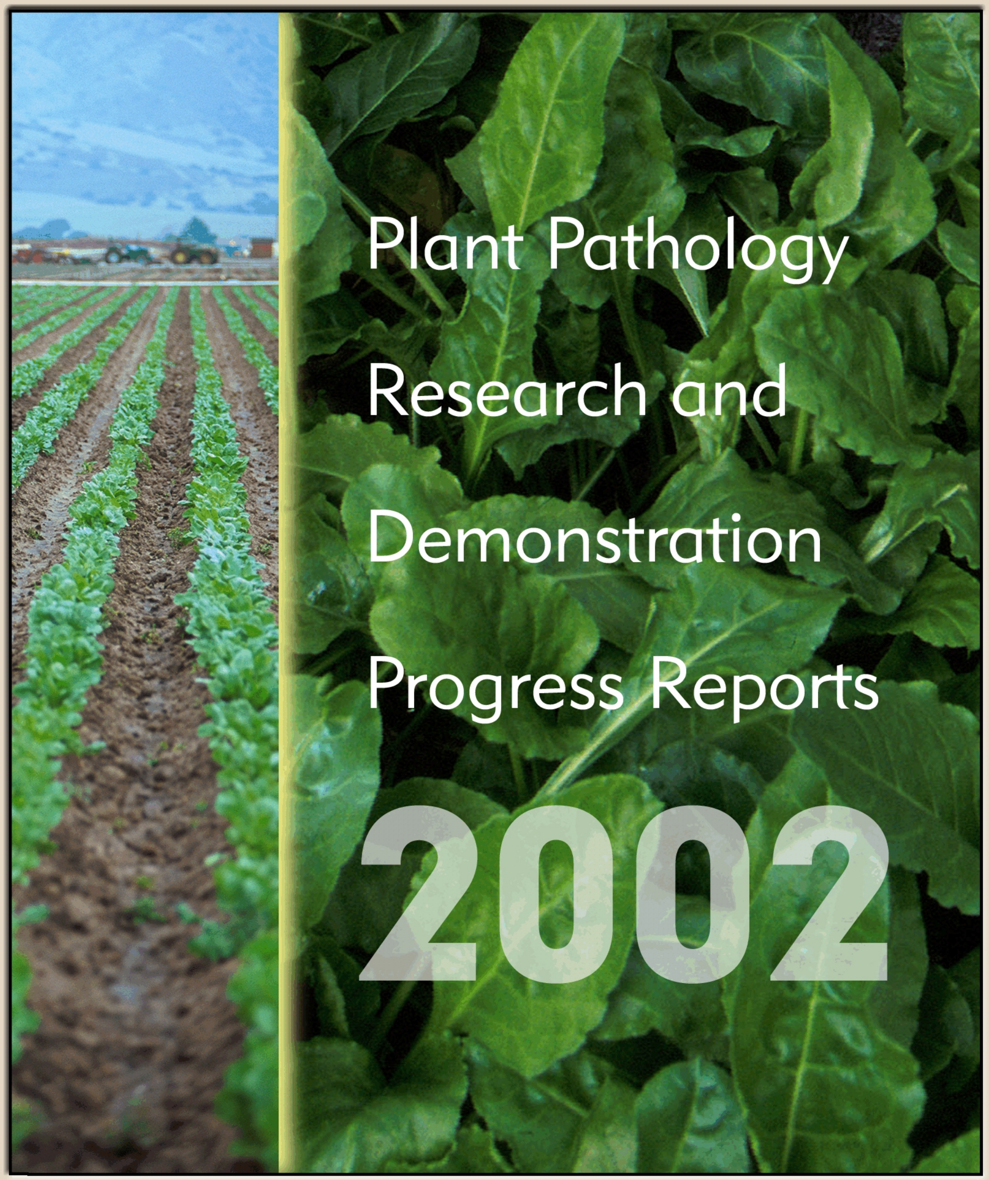

Plant Pathology Research and Demonstration Progress Reports 2002

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

This publication is available online at www.uwyo.edu/ces/plantsci.htm. Questions regarding this publication may be answered by calling (307) 766-2397 or by e-mailing FrancG@uwyo.edu.

University of Wyoming
Agricultural Experiment Station

MP101-03

2002 Plant Pathology Research and Demonstration Progress Reports

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

Additional copies are available by contacting telephone 307-766-2397, or by e-mail to: FrancG@uwyo.edu. This report also will be published during the spring of 2003 as MP101-03 and will be available online from the University of Wyoming Plant Sciences website at: www.uwyo.edu/ces/plantsci.htm.

Table of Contents

Research Project	**Management of Potato Foliar and Tuber Diseases with Foliar Fungicide Programs, 2002**
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**: 14 May. **Variety**: Atlantic. **Fertilizer**: 130 lb N + 60 lb P_2O_5 on 6 May. **Herbicide**: Eptam + Prowl (3 pt + 1.2 pt product) PRE on 16 May. **Insecticide**: Asana (4 fl oz product) on 28 June for Colorado potato beetle. **Harvest Date**: 24 September, two rows X 10 feet were harvested.
Disease Development	Early blight development was from natural inoculum and the first typical foliar lesions were observed on 6 August. Late blight was not detected during the growing season.
Treatment Applications	Treatments targeting post-harvest tuber disease management via applications of FAC-321 or Ridomil Gold (treatments 12 and 13, respectively) were made on 3 and 17 July. The Load application (treatment 14) also was made on 3 July. Treatments for foliar disease management consisted of spray programs initiated on 17 July and application dates are indicated in the Tables. Fungicides were applied with the aid of a portable (CO_2) sprayer in a total volume of 43 gal/A @ 30 psi boom pressure (four #8004 flat fan nozzles spaced @ 20 inches).

Disease and other Treatment Ratings

Early blight disease severity was measured by calculating the average number of lesions per leaflet for leaves collected on 16, 24, 30 July, 6, 13, 21, 27 August, and 3 and 10 September. Six leaves were randomly selected from each treatment plot (two leaves each from the top, middle, and bottom third of the canopy) and the number of early blight lesions, on up to seven leaflets from each leaf, was counted. Data from the last four data collection dates are summarized in Table 1. Disease severity data from 6 August to 10 September were used to calculate an area under the disease progress curve (AUDPC) rating for each treatment program. The AUDPC is a measure of season long disease severity for each treatment. Plots were visually rated using the Horsfall-Barratt scale (0-11) to estimate the percentage of foliar necrosis (combined effects of disease and senescence) on 4 and 11 September. Data from 11 September is shown in Table 1.

Harvest

Treatments 1, 12 and 13 were carefully dug by hand on 19 September to avoid tuber injury that would affect the tuber bioassay for fungicide presence in tubers. Two rows X 10 ft were dug, and tubers were sorted and weighed to determine yield and grade. A 50-tuber (US#1) per replicate subsample was collected for bioassay. The remainder of the treatments were dug with a one-row mechanical digger (two rows X 10 ft) on 24 September, and tubers were sorted and weighed by grade. All yield data are summarized in Table 2.

Tuber Bioassay for Pink Rot Suppression by Foliar FAC 321 and Ridomil Gold

Tuber bioassays conducted to determine susceptibility to the pink rot fungus (*Phytophthora erythroseptica*) were done in Gary Secor's laboratory at NDSU, Fargo, ND. Forty tubers per replicate from treatments 1, 12, and 13 were inoculated with the pink rot fungus and disease incidence was recorded following their standard protocol. Because the pink rot bioassay successfully indicated fungicide accumulation in tubers harvested from the plots, bioassay by the late blight fungus (*Phytophthora infestans*: US1) was deemed unnecessary.

Statistical Analysis

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

Results and Discussion

Early blight disease development was light to moderate during 2002 and significance among treatments was not observed until 27 August. Late blight was not detected in the plots and phytotoxicity was not observed for any of the fungicide programs. Potato plants in the plots appeared to develop senescence normally.

Although significance among treatments for early blight disease severity was not observed until 27 August, it was not until 3 September that most fungicide programs significantly reduced the average number of early blight lesions per leaflet compared to the nontreated check (Table 1, $\underline{P} \leq 0.05$). The application of Load (treatment 14) resulted in disease severity on 3 September that was significantly greater than that measured in the nontreated check ($\underline{P} \leq 0.05$). Load is not a fungicide, but, instead, treatment with Load is reported to affect nitrogen distribution in the plant: nitrogen deficient foliage is more susceptible to early blight. All treatments except Load (treatment 14), significantly reduced season long disease severity (AUDPC) compared to the nontreated check ($P \leq 0.05$). Lack of further differentiation among fungicide programs for disease suppression was likely due to the low disease pressure. Most fungicide programs significantly reduced foliar necrosis on 11 September compared to the nontreated check ($\underline{P} \leq 0.05$).

Treatment effects on yield and quality are shown in Table 2. Total yield was not significantly affected by treatment ($\underline{P}=0.05$), however there was a trend in the data of greater total yield for all treatments compared to the nontreated check. Significant treatment differences in tuber quality were found within the US#1 and culls categories ($\underline{P} \leq 0.05$). The nontreated control and the FAC 321 and Ridomil Gold treatments for post-harvest tuber disease management (treatments 12 and 13) had significantly greater yields in the US#1 >10 oz tuber category than all other treatments ($\underline{P} \leq 0.05$). The majority of fungicide programs also resulted in greater yields in the US#1 <10 oz tuber category compared to the nontreated check ($\underline{P} \leq 0.05$).

