
2.	Dp+trif+clop+MS/dp+trif+clop+MS/ dp+trif+clop+seth+MS	0.08+0.004+0.023/0.08+0.004 +0.023/0.08+0.004+0.023+0.19	14D 7D	30.8	15.7	0	13.4	14.91
3.	Hand weeded check+Quadris(Quad)	0.1	14D	29.6	16.3	0	18.3	15.06
4.	Hand weeded Check+Quadris	0.1	CO/7D/	29.6	16.3	0	16.4	15.11
5.	Dp+trif/dp+clop+Quadris/ dp+seth	0.25+0.016/0.25+0.09+ 0.1/0.25+0.19	14D CO/7D/	30.7	16.3	3	14.6	15.38
6.	Dp+trif/dp+clop/ dp+seth+Quadris	0.25+0.016/0.25+0.09/ 0.25+0.19+0.1	14D CO/7D/	28.5	17.4	0	17.6	15.64
7.	Dp+trif+clop+MS/dp+trif+clop+Quad+MS/ dp+trif+clop+seth+MS	0.08+0.004+0.023/0.08+0.004 +0.023+0.1/0.08+0.004+0.023+0.19	14D CO/7D	29.6	17.1	0	16.6	15.54
8.	Dp+trif+clop+MS/dp+trif+clop+MS/ dp+trif+clop+seth+Quad+MS	0.08+0.004+0.23/0.08+0.004 +0.023/0.08+0.004+0.023+0.19+0.1	14D 7D/21D/28D	30.2	17.7	0	13.8	15.64
9.	Hand weeded check	-----	-----	29.6	15.7	0	18.8	15.04
10.	Weedy Check	-----	-----	20.9	5.3	0	9.9	14.33

* Treatments applied June 9, 16 and 23, 1999; MS=methylated seed oil Sun-It at 1 qt/A, -=package mix and /=split application. Treatment trade names can be found in Appendix A.

** Crop injury and stand evaluated July 8 and plots harvested October 1, 1999.

Table 2. Weed control with postemergence herbicide treatments applied with and without Quadris. Torrington Research and Extension Center, 1999.

Treatment*	Rate lb/A	Application	Weed control**				
			CHEAL	AMARE	KCHSC	POLER	SETVI
----- % -----							
1. Desmedipham-phenmedipaham(dp)+ triflusaluron(trif)/dp+clopyralid(clop)/ dp+setoxydim(seth)	0.25+0.016/ 0.25+0.09/ 0.25+0.19	CO/ 7D/ 14D	100	92	100	100	99
2. Dp+trif+clop+MS/dp+trif+clop+MS/ dp+trif+clop+seth+MS	0.08+0.004+0.023/0.08+0.004 +0.023/0.08+0.04+0.023+0.19	CO/7D/ 14D	92	73	100	100	98
3. Hand weeded check+Quadris(Quad)	0.1	7D	100	100	100	100	100
4. Hand weeded Check+Quadris	0.1	14D	100	100	100	100	100
5. Dp+trif/dp+clop+Quadris/ dp+seth	0.25+0.016/0.25+0.09+ 0.1/0.25+0.19	CO/7D/ 14D	100	93	100	100	99
6. Dp+trif/dp+clop/ dp+seth+Quadris	0.25+0.016/0.25+0.09/ 0.25+0.19+0.1	CO/7D/ 14D	100	94	100	100	99
7. Dp+trif+clop+MS/dp+trif+clop+Quad+MS/ dp+trif+clop+seth+MS	0.08+0.004+0.023/0.08+0.004 +0.023+0.1/0.08+0.004+0.023+0.19	CO/7D/ 14D	90	76	100	100	98
8. Dp+trif+clop+MS/dp+trif+clop+MS/ dp+trif+clop+seth+Quad+MS	0.08+0.004+0.23/0.08+0.004 +0.023/0.08+0.004+0.023+0.19+0.1	CO/7D/ 14D	92	77	100	100	98
9. Hand weeded check	-----	7D/21D/28D	100	100	100	100	100
10. Weedy Check	-----	-----	0	0	0	0	0
Plants/ft. row 6-inch band			2.1	3.9	0.6	0.5	10.2

* Treatments applied June 9, 16 and 23, 1999; MS=methylated seed oil Sun-It at 1 qt/A, -=package mix and /=split application. Treatment trade names can be found in Appendix A.