Results for the tuber bioassays are shown in Table 3. The tuber bioassay tested for the presence of fungicide in tubers via a challenge inoculation with mefenoxam/metalaxyl sensitive isolates of the pink rot fungus (*Phytophthora erythroseptica*). Tuber inoculations with the pink rot fungus resulted in 30.6 % of the tubers becoming infected for the nontreated check. In contrast, FAC 321 and Ridomil Gold (treatments 12 and 13, respectively) significantly reduced tuber infection compared to the nontreated check ($\underline{P} \leq 0.05$). FAC 321 and Ridomil Gold provided equal levels of tuber protection with 5.6% of inoculated tubers developing symptoms ($\underline{P} \leq 0.05$). Therefore, FAC 321 and Ridomil Gold treatments had approximately 82% less disease than did the nontreated check.

Table 1. Effects of foliar fungicide programs on foliar potato disease (G.D. Franc and W.L. Stump, U of WY; 2002).

Treatment and application rate (a.i/acre)	Application dates [1]	Early blight lesions per leaflet				AUDPC [2]	% foliar necrosis
		21 Aug	27 Aug	3 Sep	10 Sep		11 Sep
1. Nontreated check	NA	0.04 a [3]	0.01 bc	2.90 b	5.64 a	40.33 b	59.5 ab
2. Equation Contact 68.8WG (11 oz)	B	0.00 a	0.00 c	0.04 c	0.06 b	0.52 c	29.5 c
2. Equation Contact 68.8WG (16.5 oz)	C-H						
3. Equation Contact 68.8WG (11 oz)	B	0.01 a	0.02 bc	0.06 c	0.14 b	1.09 c	29.5 c
3. Equation Contact 68.8WG (11 oz)	C-H						
4. Tanos 50WG + Manzate 75WG (3 + 12 oz)	B	0.00 a	0.01 bc	0.05 c	0.05 b	0.65 c	37.0 c
4. Tanos 50WG + Manzate 75WG (4 + 18 oz)	C-H						
5. DPXJE874 50WG + Weather Stik 6F (1.5 + 9 oz)	B	0.01a	0.00 c	0.01 c	0.28 b	1.04 c	38.5 c
5. DPXJE874 50WG + Weather Stik 6F (2 + 12 oz)	C-H						
6. Tanos 50WG + Weather Stik 6F (3 + 9 oz)	B	0.00 a	0.02 bc	0.00 c	0.05 b	0.32 c	38.5 c
6. Tanos 50WG + Weather Stik 6F (4 + 12 oz)	C-H						
7. Weather Stik 6F (18 oz)	B, D, F-H	0.01 a	0.00 c	0.03 c	0.06 b	0.56 c	37.0 c
7. Quadris 2.08SC (1.6 oz)	C, E						
8. Weather Stik 6F (18 oz)	B-H	0.00 a	0.02 bc	0.03 c	0.26 b	1.28 c	23.5 c
9. Echo ZN 4.17F (1.1 lb)	B-H	0.01 a	0.00 c	0.12 c	0.40 b	2.30 c	28.0 c
10. Echo ZN 4.17F + Quadris 2.08SC (0.8 lb + 1.6 oz) . .	B, D	0.00 a	0.01 bc	0.01 c	0.06 b	0.85 c	29.5 c
10. Echo ZN 4.17F (1.1 lb)	C, E, F						
10. Polyram 80WP + Super Tin 80WP (1.6 lb + 3 oz) . . .	G						
10. Echo ZN 4.17F + Polyram 80WP (0.65 + 1.2 lb)	H						
11. Echo ZN 4.17F (1.1 lb)	B, C, E, G	0.00 a	0.01 bc	0.05 c	0.10 b	0.75 c	29.5 c
11. Echo ZN 4.17F + Gem 25WG (1.1 lb + 1.5 oz)	D, F, H						

(Table 1. cont.)

Treatment and application rate (a.i./acre)	Application dates [1]	Early blight lesions per leaflet				AUDPC [2]	% foliar necrosis
		21 Aug	27 Aug	3 Sep	10 Sep		11 Sep
12. FAC 321 2EC + Weather Stik 6F (3.2[4] + 18 oz)	A, B	0.01 a	0.00 c	0.37 c	0.15 b	3.17 c	37.0 c
12. Weather Stik 6F (18 oz)	C-H						
13. Ridomil Gold 4EC + Weather Stik 6F (1.6[4] + 18 oz) .	A, B	0.01 a	0.02 bc	0.14 c	0.45 b	2.77 c	33.0 c
13. Weather Stik 6F (18 oz)	C-H						
14. Load (1.2 gal product)	A	0.02 a	0.08 a	4.19 a	4.87 a	47.69 a	61.5 a
15. Bravo ZN 4.17F (1.1 lb)	B-H	0.01 a	0.02 bc	0.17 c	0.35 b	2.62 c	28.0 c
16. Headline 2.08EC (2.4 oz)	B-H	0.01 a	0.01 bc	0.01 c	0.04 b	0.25 c	29.5 c
17. Gem 25WG (1 oz)	B, D, F, H	0.01 a	0.00 c	0.00 c	0.19 b	0.74 c	33.0 c
17. Weather Stik 6F (18 oz)	C, E, G						
18. Gem 25WG (1.5 oz)	B, D, F, H	0.00 a	0.01 bc	0.05 c	0.21 b	1.29 c	33.0 c
18. Weather Stik 6F (18 oz)	C, E, G						
19. Gem 25WG (2 oz)	B, D, F, H	0.00 a	0.04 b	0.07 c	0.19 b	1.40 c	40.5 bc
19. Weather Stik 6F (18 oz)	C, E, G						
20. BAS 510 70WG (3.2 oz)	B, D, F, H	0.02 a	0.01 bc	0.03 c	0.05 b	0.60 c	38.5 c
20. Weather Stik 6F (18 oz)	C, E, G						

[1] Application dates: A= 3 Jul, B= 17 Jul, C= 24 Jul, D= 31 Jul, E= 7 Aug, F= 14 Aug, G= 21 Aug, H= 28 Aug. NA= not-applicable.

[2] Area under the disease progress curve for data collected from 6 August through 10 September.

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

[4] The active ingredient for FAC 321 is metalaxyl and the active ingredient for Ridomil Gold is mefenoxam.

Table 2. The effects of foliar fungicide programs on potato yield and quality (G.D. Franc and W.L. Stump, U of WY; 2002).

Treatment and application rate (a.i/acre)	Application dates [1]	Yield (cwt)						
		US#1			US#2	Grade B	Cull	Total
		>10 oz	<10 oz	total				
1. Nontreated check	NA	37.67 a [2]	209.27 e	225.15 a	5.26 a	27.59 a	0.00 d	258.00 a
2. Equation Contact (11 oz)	B	7.80 b	266.81 a-d	274.61 a	7.53 a	26.41 a	7.80 cd	316.35 a
2. Equation Contact (16.5 oz)	C-H							
3. Equation Contact (11 oz)	B	11.25 b	317.63 a	328.88 a	3.09 a	20.06 a	11.62 bc	363.64 a
3. Equation Contact (11 oz)	C-H							
4. Tanos + Manzate (3 + 12 oz)	B	7.17 b	251.20 b-e	258.37 a	7.17 a	27.41 a	9.98 bc	302.92 a
4. Tanos + Manzate (4 + 18 oz)	C-H							
5. DPXJE874 + Weather Stik (1.5 + 9 oz)	B	5.36 b	262.09 a-d	267.44 a	4.81 a	20.24 a	13.88 abc	306.37 a
5. DPXJE874 + Weather Stik (2 + 12 oz)	C-H							
6. Tanos + Weather Stik (3 + 9 oz)	B	8.99 b	275.52 abc	284.50 a	2.90 a	25.77 a	9.98 bc	323.16 a
6. Tanos + Weather Stik (4 + 12 oz)	C-H							
7. Weather Stik (18 oz)	B, D, F-H	6.45 b	278.42 abc	284.86 a	2.09 a	20.78 a	21.69 a	329.42 a
7. Quadris (1.6 oz)	C, E							
8. Weather Stik (18 oz)	B-H	4.36 b	319.80 a	324.16 a	7.62 a	24.59 a	10.35 bc	366.72 a
9. Echo ZN (1.1 lb)	B-H	0.00 b	283.68 abc	283.68 a	3.54 a	28.13 a	16.34 abc	331.69 a
10. Echo ZN + Quadris (0.8 lb + 1.6 oz)	B, D	13.34 b	288.59 abc	301.93 a	6.08 a	21.33 a	15.34 abc	344.67 a
10. Echo ZN (1.1 lb)	C, E, F							
10. Polyram + Super Tin (1.6 lb + 3 oz)	G							
10. Echo ZN + Polyram (0.65 + 1.2 lb)	H							
11. Echo ZN (1.1 lb)	B, C, E, G	5.81 b	280.96 abc	286.77 a	2.81 a	26.50 a	11.80 bc	327.88 a
11. Echo ZN + Gem (1.1 lb + 1.5 oz)	D, F, H							

(Table 2. cont.)

Treatment and application rate (a.i/acre)	Application dates [1]	Yield (cwt)						
		US#1			US#2	Grade B	Cull	Total
		>10 oz	<10 oz	total				
12. FAC 321 + Weather Stik (3.2 [3] + 18 oz)	A, B	43.92 a [2]	237.40 cde	281.33 a	0.00 a	26.68 a	0.36 d	308.37 a
12. Weather Stik (18 oz)	C-H							
13. Ridomil Gold + Weather Stik (1.6 [3] + 18 oz)	A, B	38.48 a	207.09 de	245.57 a	4.90 a	29.58 a	0.18 d	280.24 a
13. Weather Stik (18 oz)	C-H							
14. Load (1.2 gal product)	A	2.82 b	240.31 cde	243.12 a	2.45 a	23.32 a	13.34 abc	282.23 a
15. Bravo ZN (1.1 lb)	B-H	3.63 b	312.72 ab	316.35 a	1.45 a	25.32 a	14.52 abc	357.65 a
16. Headline (2.4 oz)	B-H	5.99 b	294.76 abc	300.75 a	5.81 a	20.24 a	12.25 bc	339.04 a
17. Gem (1 oz)	B, D, F, H	8.81 b	241.40 cde	250.20 a	8.44 a	15.97 a	8.44 cd	283.05 a
17. Weather Stik (18 oz)	C, E, G							
18. Gem (1.5 oz)	B, D, F, H	15.88 b	281.14 abc	297.02 a	2.54 a	28.40 a	15.06 abc	343.04 a
18. Weather Stik (18 oz)	C, E, G							
19. Gem (2 oz)	B, D, F, H	8.62 b	266.44 a-d	275.06 a	8.98 a	25.77 a	18.69 ab	328.52 a
19. Weather Stik (18 oz)	C, E, G							
20. BAS 510 70WG (3.2 oz)	B, D, F, H	0.00 b	243.94 cde	243.94 a	6.35 a	18.51 a	11.53 bc	280.33 a
20. Weather Stik 6F (18 oz)	C, E, G							

[1] Application dates: A= 3 Jul, B= 17 Jul, C= 24 Jul, D= 31 Jul, E= 7 Aug, F= 14 Aug, G= 21 Aug, H= 28 Aug. NA= not-applicable.

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

[3] The active ingredient for FAC 321 is metalaxyl and the active ingredient for Ridomil Gold is mefenoxam.

Table 3. The effects of foliar applications of Ridomil Gold and FAC 321 on post harvest infection by the pink rot fungus (*Phytophthora erythroseptica*) (G.D. Franc and W.L. Stump, U of WY; 2002).

Treatment and application rate (a.i/acre)	Application dates [1]	% of inoculated tubers that developed symptoms during the bioassay [2]
1. Nontreated check	NA	30.6 a [3]
12. FAC 321 + Weather Stik (3.2 [4] + 18 oz)	A, B	5.6 b
12. Weather Stik (18 oz)	C-H	
13. Ridomil Gold + Weather Stik (1.6 [4] + 18 oz) .	A, B	5.6 b
13. Weather Stik (18 oz)	C-H	

1 Application dates: A= 3 Jul, B= 17 Jul, C= 24 Jul, D= 31 Jul, E= 7 Aug, F= 14 Aug, G= 21 Aug, H= 28 Aug. NA= non-applicable.

2 Forty tubers per replication were inoculated with *Phytophthora erythroseptica* and rated for disease incidence following incubation. The bioassay was performed in Gary Secor's laboratory at NDSU, Fargo, ND.

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

4 The active ingredient for FAC 321 is metalaxyl and the active ingredient for Ridomil Gold is mefenoxam.

Research Project	**Rhizoctonia Root and Crown Rot Management with Banded Fungicide Applications to Sugar Beet, 2002**
Research Team Tel: 307-766-2397 FAX: 307-766-5549 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 (30-in row centers) X 20 ft; 5 ft in-row buffer. Fungicide treatments were made to, and all data were collected from, the center two rows of each plot.
Plot Management	**Planting Date**: 18 April, replanted 14 May. **Variety**: Monohikari **Fertilizer**: 150 lb N + 50 lb P_2O_5 **Herbicide**: Preplant application of Roundup (0.5 qt product/A) on 14 May. Post-emergence applications of Progress + Stinger + Select (17 fl oz + 5.0 fl oz + 8 fl oz product/A) on 28 May, Progress + Upbeet + Select (20 fl oz + 0.5 oz + 8 fl oz product/A) on 6 June, and Progress + Select (20 fl oz + 8 fl oz product/A) on 14 June.
Disease Development	Immediately following the first fungicide applications on 21 June, inoculum (0.25 tsp = 0.8 g) was applied to the crown of each plant in the two center rows of each plot. Plants were in the 6 to 10 leaf growth stage when inoculated. Immediately after inoculation, plots were cultivated then watered with 0.75 inches of water and once again on 24 June to favor infection. Inoculum was prepared from cultures of *Rhizoctonia solani* AG2-2 isolates grown on winter wheat, followed by air-drying and grinding. Inoculum used in 2002 was extra from the 2001 season and had been stored for approximately 14 months in the freezer.
Treatment Applications	Fungicide (7-inch band) applications were made on 21 June (immediately prior to inoculation), and 5 July (2 weeks later), depending individual treatment protocol. Beets were in the 6-10 leaf-stage on 21 June and the 15 leaf-stage on 5 July. Fungicide was applied with the aid of a backpack sprayer in a total spray volume of 22 gal/A at 50 psi boom pressure. The boom was equipped with a single #8002 flat fan nozzle.

Disease Ratings Rhizoctonia crown rot **incidence** was rated for both center rows (2 x 10 ft) on 10 and 16 July. Infected beets were those that had rapidly wilting leaves, darkened petioles and/or decayed crowns evident with necrotic leaves present. Visual estimates of disease severity (the percentage of canopy necrosis following petiole infection and leaf collapse) were made on 31 July, 13, 22 August, and 11 September. At harvest, both Rhizoctonia **severity** and **incidence** were rated from the 2 row x 5 ft subsample dug to determine yields (see below). Disease severity was determined by visually estimating the surface area of beet root affected by decay while disease incidence was the percentage of roots with any visible amount of decay.

To assess the residual effects of fungicide treatments on Cercospora leaf spot suppression, five leaves per plot were collected on 27 August and the average number of lesions per leaf was determined.

Harvest A 5-foot section in the middle of each of the two inoculated rows was dug on 3 October and total root yields were determined. The percentage of total sucrose was determined by Western Sugar's laboratory.

Statistical Analysis ANOVA with four replications. Mean separations were done using Fisher's protected LSD ($\underline{P} \leq 0.05$). Because of severe disease some treatment plots had no beets available for disease and sucrose evaluation at harvest. Therefore, statistical analysis of disease incidence, disease severity and the percentage of total sucrose at harvest was not performed. Therefore, treatment means in Table 2 for these variables represent the averages of replicates where data collection was possible.

Results and Discussion

Rhizoctonia root and crown rot (RRCR) quickly developed after inoculation and symptoms were visible in the plots by early July. The unusually rapid disease development observed in 2002 suggested that infection occurred during a short period of time, most likely because highly favorable (i.e., unusually warm) conditions for infection occurred during late June and early July. The first RRCR symptoms observed in the plots were rapidly wilting leaves with darkened petioles. Most plants in the nontreated control plots were dead by late July, indicating severe disease development in 2002 and a rigorous test of fungicide efficacy.

Treatment effects on RRCR incidence during the growing season are summarized in Table 1. By 10 July, all fungicide treatments significantly reduced RRCR incidence ($P \leq 0.05$). As RRCR development continued, differences among treatments became more evident. Topsin M treatments generally had greater disease incidence than did most strobilurin fungicide class treatments (Quadris, Gem, and Headline). Disease suppression afforded by split (half-rate) applications of a fungicide made at inoculation and 2 wk later did not differ from the single full-rate application of the same fungicide made at the time of inoculation ($P=0.05$). Disease suppression by Headline applied 2 wk after inoculation (treatment 11) did not differ significantly from the nontreated control, in sharp contrast to the same rate of Headline applied at the time of inoculation (treatment 10: $P \leq 0.05$). Therefore, results for treatments 10 and 11 reveal that most infection occurred shortly after inoculation and that fungicide applications made 2 wk (on 5 July) after inoculation contributed very little to season-long disease suppression. Therefore, the first fungicide application for split application treatments 6, 7, 8, and 9 contributed most to disease suppression compared to the second application of the split treatments. Disease severity as measured by the loss of canopy (percentage of canopy necrosis) showed treatment relationships similar to those observed for disease incidence data.

Fungicide applied for RRCR suppression had no significant residual effect on Cercospora leaf spot (CLS) development (Table1: $P=0.05$). Although RRCR destroyed the nontreated check and CLS data could not be collected, nearby plants evaluated for CLS severity revealed a range of 0.45 to 4.05 Cercospora lesions per leaf, which was similar to the range (0.3 to 3.2 lesions per leaf) measured in plots treated for RRCR suppression. The absence of residual fungicide effects on Cercospora leaf spot suggests that fungicide applications made for RRCR suppression would not appreciably impact programs for fungicide resistance management in the Cercospora population.

Disease incidence (percentage of symptomatic beet roots) and disease severity (surface area of the beet root decayed) of harvested beet roots are shown in Table 2. Data need to be interpreted cautiously since treatments with high disease incidence during the growing season had few beet roots available for evaluation at the time of harvest and, therefore, an ANOVA was not possible. However, the number of replications contributing to each treatment mean is presented in the Table to provide information on sample size.