** Weed counts determined July 8, 1999. Weed common names can be found in Appendix A.

Table 3. Postemergence herbicide treatments applied with and without Quadris effects on beet numbers, Rhizoctonia incidence, and severity at harvest. Torrington Research and Extension Center, 1999.

Treatment ¹	Rate (lb/A)	Application timing	Per 5 row ft		Rhizoctonia severity SA rotted (%) ²
			Beet number	Number of beets with rot	
1. Desmedipham-phenmedipaham(dp)+ triflusaluron(trif)/dp+clopyralid(clop)/ dp+sethoxymdim(seth)	0.25+0.016/ 0.25+0.09/ 0.25+0.19	CO/ 7D/ 14D	9.7 a ³	3.8 a	14.0 a
2. Dp+trif+clop+MS/dp+trif+clop+MS/ dp+trif+clop+seth+MS	0.08+0.004+0.023/0.08+0.004 +0.023/0.08+0.004+0.023+0.19	CO/7D/ 14D	10.0 a	2.5 ab	14.0 a
3. Hand weeded check+Quadris(Quad)	0.1	7D	9.8 a	0.3 c	4.5 a
4. Hand weeded Check+Quadris	0.1	14D	9.0 a	0.5 bc	4.0 a
5. Dp+trif/dp+clop+Quadris/ dp+seth	0.25+0.016/0.25+0.09+ 0.1/0.25+0.19	CO/7D/ 14D	8.5 a	0.8 bc	3.0 a
6. Dp+trif/dp+clop/ dp+seth+Quadris	0.25+0.016/0.25+0.09/ 0.25+0.19+0.1	CO/7D/ 14D	9.2 a	0.5 bc	2.0 a
7. Dp+trif+clop+MS/dp+trif+clop+Quad+MS/ dp+trif+clop+seth+MS	0.08+0.004+0.023/0.08+0.004 +0.023+0.1/0.08+0.004+0.023+0.19	CO/7D/ 14D	9.3 a	1.2 bc	4.5 a
8. Dp+trif+clop+MS/dp+trif+clop+MS/ dp+trif+clop+seth+Quad+MS	0.08+0.004+0.23/0.08+0.004 +0.023/0.08+0.004+0.023+0.19+0.1	CO/7D/ 14D	10.2 a	0.8 bc	3.0 a
9. Hand weeded check	-----	7D/21D/28D	5.7 b	0.3 c	1.0 a
10. Weedy Check	-----	-----	8.8 a	1.0 bc	4.0 a

¹ Treatments applied June 9, 16 and 23, 1999; MS=methylated seed oil Sun-It at 1 qt/A, -=package mix and /=split application. Treatment trade names can be found in Appendix A.

² Percentage data for Rhizoctonia symptoms were converted from Horsfall-Barratt ratings (0-11).

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

Table 4. Results of linear contrasts on treatments that contained Quadris vs. treatments that did not, and early Quadris treatments vs. later Quadris treatments; on beet numbers, *Rhizoctonia* incidence, and severity at harvest. Torrington Research and Extension Center, 1999.

Contrast variable	Treatment contrast and (contrast mean)	P value
Beet number harvested per 5 row feet	+ Quadris vs. No Quadris (9.3 vs. 8.5)	0.1514
	Quadris early vs Quadris late (9.2 vs. 9.4)	0.7471
Beet number rotted per 5 row feet	+ Quadris vs. No Quadris (0.7 vs. 1.9)	0.0112*
	Quadris early vs Quadris late (0.8 vs. 0.6)	0.7754
Rhizoctonia severity (% SA rotted)	+ Quadris vs. No Quadris (2.5 vs. 6.0)	0.0380*
	Quadris early vs Quadris late (1.6 vs. 1.2)	0.4882

* Contrast significant at P#0.05.