Effects of fungicide applications on sugar beet root yield and quality (sucrose percentage) also are shown in Table 2. Strobilurin class fungicide treatments that included a fungicide application made at the time of inoculation resulted in the greatest yields ($P \leq 0.05$). Topsin M treatments generally improved yields compared to the nontreated control but only Topsin M treatment 3 (Topsin M @ 0.364 oz ai/1000 ft row) significantly increased yields compared to the nontreated control ($P \leq 0.05$). An ANOVA for the percentage of sucrose was not possible due to a small sample size in some plots. Increases in the percentage of sucrose in harvested roots following fungicide treatment ranged from 2X (Topsin M low rate) to 4X (Quadris) compared to the nontreated check.

Results indicate that under conditions favorable for severe disease development, properly-timed banded application of strobilurin fungicides provided excellent season-long RRCR disease control. Headline treatments 10 and 11 indicate the critical importance of fungicide application timing relative to the time when inoculum is introduced onto the beet crown. Cultivation introduces contaminated field soil onto the beet crown and this is believed to be the time when most inoculations of sugar beet occur under natural field conditions. Topsin M applications resulted in early season RRCR suppression but did not provide season-long control. However, Topsin M may provide a suitable alternative for strobilurin under less severe and more normal disease pressure, or as a tank-mix partner or in rotation with strobilurin fungicide. Evaluation of CLS late in the season suggests little exposure of the Cercospora population would occur in the High Plains following early season applications of fungicide for RRCR suppression.

Table 1. Effects of banded fungicide applications on Rhizoctonia root and crown rot management (G.D. Franc and W.L. Stump, University of Wyoming; 2002).

Treatment	Timing and application rate (oz ai/1000 ft row)[1]	Disease incidence (# symptomatic plants per 20 row ft)		Disease severity (percentage of canopy necrosis)				Cercospora lesions per leaf
		10 July	16 July	31 July	13 Aug	22 Aug	11 Sep	27 Aug
1. Nontreated Control	NA	20.9 a [2]	39.6 a	89.8 a	97.0 a	98.0 a	98.5 a	NA [3]
2. Topsin M 70WP	at inoculation (0.2345)	7.8 cd	19.4 b	45.0 bc	69.0 bcd	72.8 c	85.5 b	1.0 a
3. Topsin M 70WP	at inoculation (0.364)	4.5 def	12.5 bc	40.5 c	64.0 cd	79.8 bc	79.8 b	3.2 a
4. Topsin M 70WP	at inoculation (0.469)	6.0 cde	14.3 b	36.0 c	45.0 d	55.0 c	76.5 b	1.8 a
5. Quadris 2.08EC	at inoculation (0.15)	1.4 f	2.1 d	3.0 d	6.0 e	1.5 d	4.8 d	0.7 a
6. Topsin M 70WP 6. Topsin M 70WP	at inoculation (0.2345) 2 weeks after inoculation (0.2345)	9.0 c	17.8 b	59.5 bc	85.5 abc	79.8 bc	85.5 b	1.1 a
7. Quadris 2.08EC 7. Quadris 2.08EC	at inoculation (0.075) 2 weeks after inoculation (0.075)	1.6 f	2.5 d	1.0 d	2.0 e	3.0 d	4.8 d	0.8 a
8. Gem 25WG 8. Gem 25WG	at inoculation (0.075) 2 weeks after inoculation (0.075)	2.5 ef	3.3 d	4.8 d	7.3 e	4.0 d	17.0 cd	0.3 a
9. Headline 2.08EC 9. Headline 2.08EC	at inoculation (0.075) 2 weeks after inoculation (0.075)	3.4 ef	5.8 cd	6.0 d	10.3 e	12.0 d	27.3 c	0.3 a
10. Headline 2.08EC	at inoculation (0.15)	1.5 f	2.8 d	4.0 d	8.5 e	10.3 d	17.0 cd	0.3 a
11. Headline 2.08EC	2 weeks after inoculation (0.15)	14.0 b	36.1 a	76.5 ab	91.5 ab	95.3 ab	97.0 a	0.4 a

[1] All applications were made in a 7-inch banded spray in 22 gal/A @ 50 psi boom pressure. Plants in the two center rows of each treatment plot were inoculated with *Rhizoctonia solani* AG2-2 on 21 June, 2002 immediately after the first fungicide application.

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

[3] Although RRCR destroyed the nontreated check and CLS data could not be collected, nearby plants evaluated for CLS severity revealed a range of 0.45 to 4.05 Cercospora lesions per leaf, similar to the range (0.3 to 3.2 lesions per leaf) measured in plots treated for RRCR suppression.

Table 2. Effects of banded fungicide applications for Rhizoctonia root and crown rot management on beet disease present at harvest and beet root yield and quality (G.D. Franc and W.L. Stump, University of Wyoming; 2002).

Treatment	Timing and application rate (oz a.i./1000ft) [1]	Disease incidence (%) and disease severity at harvest on 3 October [2]			Beet root yield and quality		
		# of replicates evaluated	Symptomatic beets (%)	Surface area of root decayed (%)	# of replicates evaluated	% total sucrose [2]	Beet yield (tons/A)
1. Nontreated Control	NA	2	100	59.5	1	3.7	0.3 c [3]
2. Topsin M 70WP . . .	at inoculation (0.2345)	3	68	46.0	3	8.1	3.0 bc
3. Topsin M 70WP . . .	at inoculation (0.364)	2	51	40.5	2	12.8	6.1 b
4. Topsin M 70WP . . .	at inoculation (0.469)	4	80	50.0	4	11.3	4.2 bc
5. Quadris 2.08EC	at inoculation (0.15)	4	4	3.0	4	14.6	22.6 a
6. Topsin M 70WP . . . 6. Topsin M 70WP . . .	at inoculation (0.2345) 2 weeks after inoculation (0.2345)	4	83	23.5	3	12.3	5.0 bc
7. Quadris 2.08EC . . . . 7. Quadris 2.08EC	at inoculation (0.075) 2 weeks after inoculation (0.075)	4	10	6.0	4	14.5	23.3 a
8. Gem 25WG . . . . 8. Gem 25WG	at inoculation (0.075) 2 weeks after inoculation (0.075)	4	47	31.0	4	12.4	19.0 a
9. Headline 2.08EC . . . 9. Headline 2.08EC . . .	at inoculation (0.075) 2 weeks after inoculation (0.075)	4	37	17.0	4	13.7	18.7 a
10. Headline 2.08EC . .	at inoculation (0.15)	4	27	12.0	4	13.9	18.8 a
11. Headline 2.08EC . .	2 weeks after inoculation (0.15)	2	83	40.5	2	12.2	1.8 bc

[1] All applications were made in a 7-inch banded spray in 22 gal/A @ 50 psi boom pressure. Plants were inoculated with *Rhizoctonia solani* (AG2-2) on 21 June, 2002 immediately after the first fungicide application.

[2] Because of severe disease some treatment plots had no beet roots available for evaluation at harvest. Therefore, these missing data precluded statistical analysis. The number of replicates contributing to each treatment mean is shown. Yield data were analyzed since loss of a replicate due to disease indicated a yield of "0" and, therefore, was not a missing data point.

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

Research Project	**Cercospora Leaf Spot and Powdery Mildew Management in Sugar Beet, 2002**
Research Team Tel: 307-766-2397 FAX: 307-766-5549 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 (30-in row centers) X 20 ft; 5 ft in-row buffer. Fungicide treatments were made to, and all data were collected from, the center two rows of each plot.
Plot Management	**Planting Date**: 18 April, replanted 14 May. **Variety**: Monohikari **Fertilizer**: 150 lb N + 50 lb P_2O_5 **Herbicide**: Preplant application of Roundup (0.5 qt product/A) on 14 May. Post-emergence applications of Progress + Stinger + Select (17 fl oz + 5.0 fl oz + 8 fl oz product/A) on 28 May, Progress + Upbeet + Select (20 fl oz + 0.5 oz + 8 fl oz product/A) on 6 June, and Progress + Select (20 fl oz + 8 fl oz product/A) on 14 June.
Disease Development	On 31 July, two greenhouse-grown plants co-infected with local isolates of *Cercospora beticola* (Cercospora leaf spot fungus) and *Erysiphe polygoni* DC (syn. *E. betae* {Vanha} Weltzien) were transplanted into the buffer row of each treatment plot. The *C. beticola* isolate used was benzimidazole and TPTH sensitive and *E. polygoni* is the causal agent of powdery mildew. Scattered Cercospora lesions were first noted on 6 August and powdery mildew was not evident until early September. Observations of disease in the nearby production area suggested that symptoms of both disease largely resulted from natural inoculum.
Treatment Applications	Foliar fungicide applications indicated as A, B, and C in the tables were made on 7, 14, August, and 4 September respectively. Fungicides were applied with the aid of a portable (CO_2) sprayer in a total volume of 43 gal/A at 30 psi boom pressure (four #8004 flat fan nozzles spaced at 20 inches). Phytotoxicity was not observed in the plots.

Disease Ratings	**Cercospora leaf spot** severity was determined on 6, 13, 27, August, and 3, 10, 17, and 23 September. The lesions present on five leaves per plot were counted and the averages calculated. A portion of the field data is summarized in Table 1. **Rhizoctonia crown rot** incidence was estimated on 27 August (Table 2). Plants in each of the two treated rows were inspected and the percentage of crowns with symptoms was estimated. **Powdery mildew** severity was visually estimated using the Horsfall-Barratt scale on 19 September as a percentage of the visible canopy with signs of disease (Table 2).
Harvest	One 20-ft row of the two treated rows was harvested 4 October and the total root yield was determined. The percentage of total sucrose was determined by Western Sugar's laboratory.
Statistical Analysis	ANOVA with four replications. Most mean separations were done using Fisher's protected LSD ($\underline{P}\leq 0.05$). Beet root yield and quality mean separations were done using Fisher's protected LSD ($\underline{P}\leq 0.10$).

Results and Discussion

Cercospora leaf spot (CLS) development was light to moderate in 2002. Disease development resulted from naturally occurring inoculum and from greenhouse-grown inoculated plants transplanted into the plots. Fungus isolates sensitive to benzimidazole and triphenyltin hydroxide fungicides were used to inoculate these transplants in the greenhouse. Powdery mildew, although present on the sugar beet transplants, did not become evident in the field plots until September. Weather during 2002 was unusually hot and dry and was not particularly conducive for CLS or powdery mildew disease development.

CLS disease severity data collected early in the epidemic, from 6 August to 3 September, revealed no significant differences ($\underline{P}$=0.05) among treatment means (not all data is shown, Table 1). By 10 September, all fungicide programs except the lowest rate of HMO 125 (treatment 11) significantly suppressed CLS lesion development compared to the nontreated check ($\underline{P}\leq 0.05$). For the remainder of the evaluation dates all treatments except the HMO 125 treatment series (treatments 11, 12, and 13) had significantly less CLS lesion development than did the nontreated check ($\underline{P}\leq 0.05$). The AUDPC values for season-long CLS disease severity revealed a trend in the HMO treatment series: increasing application rates resulted in less disease. However, none of the HMO treatments had less disease than the nontreated check and the lowest HMO 125 rate actually had significantly more disease ($\underline{P}\leq 0.05$). The AUDPC value for the Quadris/Eminent program (treatment 7) did not differ from the nontreated check ($\underline{P}$=0.05).

Disease development for powdery mildew during 2002 was light and none of the fungicide programs significantly reduced disease compared to the nontreated check (Table 2: $\underline{P}$=0.05). However, powdery mildew severity data reveal that the two lowest rates of HMO 125 (treatments 11 and 12, respectively) significantly increased powdery mildew compared to the nontreated check ($\underline{P} \leq 0.05$). As expected, there were no treatment effects on Rhizoctonia crown rot incidence (Table 2: $\underline{P}$=0.05).

Treatment effects on sugar beet yield and sugar percentages were not significant at $\underline{P}$=0.05. However, although there was low disease pressure some significant treatment effects were observed at $\underline{P}$=0.10 (Table 3). All fungicide treatments had greater yields compared to the nontreated check even though increases were not always statistically significant. The two higher rates of HMO 125 significantly improved yields compared to the nontreated check, as did several other fungicide programs ($\underline{P} \leq 0.10$). There were no significant treatment affects on sugar percentages ($\underline{P}$=0.05).

The data for HMO 125 is puzzling because it suggests that both CLS and powdery mildew were increased by application of HMO 125. However, it was the lower rates of HMO 125 that tended to result in the greatest amount of disease. If HMO 125 increased disease, as suggested by the data, it is reasonably expected that the highest rates of HMO 125 would result in the greatest amount of disease, not the lower rates as reported herein. That being said, the HMO 125 treatments were not applied in accordance to the protocol. The HMO 125 treatments were to be applied in a low spray volume to simulate applications made by airplane and not at the 43 gallon per acre rate reported herein. Therefore, a separate study was conducted that compared HMO 125 rates with Headline at a low spray volume of 7.3 gallons per acre. Results for low volume applications revealed similar trends for CLS severity and yields: i.e., HMO 125 treatments had greater CLS disease severity and root yields compared to the nontreated check, although differences for all treatments, including Headline, were not significant ($\underline{P}$=0.05). For details see the following report *Cercospora Leaf Spot and Powdery Mildew Management with Low Volume HMO 125 Applications in Sugar Beet, 2002*.

Table 1. Cercospora leaf spot (CLS) management with foliar fungicide programs (G.D. Franc and W.L. Stump, University of Wyoming; 2002).

Treatment and application rate (a.i./acre)	Application dates [1]	Number of Cercospora lesions per leaf					CLS AUDPC [2]
		27 Aug	3 Sep	10 Sep	17 Sep	23 Sep	
1. Nontreated check	NA	0.45 a	5.90 a	23.05 a	27.45 bc	53.75 a	548.0 bc
2. AMS21619A 480SC (2.1 oz)	A , B, C	1.15 a	0.10 a	0.80 b	2.25 c	2.65 c	41.3 d
3. AMS21619A 480SC (2.9 oz)	A, B, C	0.35 a	1.15 a	0.55 b	0.35 c	0.55 c	19.9 d
4. Eminent 125SL (1.7 oz) . . .	A, B, C	0.25 a	0.50 a	1.60 b	0.75 c	0.95 c	25.4 d
5. AMS21619A 480SC (2.9 oz) 5. Gem 25WP (1.5 oz)	A, C B	0.75 a	10.60 a	3.60 b	4.25 c	3.45 c	146.2 d
6. Gem 25WP 9 (1.8 oz) . . . . . 6. Eminent 125SL (1.7 oz) . . .	A, C B	0.10 a	2.30 a	0.95 b	1.20 c	21.40 bc	97.8 d
7. Quadris 2.08SC (2.3 oz) . . . 7. Eminent 125SL (1.7 oz) . . .	A, C B	3.05 a	14.40 a	5.20 b	6.85 c	7.45 bc	237.0 cd
8. Eminent 125SL (1.7 oz) . . . 8. Headline 2.08EC (2.3 oz) . .	A, C B	0.05 a	3.45 a	1.10 b	1.90 c	2.55 c	64.8 d
9. Eminent 125SL (1.7 oz) . . . 9. Gem 25WP (1.8 oz)	A, C B	5.05 a	1.15 a	1.05 b	0.60 c	0.25 c	75.6 d
10. Eminent 125SL (1.7 oz) . . 10. Headline 2.08EC (2.3 oz) . 10. Super Tin 80WP (4.0 oz) .	A B C	0.10 a	0.25 a	4.90 b	1.60 c	2.85 c	57.0 d
11. HMO125 100WP (1.0 lb) .	A, B, C	11.08 a	13.60 a	19.60 a	78.8 a	31.15 abc	957.3 a
12. HMO125 100WP (1.5 lb) .	A, B, C	4.10 a	4.00 a	6.50 b	84.3 a	37.95 ab	784.0 ab
13. HMO125 100WP (2.0 lb) .	A, B, C	7.00 a	7.70 a	7.45 b	48.65 ab	60.85 a	679.8 ab
14. Headline 2.08EC (2.3 oz) .	A, B, C	0.95 a	2.95 a	0.60 b	2.30 c	1.10 c	81.8 d
15. Topsin M 70WP + Penncozeb 80WP (0.4 + 1.6 lb) 15. Super Tin 80WP (4.0 oz) . 15. Headline 2.08EC (2.3 oz) .	A B C	0.50 a	2.45 a	2.70 b	4.95 c	0.60 c	75.7 d
16. Eminent 125SL (1.7 oz) . . 16. Super Tin 80WP (4.0 oz) . 16. Headline 2.08EC (2.3 oz) .	A B C	0.20 a	4.60 a	3.80 b	7.15 c	1.35 c	112.3 d
17. Headline 2.08EC (2.3 oz) . 17. AgriTin 80WP (4.0 oz) . . . 17. Eminent 125SL (1.7 oz) . .	A B C	1.90 a	3.65 a	1.55 b	1.20 c	1.70 c	71.2 d
18. Eminent 125SL (1.7 oz) . . 18. AgriTin 80WP (4.0 oz) . . . 18. Headline 2.08EC (2.3 oz) .	A B C	0.85 a	1.85 a	0.90 b	4.85 c	14.35 bc	105.8 d

[1] Application dates: A=7 Aug, B=14 Aug, C=4 Sep. NA= not applicable.
[2] Area under the disease progress curve for lesion count data collected from 6 Aug to 23 Sep.
[3] Treatment means followed by different letters differ significantly (Fisher's protected LSD, P=0.05).

Table 2. Effects of foliar fungicide programs on powdery mildew and Rhizoctonia crown rot (G.D. Franc and W.L. Stump, University of Wyoming; 2002).