Appendix 1. Herbicide index (by common name or code designation). This table was compiled from approved nomenclature adopted by the Weed Science Society of America (Weed Science 44(4):1998) and the herbicide handbook of the WSSA (8th Edition).

acetochlor	2-chloro-N-(ethoxymethyl)-N-(2-ethyl-6-methylphenyl)acetamide	Harness, Surpass
alachlor	2-chloro-N-(2,6-diethylphenyl)-N-(methoxymethyl)acetamide	Lasso Micro-Tech, Partner
atrazine	6-chloro-N-ethyl-N-(1-methyl-ethyl)-1,3,5-triazine-2,4-diamine	Aatrex
bentazon	3-(1-methylethyl)-(1H)-2,1,3-benzothia-diazin-4(3H)-one,2,2-dioxide	Basagran
bromoxynil	3,5-dibromo-4-hydroxybenzoxynitrile	Brominal, Buctril
carfentrazone	ethyl 2-chloro-3-[2-chloro-4-fluoro-5-(4-difluoromethyl-4,5-dihydro-3-methyl-5-oxo-1H-1,2,4 triazol-1yl)phenyl]propanoate	Aim, Affinity
CGA-362622	not available	None
chlorsulfuron	2-chloro-N-[[4-methoxy-6-methyl-1,3,5,-triazin-2-yl)amino]carbonyl]benzenesulfonamide	Glean
clethodim	(E,E)(±)-2[1-[[3-chloro-2-propenyl)oxy]imino]propyl]-5-[2-ethylthio]propyl]-3-hydroxy-2-cyclohexen-1-one	Select Prism
clopyralid	3,6-dichloro-2-pyridinecarboxylic acid	Stinger, Lontrel
cyanazine	2-[[4-chloro-6-(ethylamino)-1,3,5-triazin-2-yl]amino]-2-methyl propanenitrile	Bladex
cycloate	S-ethyl cyclohexylethylcarbamothioate	Ro-Neet
2,4-D	(2,4-dichlorophenoxy)acetic acid	numerous
2,4-DB	4-(2,4-dichlorophenoxy)butanoic acid	Butyrac
desmedipham	ethyl [3-[[phenylamino]carbonyl]oxy]phenyl] carbamate	Betanex
dicamba	3,6-dichloro-methoxybenzoic acid	Banvel, Clarity
dichlormid (safener)	2,2-dichloro-N,N-di-2-propenylacetamide	None
diclofop	(±)-2-[4-(2,4-dichlorophenoxy)phenoxy]propanoic acid	Hoelon
difenzoquat	1,2-dimethyl-3,5-diphenyl-1H-pyrazolium	Avenge
diflufenzopyr	2-[1-[[[3,5-difluorophenyl]amino]-carbonyl]hydrazono]ethyl]-3-pyridine carboxylic acid	BAS-654H
dimethenamid, dimethenamid-P	2-chloro-N(2,4-dimethyl-3-thienyl)-N-(2-methoxy-1-methylethyl)acetamide	Frontier
EPTC	s-ethyl dipropylcarbamothioate	Eptam
ethalfluralin	N-ethyl-N-(2-methyl-2-propenyl)-2,6-dinitro-4-(trifluoromethyl)benzeneamine	Sonalan