Treatment and application rate (a.i./acre)	Application dates [1]	Powdery Mildew severity (% of plant canopy affected)	Rhizoctonia incidence (% of crowns with decay)
		19 Sep	27 Aug
1. Nontreated check	NA	0.5 c [2]	7.2 a
2. AMS21619A 480SC (2.1 oz)	A , B, C	1.0 bc	12.0 a
3. AMS21619A 480SC (2.9 oz)	A, B, C	0.0 c	1.5 a
4. Eminent 125SL (1.7 oz)	A, B, C	0.0 c	4.0 a
5. AMS21619A 480SC (2.9 oz)	A, C	0.0 c	4.0 a
5. Gem 25WP (1.5 oz)	B		
6. Gem 25WP 9 (1.8 oz)	A, C	0.0 c	4.8 a
6. Eminent 125SL (1.7 oz)	B		
7. Quadris 2.08SC (2.3 oz)	A, C	0.0 c	3.0 a
7. Eminent 125SL (1.7 oz)	B		
8. Eminent 125SL (1.7 oz)	A, C	0.0 c	1.5 a
8. Headline 2.08EC (2.3 oz)	B		
9. Eminent 125SL (1.7 oz)	A, C	0.0 c	1.5 a
9. Gem 25WP (1.8 oz)	B		
10. Eminent 125SL (1.7 oz)	A	0.0 c	2.0 a
10. Headline 2.08EC (2.3 oz)	B		
10. Super Tin 80WP (4.0 oz)	C		
11. HMO125 100WP (1.0 lb)	A, B, C	4.0 ab	2.0 a
12. HMO125 100WP (1.5 lb)	A, B, C	8.5 a	1.5 a
13. HMO125 100WP (2.0 lb)	A, B, C	2.0 bc	2.0 a
14. Headline 2.08EC (2.3 oz)	A, B, C	0.0 c	1.5 a
15. Topsin M 70WP + Penncozeb 80WP (0.4 + 1.6 lb)	A	0.0 c	2.0 a
15. Super Tin 80WP (4.0 oz)	B		
15. Headline 2.08EC (2.3 oz)	C		
16. Eminent 125SL (1.7 oz)	A	0.5 c	1.0 a
16. Super Tin 80WP (4.0 oz)	B		
16. Headline 2.08EC (2.3 oz)	C		
17. Headline 2.08EC (2.3 oz)	A	0.0 c	1.0 a
17. AgriTin 80WP (4.0 oz)	B		
17. Eminent 125SL (1.7 oz)	C		
18. Eminent 125SL (1.7 oz)	A	0.0 c	0.5 a
18. AgriTin 80WP (4.0 oz)	B		
18. Headline 2.08EC (2.3 oz)	C		

[1] Application dates: A=7 Aug, B=14 Aug, C=4 Sep. NA= not applicable.
[2] Treatment means followed by different letters differ significantly (Fisher's protected LSD, P=0.05).

Table 3. Effects of foliar fungicide programs on sugar beet root yield and quality (G.D. Franc et. al., U of WY; 2001).

Treatment and application rate (a.i./acre)	Application dates [1]	Beet root yield and quality	
		Beet yield (tons/A)	% total sucrose
1. Nontreated check	NA	15.0 c [2]	14.2 a
2. AMS21619A 480SC (2.1 oz)	A , B, C	20.9 abc	13.6 a
3. AMS21619A 480SC (2.9 oz)	A, B, C	21.3 ab	14.7 a
4. Eminent 125SL (1.7 oz)	A, B, C	20.7 abc	15.1 a
5. AMS21619A 480SC (2.9 oz)	A, C	19.6 bc	14.9 a
5. Gem 25WP (1.5 oz)	B		
6. Gem 25WP 9 (1.8 oz)	A, C	21.3 ab	15.0 a
6. Eminent 125SL (1.7 oz)	B		
7. Quadris 2.08SC (2.3 oz)	A, C	19.2 bc	14.9 a
7. Eminent 125SL (1.7 oz)	B		
8. Eminent 125SL (1.7 oz)	A, C	24.1 ab	14.7 a
8. Headline 2.08EC (2.3 oz)	B		
9. Eminent 125SL (1.7 oz)	A, C	22.1 ab	14.0 a
9. Gem 25WP (1.8 oz)	B		
10. Eminent 125SL (1.7 oz)	A	20.4 abc	14.4 a
10. Headline 2.08EC (2.3 oz)	B		
10. Super Tin 80WP (4.0 oz)	C		
11. HMO125 100WP (1.0 lb)	A, B, C	19.7 bc	14.5 a
12. HMO125 100WP (1.5 lb)	A, B, C	26.0 a	14.7 a
13. HMO125 100WP (2.0 lb)	A, B, C	23.4 ab	14.7 a
14. Headline 2.08EC (2.3 oz)	A, B, C	19.6 bc	14.4 a
15. Topsin M 70WP + Penncozeb 80WP (0.4 + 1.6 lb)	A	21.6 ab	14.4 a
15. Super Tin 80WP (4.0 oz)	B		
15. Headline 2.08EC (2.3 oz)	C		
16. Eminent 125SL (1.7 oz)	A	24.7 ab	14.7 a
16. Super Tin 80WP (4.0 oz)	B		
16. Headline 2.08EC (2.3 oz)	C		
17. Headline 2.08EC (2.3 oz)	A	18.9 bc	14.7 a
17. AgriTin 80WP (4.0 oz)	B		
17. Eminent 125SL (1.7 oz)	C		
18. Eminent 125SL (1.7 oz)	A	24.8 ab	14.2 a
18. AgriTin 80WP (4.0 oz)	B		
18. Headline 2.08EC (2.3 oz)	C		

[1] Application dates: A=7 Aug, B=14 Aug, C=4 Sep. NA= not applicable.

[2] Treatment means followed by different letters differ significantly (Fisher's protected LSD, P=0.10). Data were not significant at P=0.05.

Research Project	**Foliar Disease Management with Low Volume HMO 125 Applications in Sugar Beet, 2002**
Research Team Tel: 307-766-2397 FAX: 307-766-5549 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 (30-in row centers) X 20 ft; 5 ft in-row buffer. Fungicide treatments were made to, and all data were collected from, the center two rows of each plot.
Plot Management	**Planting Date**: 18 April, replanted 14 May. **Variety**: Monohikari **Fertilizer**: 150 lb N + 50 lb P_2O_5 **Herbicide**: Preplant application of Roundup (0.5 qt product/A) on 14 May. Post-emergence applications of Progress + Stinger + Select (17 fl oz + 5.0 fl oz + 8 fl oz product/A) on 28 May, Progress + Upbeet + Select (20 fl oz + 0.5 oz + 8 fl oz product/A) on 6 June, and Progress + Select (20 fl oz + 8 fl oz product/A) on 14 June.
Disease Development	Scattered Cercospora lesions were first noted on 6 August and powdery mildew was not evident until early September. Observations of disease in the nearby production area suggested that symptoms of both diseases largely resulted from natural inoculum.
Treatment Applications	Foliar fungicide applications were made on 27, August, and 11 September. Fungicides were applied with the aid of a portable (CO_2) sprayer in a total volume of 7.3 gal/A at 20 psi boom pressure (four #800067 flat fan nozzles spaced at 20 inches). Applications were meant to approximate the low carrier volume typical of aerial applications. Phytotoxicity was not observed in the plots.
Disease Ratings	**Cercospora leaf spot** severity was determined on 27, August, and 3, 10, 17, and 23 September. The lesions present on five leaves per plot were counted and the averages calculated. A portion of the field data is summarized in Table 1. **Powdery mildew** severity was visually estimated using the Horsfall-Barratt scale on 19 September as a percentage of the visible canopy with signs of disease (Table 2).
Harvest	One row of the two treated rows was harvested (20 ft) on 4 October and total root yields were determined. The percentage of total sucrose was determined by Western Sugar's laboratory.

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

Results and Discussion

Cercospora leaf spot (CLS) development was light to moderate in 2002. Disease development resulted from naturally occurring inoculum and may have been influenced by greenhouse-grown inoculated sugar beet plants transplanted into nearby plots. Cercospora isolates sensitive to benzimidazole and triphenyltin hydroxide fungicides were used to inoculate these transplants in the greenhouse. Powdery mildew, although present on the sugar beet transplants, did not become evident in the field plots until September. Weather during 2002 was unusually hot and dry and was not particularly conducive for CLS or powdery mildew disease development.

CLS and powdery mildew disease severity data revealed no significant differences among treatment means (Table 1: $\underline{P}=0.05$). Although not significant, season-long CLS disease severity (AUDPC) was an average 34% greater for the HMO 125 treatment series compared to the nontreated check and the Headline treatment AUDPC was 37% less than the nontreated check ($\underline{P}=0.05$). Because these were trends in the data and not significance, it is difficult to make conclusions about the HMO 125 effect on CLS disease development.

Beet yield and quality were not significantly affected by treatment (Table 2: $\underline{P}=0.05$). However, all HMO 125 treatments and Headline had total root yields greater than the negative check.

Trends in the data for HMO 125 applied at low application volumes weakly suggests that CLS was increased by application of HMO 125. While trends in the data may be considered weak, a second study done within the same field and at different application volumes, also revealed the same trends. For details of the second study, see the previous report *Cercospora Leaf Spot and Powdery Mildew Management in Sugar Beet, 2002*.

Table 1. Cercospora leaf spot (CLS) and powdery mildew management with low volume foliar fungicide applications (G.D. Franc and W.L. Stump, University of Wyoming; 2002).

Treatment and application rate (a.i./acre)	Application dates [1]	Number of Cercospora lesions per leaf				CLS AUDPC [2]	Powdery Mildew severity (%)[3]
		3 Sep	10 Sep	17 Sep	23 Sep		19 Sep
1. Nontreated check	NA	2.3 a [4]	25.3 a	106.5 a	67.2 a	1091 a	1.5 a
2. HMO 125 100WP (1.0 lb)	A, B	6.2 a	42.8 a	142.2 a	88.4 a	1543 a	1.5 a
3. HMO 125 100WP (1.5 lb)	A, B	4.4 a	35.9 a	130.0 a	85.1 a	1405 a	0.5 a
4. HMO 125 100WP (2.0 lb)	A, B	11.8 a	39.6 a	131.8 a	75.4 a	1446 a	2.0 a
5. Headline 2.08EC (2.3 oz)	A, B	10.8 a	27.8 a	38.7 a	53.1 a	690 a	0.0 a

1 Application dates: A= 27 August and B= 11 September. Spray volume was 7.3 gallons per acre at 20 psi. NA= not applicable.

2 Area under the disease progress curve (AUDPC) is an estimate of season long CLS disease severity and includes lesion count data collected from 27 August to 23 September.

3 Visual estimate of powdery mildew severity expressed as the percentage of the plant canopy with signs of disease.

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

Table 2. Effects of low volume foliar fungicide applications on sugar beet root yield and quality (G.D. Franc and W.L. Stump, University of Wyoming; 2002).

Treatment and application rate (a.i./acre)	Application dates [1]	Beet root yield and quality	
		Beet yield (tons/A)	% total sucrose
1. Nontreated check	NA	17.4 a [2]	14.6 a
2. HMO 125 100WP (1.0 lb)	A, B	19.9 a	14.0 a
3. HMO 125 100WP (1.5 lb)	A, B	19.2 a	14.9 a
4. HMO 125 100WP (2.0 lb)	A, B	18.6 a	14.1 a
5. Headline 2.08EC (2.3 oz)	A, B	20.6 a	14.7 a

1 Application dates: A= 27 August and B= 11 September. Spray volume was 7.3 gpa at 20 psi. NA= not applicable.

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

Research Project	**Use of Bio Forge to Reduce Herbicide Stress on Sugar Beet Production Systems, 2002**
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**: 18 April, replanted 14 May. **Variety**: Monohikari **Fertilizer**: 150 lb N + 50 lb P_2O_5 **Herbicide**: Preplant application of Roundup (0.5 qt product/A) on 14 May. Post-emergence applications of Progress + Stinger + Select (17 fl oz + 5.0 fl oz + 8 fl oz product/A) on 28 May, Progress + Upbeet + Select (20 fl oz + 0.5 oz + 8 fl oz product/A) on 6 June, and Progress + Select (20 fl oz + 8 fl oz product/A) on 14 June. **Fungicide**: Eminent (13 fl oz product/A) was applied on 13 August for Cercospora leaf spot management.
Treatment Applications	Bio Forge applications (7-inch band) indicated as A, B, and C in the tables were made on 5, 10, and 17 June, respectively. Bio Forge was applied with the aid of a backpack sprayer in a total spray volume of 20 gal/A at 50 psi boom pressure. The boom was equipped with a single #8002 flat fan nozzle.
Sugar Beet Ratings	Sugar beet population counts and phytotoxicity (stunting) ratings due to herbicide applications, were determined on 5, 10, 20 June, and 3 July. An additional phytotoxicity and chlorosis rating was made on 25 July.
Harvest	Two rows 5 ft long were harvested on 27 September. Root weights were measured and the percentage of total sucrose and nitrate levels were determined by Holly Sugar's testing laboratory.
Statistical Analysis	The design was an ANOVA with four replications. Mean separations were done using Fisher's protected LSD ($P \leq 0.05$).

Results and Discussion

All treatments received the standard herbicide program, including the nontreated check. The nontreated check received no Bio Forge application, while treatments 2 and 3 received Bio Forge applications at the times indicated in the Tables. Data were collected during the growing season to determine if herbicide effects were mitigated by Bio Forge application. Measurements included assessment of Bio Forge effects on sugar beet as well as Bio Forge effects on weeds.

Bio Forge applications had no effect on beet populations compared to the nontreated check (Table 1, P=0.05). Additionally, Bio Forge applications had no effect on sugar beet phytotoxicity (stunting was not reduced) compared to the nontreated check (Table 2, P=0.05). Chlorosis was not changed by Bio Forge application. Because of design constraints, there was no comparison to sugar beet without herbicide. Therefore it is not known how much the sugar beet plants were stressed due to herbicide applications.

Because Bio Forge application may reduce herbicide injury potential, the effect of Bio Forge application on weed control also was measured (Table 3). On 20 June, treatment 3 had improved weed control (reduced weed incidence) compared to the nontreated check and treatment 2 ($P \leq 0.05$). This suggests that the treatment 3 Bio Forge application increased herbicide efficacy (opposite of what was expected) or that Bio Forge-treated sugar beet plants were more competitive (a conclusion not supported by data in Tables 1 and 2). Weed control data collected prior to 20 June were not significant (Table 3: $P \leq 0.05$).

Bio Forge applications had no significant effect on sugar beet root yield or percentage of sugar in harvested roots (Table 4, P=0.05). However, there was a trend toward increased root yield and reduced NO_3 levels following Bio Forge application.

Table 1. The effects of Bio Forge banded applications on sugar beet population (G.D. Franc and W.L. Stump, U of WY; 2002).

Treatment and application rate (pr/acre)	Application dates[1] (7 in band)	Number of plants per 20 row ft			
		5 Jun	10 Jun	20 Jun	3 Jul
1. Nontreated check	NA	62 a[2]	62 a	62 a	53 a
2. Bio Forge (1 pt)	C	66 a	62a	62 a	53 a
3. Bio Forge (0.33 pt) . . .	A	64 a	64 a	62 a	51 a
3. Bio Forge (0.33 pt) . . .	B				
3. Bio Forge (0.33 pt) . . .	C				

[1] All treatments including the nontreated check received the standard herbicide program. Bio Forge was applied to treatments 2 and 3 in a total spray volume of 20 gal/A at 50 psi boom pressure. Bio Forge application dates were A= 5 June, B= 10 June, and C= 17 June: NA= not applicable (no Bio Forge applied).

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

Table 2. The effects of Bio Forge banded applications on sugar beet phytotoxic response to herbicide applications (G.D. Franc and W.L. Stump, U of WY; 2002).

Treatment and application rate (pr/acre)	Application dates[1] (7 in band)	Injury as a percentage of nontreated plants[2]					Chlorosis (%)[3]
		5 Jun	10 Jun	20 Jun	3 Jul	25 Jul	25 Jul
1. Nontreated check	NA	100 a[4]	100 a	105 a	104 a	106 a	7.3 a
2. Bio Forge (1 pt)	C	100 a	100 a	100 a	102 a	99 a	14.5 a
3. Bio Forge (0.33 pt) . . .	A	100 a	100 a	106 a	106 a	102 a	8.5 a
3. Bio Forge (0.33 pt) . . .	B						
3. Bio Forge (0.33 pt) . . .	C						

[1] All treatments including the nontreated check received the standard herbicide program. Bio Forge was applied to treatments 2 and 3 in a total spray volume of 20 gal/A at 50 psi boom pressure. Bio Forge application dates were A= 5 June, B= 10 June, and C= 17 June: NA= not applicable (no Bio Forge applied).

[2] Visual estimate of plant size (stunting) compared to plants in the adjacent border row. Border row plants received the standard herbicide program and were not treated with Bio Forge. A rating greater than 100 indicates an average plant height that is taller than the border row and a rating less than 100 indicates an average plant height shorter than the border row.

[3] The average percentage of foliage chlorotic converted from the Horsfall Barratt scale (0-11).

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

Table 3. The effects of Bio Forge banded applications on weed control (G.D. Franc and W.L. Stump, U of WY; 2002).

Treatment and application rate (pr/acre)	Application dates [1] (7 in band)	Overall weed control as a percentage of the nontreated check		
		5 Jun[2]	10 Jun[2]	20 Jun[3]
1. Nontreated check	NA	100 a[4]	100 a	100 b
2. Bio Forge (1 pt)	C	101 a	116 a	59 b
3. Bio Forge (0.33 pt) ...	A	126 a	131 a	158 a
3. Bio Forge (0.33 pt) ...	B			
3. Bio Forge (0.33 pt) ...	C			

[1] All treatments including the nontreated check received the standard herbicide program. Bio Forge was applied to treatments 2 and 3 in a total spray volume of 20 gal/A at 50 psi boom pressure. Bio Forge application dates were A= 5 June, B= 10 June, and C= 17 June: NA= not applicable (no Bio Forge applied).

[2] Weed control was averaged over puncture vine, green foxtail, and redroot pigweed control. A rating greater than 100 indicates improved weed control (reduced weed incidence) compared to the nontreated check (treatment 1).

[3] Weed control was averaged over puncture vine, green foxtail, common lambsquarters, black nightshade, Russian thistle, and redroot pigweed control. A rating greater than 100 indicates improved weed control (reduced weed incidence) compared to the nontreated check (treatment 1).

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

Table 4. The effects of Bio Forge banded applications on sugar beet yield and quality (G.D. Franc and W.L. Stump, U of WY; 2002).

Treatment and application rate (pr/acre)	Application dates [1] (7 in band)	Sugar beet yield and quality		
		root yield (lb/10 row ft)	NO_3 ppm	% Sugar
1. Nontreated check	NA	13.8 a[2]	189 a	16.1 a
2. Bio Forge (1 pt)	C	15.2 a	116 a	15.9 a
3. Bio Forge (0.33 pt) ...	A	17.8 a	129 a	16.1 a
3. Bio Forge (0.33 pt) ...	B			
3. Bio Forge (0.33 pt) ...	C			

[1] All treatments including the nontreated check received the standard herbicide program. Bio Forge was applied to treatments 2 and 3 in a total spray volume of 20 gal/A at 50 psi boom pressure. Bio Forge application dates were A= 5 June, B= 10 June, and C= 17 June: NA= not applicable (no Bio Forge applied).