ethofumesate	(±)-2-ethoxy-2,3-dihydro-3,3-dimethyl-5-benzofuranyl methanesulfonate	Nortron
ETK 2303	N-(phosphonomethyl)glycine	None
ETK 2350	N-(phosphonomethyl)glycine+(2,4-diclorophenoxy)acetic acid	None
fenoxaprop	(±)-2-[4-[(6-chloro-2-benzoxazolyl)oxy]phenoxy]propanoic acid	Whip
flumioxizin	7-fluoro-6-[(3,4,5,6-tetrahydro)phthalimido]-4-(2-propynyl)-1,4-benzoxazin-3(2H)one	Valor
fluroxypyr	[(4-amino-3,5-dichloro-6-fluoro-2-pyridinyl)oxy]acetic acid	Starane
FOE-5043 (Flufenacet)	N-(4-fluorophenyl)-N-(1-methylethyl)-2-[[5-(trifluoromethyl)-1,3,4-thiadiazol-2-yl]-oxy]acetamide	Axiom
glyphosate	N-(phosphonomethyl)glycine	Roundup
glufosinate	2-amino-4-(hydroxymethyl acid	Liberty, Basta
ICIA 1296	not available	None
ICIA 5676	not available	None
imazamethabenz	(±)methyl-6-(4-isopropyl-4-methyl-5-oxo-2-imadazolin-2-yl)-M-toluate	Assert
imazamox	2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2yl]5-methyl-3-pyridine carboxylic acid	Raptor, Motive, Tremor
imazapyr	(±)2-[4,5-dihydro-4-methyl-4-(1-methylethyl)5-oxo-1H-imidazol-2yl]-3-pyridine carboxylic acid	Arsenal, Chopper
imazethapyr	(±)-2-[4,5-dihydro-4-methyl-4(methylethyl)-5-oxo-1H-imidazol-2-yl]-5-ethyl-3-pyridine carboxylic acid	Pursuit
isoxaflutole, Exp31809B	5-cyclopropyl-4-(methylsulphonyl-4-trifluoromethylbenzoyl isoxazole	Balance
MCPA	(4-chloro-2-methylphenoxy)acetic acid	Numerous
MCPB	4-(chloro-2-methylphenoxy)butanoic acid	Thistrol
metolachlor, S-metolachlor	2-chloro-N-(2-ethyl-6-methyl-phenyl)-N-(2-methoxy-1-methyl-ethyl)-acetamide	Dual II, Dual II Magnum
metribuzin	4-amino-6-(1,1-dimethylethyl)-3-(methylthio)-1,2,4-triazin-5(5H)-one	Sencor, Lexone
metsulfuron	2-[[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino]carbonyl]amino]sulfonyl]benzoic acid	Ally
MON-37500 (sulfosulfuron)	1-(2-ethylsulfonylimidazol[1,2-a]pyridin-3ylsulfonyl)-3-(4,6-dimethoxy pyrimidin-2yl)urea	None
nicosulfuron	2-[[[(4-dimethoxy pyrimidin-2-yl)aminocarbonyl]aminosulfonyl]-N,N-dimethyl-3-pyridine carboxamide	Accent

paraquat	1,1'-dimethyl-4,4'-bipyridinium ion	Gramoxone Cyclone
pendimethalin	N-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine	Prowl
phenmedipham	3-[(methoxycarbonyl)amino]phenyl(3-methylphenyl) carbamate	Betanal
picloram	4-amino-2,5,6-trichloro-2-pyridinecarboxylic acid	Tordon 22K
primisulfuron	2-[[[(4,6-difluoromethoxy)-2-pyrimidinyl]amino] carbonyl]sulfonyl]benzoic acid	Beacon
propazine	6-chloro-N,N'-bis(1-methylethyl)-1,3,5-triazine-2,4-diamine	Milogard
prosulfuron	1-(4-methoxy-6-methyl-triazin-2-yl)-3-[2-(3,3,3-trifluoropropyl)-phenylsulfonyl]urea	Peak
pyridate	0-(6-chloro-3-phenyl-4-pyridazinyl-5-octyl-carbamothioate	Tough
quinclorac	3,7-dichloro-8-quinoline carboxylic acid	Facet
quizalofop	(±)-2-[4-[(6-chloro-2-quinoxalinyloxy] phenoxy]propanoic acid	Assure II
rimsulfuron	N((4,6-dimethoxy pyrimidin-2-yl)aminocarboxyl)-3-[(ethylsulfonyl)-2-pyridine sulfonamide	Matrix
sulfentrazone	N-(2,4-dichloro-5-[4-(difluoromethyl)-4,5-dihydro-3-methyl-5-oxo-1H-1,2,4-triazol-1-yl-phenyl]methanesulfonamide	Spartan Authority
sulfosate	N-(phosphonomethyl)glycine sulfonium salt	Touchdown
thifensulfuron	3-[[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl) amino]carbonyl]amino]sulfonyl]-2-thio-phenylcarboxylic acid	Harmony
trakloxydim	2-[1-(ethoxyimino)propyl]-3-hydroxy-5-mesitylcyclo-hex-2-ene	Achieve
triasulfuron	N-(6-methoxy-4-methyl-1,3,5-triazin-2-yl-aminocarbonyl-2-(2-chloroethoxy)benzene-sulfonamide	Amber
ribenuron	methyl-2-[[[N-(1,3,5-triazin-2-yl)methylamino] carbonyl]amino]sulfonyl]benzoate	Express
trifluralin	2,6-dinitro-N,N-dipropyl-4-(trifluoromethyl) benzenamine	Treflan
triflurosulfuron	2-[[[[[(4-dimethylamino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl]amino]carbonyl]amino]sulfonyl]-3-methyl benzoic acid	Up-Beet

Research Project**Cercospora Management in Sugar Beet with Foliar Fungicide Programs, 1999****Research Team**

Tel: 307-766-2397

FAX: 766-5549

francg@uwyo.edu

G.D. Franc, W.L. Stump, and S.C. Briere

University of Wyoming, Dept. of Plant Sciences

P.O. Box 3354 (16th & Gibbon Streets)

Laramie, WY 82071-3354

Field Plot Location

Torrington Research & Extension Center @ Torrington, WY.
4104 ft MSL; sandy loam soil; overhead irrigation

Plot Design

RCBD with 4 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.

Plot Management

Planting Date: 6 May.

Variety: Monohikori

Fertilizer: 150 lbs N + 50 lbs P₂O₅

Herbicide: Post emergence applications of Betamix + Upbeet (32 + 0.5 oz product) on 25 May.

Disease Development

Natural: Scattered Cercospora lesions were first noted on 9 August.

Artificial: Sugar beet seedlings were inoculated with a Cercospora isolate (sensitive to benzimidazole and triphenyltin hydroxide), lesions developed, and then seedlings were transplanted into treatment plot spreader rows. One inoculated plant was transplanted per treatment plot on 11 August.

Treatment Applications

Foliar applications were initiated for all treatments on 12 August. The spray dates are summarized in the Tables. Fungicides were applied with the aid of a portable (CO₂) sprayer in a total volume of 43 gal/A @ 30 psi boom pressure (four #8004 flat fan nozzles spaced @ 20 inches). A description of chemicals tested can be found in Appendix 1.

Disease Ratings

Cercospora lesion counts were determined on 11 August, 26 August, and 9 September. The lesions on 10 leaves per plot were counted.

Harvest

Two rows X 5 ft were harvested on 1 October. The sucrose (%) and nitrate levels were determined by Holly Sugar's laboratory.

Statistical Analysis

ANOVA with four replications. Mean separations were done using Fisher's protected LSD ($P \leq 0.05$). All disease data were transformed (\log_{10}) to correct for non-homogeneity prior to analysis. Lesion count data prior to transformation are presented in Table 1. Means presented for the AUDPC are the anti-log of the transformed data.

Results and Discussion

Cercospora disease development was light to moderate during 1999. Data from 9 September reveals that most fungicide programs significantly reduced the number of *Cercospora* lesions per leaf, compared to the two nontreated checks ($P \leq 0.05$). Treatments had no significant effect on root yield and quality ($P \leq 0.05$).

Table 1. The effect of foliar fungicide programs on *Cercospora* disease progression (G.D. Franc, et al., U of WY; 1999).

Treatment and Application Rate (lb a.i./ acre)	Application dates ¹	No. of <i>Cercospora</i> lesions per leaf		AUDPC ²
		26 Aug	9 Sep	
1. Nontreated Check	A-G	16.6 a ³	33.6 a	282 abc
2. Stratego (0.13)	A, D, G	4.9 a	2.9 cde	41 fg
2. Super Tin (0.125)	B, E			
3. Stratego (0.16)	A, D, G	2.2 a	3.7 b-e	55 d-g
3. Super Tin (0.125)	B, E			
4. Topsin M (0.35)	D	18.8 a	5.3 b-e	200 a-d
4. Super Tin (0.19)	A, G			
5. Topsin M (0.35)	G	18.1 a	14.8 ab	309 ab
5. Super Tin (0.19)	A, D			
6. Topsin M (0.35)	E	6.3 a	4.4 b-e	76 b-g
6. Super Tin (0.25)	A			
7. Penncozeb (1.5)	A, B, D, E, G	12.0 a	7.7 b-e	112 a-g
8. Penncozeb (1.5)	A, B	3.3 a	1.7 cde	45 ef
8. Super Tin (0.19)	D			
8. Topsin M (0.35)	G			
9. Penncozeb (1.5)	E	6.5 a	5.7 b-e	60 d-g
9. Super Tin (0.25)	A, G			
10. Quadris (0.14)	A, D, G	21.6 a	15.0 b-e	182 a-e
11. Quadris (0.1)	A, F	7.1 a	7.5 cde	79 a-g
11. Bravo Zn (1.5)	D			

Treatment and Application Rate (lb a.i./ acre)	Application dates ¹	No. of Cercospora lesions per leaf		AUDPC ²
		26 Aug	9 Sep	
12. Quadris (0.15)	A, F	7.4 a	11.6 abc	91 a-g
12. Bravo Zn (1.5)	D			
13. Bravo Zn (1.5)	A, F	9.6 a	3.5 cde	148 a-f
13. Quadris (0.15)	C			
14. Bravo Zn (1.5)	A, C, E, G	3.1 a	2.6 cde	68 c-g
15. Quadris (0.1)	A, F	8.0 a	4.7 b-e	102 a-g
15. Super Tin (0.15)	D			
16. Quadris (0.15)	A, F	17.0 a	7.5 a-d	275 abc
16. Super Tin (0.15)	D			
17. Super Tin (0.15)	A, C, E, G	25.4 a	6.9 b-e	316 ab
18. Bravo Zn + Super Tin (0.75 + 0.1) . . .	A, F	6.6 a	9.8 a-d	123 a-g
18. Quadris (0.1)	D			
19. Super Tin (0.25)	A, D, G	11.3 a	6.9 b-e	186 a-e
20. RH-7592 + crop oil conc (0.167 + 1 pt product/A)	A, D, G	2.3 a	3.0 cde	49 d-g
21. RH-7592 + Dithane DF NT (0.125 + 1.5)	A, D, G	10.8 a	2.5 de	138 a-g
22. Nontreated Check	A-G	33.1 a	37.3 a	331 a
23. Agri Tin (0.125)	A, F	3.7 a	3.9 b-e	48 d-g
23. Dithane DF NT (0.75)	D			
24. Benlate (0.25)	A	4.0 a	1.3 e	34 g
24. Super Tin (0.25)	B, E			

¹ Application dates: A=8/12, B=8/18, C=8/24, D=8/26, E=9/1, F=9/8, and G=9/9.

² Area under the disease progress curve for data collected 11 August through 9 September. Data presented are the anti-log of transformed data (\log_{10}).

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

Table 2. The effects of foliar fungicides on sugar beet yield and quality (G.D. Franc, et al., U of WY; 1999).

Treatment and Application Rate (lb a.i./ acre)	Application dates ¹	Beet number (per 10 ft)	Beet yield (lbs per 10 ft)	% total sucrose	Nitrate (PPM)
1. Nontreated Check	A-G	24 a ²	27.7 a	15.8 a	116 a
2. Stratego (0.13)	A, D, G	19 a	23.1 a	16.7 a	138 a
2. Super Tin (0.125)	B, E				
3. Stratego (0.16)	A, D, G	18 a	25.3 a	16.7 a	90 a
3. Super Tin (0.125)	B, E				
4. Topsin M (0.35)	D	18 a	27.8 a	15.9 a	133 a
4. Super Tin (0.19)	A, G				
5. Topsin M (0.35)	G	19 a	26.3 a	16.3 a	117 a
5. Super Tin (0.19)	A, D				
6. Topsin M (0.35)	E	22 a	29.1 a	16.6 a	161 a
6. Super Tin (0.25)	A				
7. Penncozeb (1.5)	A, B, D, E, G	18 a	27.3 a	16.1 a	144 a
8. Penncozeb (1.5)	A, B	20 a	27.3 a	16.1 a	139 a
8. Super Tin (0.19)	D				
8. Topsin M (0.35)	G				
9. Penncozeb (1.5)	E	17 a	24.0 a	16.3 a	94 a
9. Super Tin (0.25)	A, G				
10. Quadris (0.14)	A, D, G	22 a	29.5 a	16.8 a	94 a
11. Quadris (0.1)	A, F	22 a	25.4 a	15.7 a	133 a
11. Bravo Zn (1.5)	D				
12. Quadris (0.15)	A, F	20 a	31.4 a	16.1 a	169 a
12. Bravo Zn (1.5)	D				
13. Bravo Zn (1.5)	A, F	24 a	26.5 a	14.4 a	135 a
13. Quadris (0.15)	C				
14. Bravo Zn (1.5)	A, C, E, G	19 a	29.8 a	15.6 a	168 a
15. Quadris (0.1)	A, F	21 a	32.5 a	16.1 a	132 a
15. Super Tin (0.15)	D				
16. Quadris (0.15)	A, F	22 a	31.0 a	16.5 a	106 a
16. Super Tin (0.15)	D				
17. Super Tin (0.15)	A, C, E, G	17 a	23.0 a	16.5 a	112 a
18. Bravo Zn + Super Tin (0.75 + 0.1) . . .	A, F	21 a	28.5 a	16.6 a	93 a
18. Quadris (0.1)	D				

Treatment and Application Rate (lb a.i./ acre)	Application dates ¹	Beet number (per 10 ft)	Beet yield (lbs per 10 ft)	% total sucrose	Nitrate (PPM)
19. Super Tin (0.25)	A, D, G	19 a	28.7 a	16.4 a	124 a
20. RH-7592 + crop oil conc (0.167 + 1 pt product/A)	A, D, G	22 a	27.9 a	16.5 a	132 a
21. RH-7592 + Dithane DF NT (0.125 + 1.5)	A, D, G	20 a	27.3 a	16.4 a	162 a
22. Nontreated Check	A-G	23 a	31.5 a	16.6 a	120 a
23. Agri Tin (0.125)	A, F	18 a	25.1 a	16.3 a	142 a
23. Dithane DF NT (0.75)	D				
24. Benlate (0.25)	A	19 a	27.8 a	16.0 a	107 a
24. Super Tin (0.25)	B, E				

¹ Application dates: A=8/12, B=8/18, C=8/24, D=8/26, E=9/1, F=9/8, and G=9/9.

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

Appendix 1. Chemicals tested.

<u>Product</u>	<u>Manufacturer</u>	<u>Composition</u>
Stratego 2.08EC	Novartis Crop Protection, Inc. P.O. Box 18300 Greensboro, NC 27419	Information not provided
Bravo Zn 4.17F	Zeneca Inc. Agricultural Products 1800 Concord Pike Wilmington, DE 19897	38.5% Chlorothalonil
Quadris 2.08SC Super Tin 80WP	Zeneca Inc. Agricultural Products Griffin Corporation P.O. Box 1847 Valdosta, GA 31603-1847	22.9% Azoxystrobin 80% Triphenyltin Hydroxide
Penncozeb 75DF	Elf Atochem North America, Inc. 2000 Market Street Philadelphia, PA 19103-3222	75 % Mancozeb
Topsin M 70W Dithane 75DF NT	Elf Atochem North America, Inc. Rohm and Haas Co. 100 Independence Mall West Philadelphia, PA 19106-2399	70% Thiophanate-methyl 75% Mancozeb
RH-7592 75WP Agri Tin 80WP	Rohm and Haas Co. Agtrol International 7322 S.W. Freeway, Suite 1400 Houston, TX 77074	Information not provided 80% Triphenyltin Hydroxide
Benlate 50DF	Dupont Agricultural products Wilmington, DE 19898	50% Benomyl methyl

Research Project	AgriTin Rainfast Trial, 1999
Research Team Tel: 307-766-2397 FAX: 766-5549 francg@uwyo.edu	G.D. Franc and W.L. Stump University of Wyoming, Dept. of Plant Sciences P.O. Box 3354 (16 th & Gibbon Streets) Laramie, WY 82071-3354
Field Plot Location	Torrington Research & Extension Center @ Torrington, WY. 4104 ft MSL; sandy loam soil; overhead irrigation
Plot Design	RCBD with 4 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.
Plot Management	Planting Date: 26 May. Variety: HM-RH3 (mono-hy) Fertilizer: 150 lbs N + 50 lbs P ₂ O ₅
Disease Development	Natural: Scattered light Cercospora lesions were first noted on 24 August. Cercospora disease development was light to moderate during 1999.
Treatment Applications	Foliar applications were made on 24 August. Plots were sprayed twice with a half rate concentration of the a.i. to provide for maximum foliar coverage. Fungicides were applied with the aid of a portable (CO ₂) sprayer in a volume of 43 gal/A @ 30 psi boom pressure (four #8004 flat fan nozzles spaced @ 20 in). Therefore, the total volume applied was to each plot was 86 gal/A.
Data Collection and Disease Ratings	Leaves from the middle canopy (10 per plot) were collected for residue analysis on 24, 26, and 27 August. Leaves were placed into plastic bags and kept cool and dry during shipping. These collection dates corresponded to; several hours after fungicide applications (spray residue was evident on leaves), after 0.15 inch natural rain, and after an additional 0.75 inch from overhead irrigation (0.9 inch total water since fungicide application). Cercospora lesion counts were determined on 16 September. The lesions on 10 leaves per plot were counted.
Harvest	None taken.
Statistical Analysis	ANOVA with four replications. Mean separations were done using Fisher's protected LSD ($P \leq 0.05$).

Results and Discussion

It was reported that all leaf assays failed to detect triphenyltin hydroxide residues for any of the treatments on any of the collection dates. However, data from 16 September reveals that all fungicide programs significantly reduced the number of *Cercospora* lesions per leaf, compared to the nontreated checks ($P \leq 0.05$). Evidently, sufficient residue remained to suppress *Cercospora* development. Also, visible residues were present on leaves at the time the first leaf collection.

Table 1. The effects of various formulations of triphenyltin hydroxide on *Cercospora* disease development (G.D. Franc and W.L. Stump, U of WY; 1999).

Treatment and Application Rate (a.i./ acre)	Formulation	No. of <i>Cercospora</i> lesions per leaf
		16 Sep
1. Nontreated Check	NA	39.1 a*
2. Super Tin 80WP (4 oz)	Current formulation	5.6 b
3. AgriTin 80WP (4 oz)	Current formulation	10.2 b
4. AgriTin 80WP (4 oz)	Old formulation	5.4 b
5. AgriTin 80WP (4 oz)	50/50 mix of current and old	7.3 b
6. AgriTin 4F (4 oz)	Flowable formulation	6.8 b

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