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

Research Project	**Use of Load and Nitrate Balancer applications to Increase Yield and Production Quality in Sugar Beets, 2002**
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 (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**: 18 April, replanted 14 May. **Variety**: Monohikari **Fertilizer**: 150 lb N + 50 lb P_2O_5 **Herbicide**: Preplant application of Roundup (0.5 qt product/A) on 14 May. Post-emergence applications of Progress + Stinger + Select (17 fl oz + 5.0 fl oz + 8 fl oz product/A) on 28 May, Progress + Upbeet + Select (20 fl oz + 0.5 oz + 8 fl oz product/A) on 6 June, and Progress + Select (20 fl oz + 8 fl oz product/A) on 14 June. **Fungicide**: On 13 August, Eminent was applied to suppress Cercospora leaf spot.
Treatment Applications	Load applications indicated as A, B, C, and D in the tables were made on 26 June, 10, 31 July, and 14 August respectively. Nitrate Balancer was applied on 27 August (indicated as E in the tables) which was 31 days prior to harvest. All applications were made with the aid of a backpack sprayer in a total spray volume of 43 gal/A at 30 psi boom pressure. The boom was equipped with a four #8004 flat fan nozzles.
Sugar Beet Ratings	Sugar beet phytotoxicity ratings (visual estimates of beet stunting) due to applications, were determined on 5 and 25 July. Beet ratings were expressed as a percentage of the beets in the adjacent nontreated border row. Additionally, a chlorosis rating was made on 25 July.

Sugar Beet Nitrate-N Levels	A composite of 12 leaf petioles (3 from each replicate plot) were squeezed within 4 hr of collection, and the sap was analyzed by the UW soil testing laboratory for nitrate-nitrogen levels. Collections were made on 30 July, 6, 13, 20, 27 August, and 3, 16, and 27 September. If treatment were scheduled on a petiole collection date, collections were made before treatment.
Harvest	Two rows X 5 ft was harvested on 27 September. Root yields were measured and the percentage of total sucrose and nitrate levels were determined by Holly Sugar's testing laboratory.
Statistical Analysis	The design was an ANOVA with four replications. Mean separations were done using Fisher's protected LSD ($P \leq 0.05$).

Results and Discussion

Petiole nitrate-nitrogen levels (ppm) of expressed sap are presented in Table 1. Data from the 20 August was omitted from the Table due to loss of labels on two of the collection vials and uncertainty of treatment identification. Concentrations were not statistically analyzed because the replications were combined.

Table 2 summarizes phytotoxicity measurements. None of the treatments were phytotoxic under the conditions that this test was performed ($P \leq 0.05$). Chlorosis was not significantly affected by treatment, as well (Table 2: $P \leq 0.05$). However, there was a trend for Load and Nitrate Balancer treatments to exhibit less chlorosis than the nontreated check.

There was no significant effect of Load or Nitrate Balancer on sugar beet root yield, NO_3 ppm and the percentage of sucrose (Table 3: $P \leq 0.05$). However, there was a trend for Load and Nitrate Balancer treatments to have increased sugar beet root yields and increased percentages of sucrose compared to the nontreated check. Also, treatments receiving Nitrate Balancer had the lowest levels of NO_3 ppm.

Table 1. Effects of Load and Nitrate Balancer on sugar beet nitrate-nitrogen concentrations in plant sap (G.D. Franc and W.L. Stump, U of WY; 2002).

Treatment and application rate (product/acre)	Application dates [1]	Petiole sap nitrate-nitrogen levels (ppm) [2]						
		30 Jul	6 Aug	13 Aug	27 Aug	3 Sep	16 Sep	27 Sep
1. Nontreated check	NA	1088	1120	820	546	1050	788	772
2. Load (1 qt)	A, B, C, D	1475	1300	1140	989	1130	1156	840
3. Load (1 qt)	A, B, C, D	1341	1340	1140	937	1050	988	950
3. Nitrate balancer (1 gal) ..	E							
4. Nitrate balancer (1 gal) ..	E	1212	1300	1030	861	1100	1126	924

[1] Load applications indicated as A, B, C, and D were made on 26 June, 10, 31 July, and 14 August, respectively. Nitrate Balancer was applied on 27 August (E), 31 days prior to harvest: NA= not applicable. Applications were made in a total spray volume of 43 gal/A at 30 psi boom pressure.

[2] Concentration is expressed as ppm present in sap squeezed from a composite of 12 (3 from each replicate plot) leaf petioles per treatment.

Table 2. Effects of Load and Nitrate Balancer applications on sugar beet phytotoxicity (G.D. Franc and W.L. Stump, U of WY; 2002).

Treatment and application rate (product/acre)	Application dates [1]	Phytotoxicity as a percentage of adjacent nontreated plants [2]		Chlorosis (%) [3]
		5 Jul	25 Jul	25 Jul
1. Nontreated check	NA	105 a [4]	103 a	20.2 a
2. Load (1 qt)	A, B, C, D	106 a	104 a	10.2 a
3. Load (1 qt)	A, B, C, D	105 a	104 a	12.0 a
3. Nitrate balancer (1 gal) ..	E			
4. Nitrate balancer (1 gal) ..	E	110 a	105 a	10.2 a

[1] Load applications indicated as A, B, C, and D were made on 26 June, 10, 31 July, and 14 August, respectively. Nitrate Balancer was applied on 27 August (E), 31 days prior to harvest: NA= not applicable. Applications were made in a total spray volume of 43 gal/A at 30 psi boom pressure.

[2] Visual estimate of plant size (stunting) compared to plants in the adjacent border row. A rating greater than 100 indicates an average plant height that is taller than the border row and a rating less than 100 indicates an average plant height shorter than the border row.

[3] The average percentage of foliage chlorotic converted from the Horsfall Barratt scale (0-11).

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

Table 3. Effects of Load and Nitrate Balancer applications on sugar beet yield and quality (G.D. Franc and W.L. Stump, U of WY; 2002).

Treatment and application rate (product/acre)	Application dates [1]	Sugar beet yield and quality		
		yield (lb/10 row ft)	NO_3 ppm	% Sugar
1. Nontreated check	NA	14.2 a [2]	161 a	15.3 a
2. Load (1 qt)	A, B, C, D	15.9 a	188 a	16.4 a
3. Load (1 qt) . . . . 3. Nitrate balancer (1 gal) . .	A, B, C, D E	15.9 a	140 a	15.7 a
4. Nitrate balancer (1 gal) . .	E	17.2 a	125 a	16.3 a

[1] Load applications indicated as A, B, C, and D were made on 26 June, 10, 31 July, and 14 August, respectively. Nitrate Balancer was applied on 27 August (E), 31 days prior to harvest: NA= not applicable. Applications were made in a total spray volume of 43 gal/A at 30 psi boom pressure.

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

Products Tested in 2002 Research Studies.

Product	Manufacturer	Composition
Agri Tin 80WP	Nufarm Americas Inc. 14140 SW Freeway, Suite 250 Sugarland, TX 77479	80 % Triphenyltin Hydroxide
AMS21619A 480SC	Bayer Corp. Agriculture Division P.O. Box 4913, Hawthorn Rd Kansas City, MO 64120	Information not provided
BAS 510 70WP	BASF Corp. 26 Davis Dr Research Triangle Park, NC 27709	Information not provided
Bio Forge	Stoller Enterprises, Inc. 4001 W Sam Houston Pkwy, Suite 100 Houston, TX 77043	2 % urea nitrogen, 3 % K_2O
Bravo Weather Stik 6F	Syngenta Crop Protection, Inc. P.O. Box 18300 Greensboro, NC 27419	54 % Chlorothalonil
Bravo ZN 4.17F	Syngenta Crop Protection, Inc.	40.4 % Chlorothalonil
DPXJE874 50WG	Dupont Agricultural Products Wilmington, DE 19880-0402	30 % Cymoxanil, 22.5 % Famoxadone
Echo ZN 4.17F	Sipcam Agro USA, Inc. 70 Mansell Ct., Suite 230 Roswell, GA 30076	38.5 % Chlorothalonil
Eminent 1.04SC	Sipcam Agro USA, Inc.	11.6 % Tetraconazole
Equation Contact 68.8WG	Dupont	62.5 % Mancozeb, 6.25 % Famoxate
FAC 321 2EC	LG Chem LTD. LG Twin Towers Yoido-dong 20, Youngdungpo-gu Seoul, 150-721, Korea	23 % Metalaxyl
Gem 25 WG	Bayer Corp.	25 % Trifloxystrobin
Headline 2.09EC	BASF Corp.	22.9 % Pyraclostrobin
HMO 125 100WP	Helena Chemical Co 6075 Poplar, Suite 500 Memphis, TN 38119	Proprietary blend of alkali metal bicarbonate
Load	Stoller Enterprises	7 % boron, 0.004 % molybdenum

Product	Manufacturer	Composition
Manzate 75DF	Griffin Corp.	75 % Mancozeb
Nitrate Balancer	Stoller Enterprises	3 % dimethyl amino propylamine, <1% molybdic acid, 53 % orthoboric acid
Penncozeb 80WP	Cerexagri 900 First Ave. King of Prussia, PA 19406	80 % Mancozeb
Polyram 80WP	United Agri Products PO Box 667 Greeley, CO 80632	80 % Metiram
Quadris 2.08 SC	Syngenta Crop Protection, Inc.	22.9 % Azoxystrobin
Ridomil Gold 4EC	Syngenta Crop Protection, Inc.	47.6 % Mefenoxam
Super Tin 80WP	Griffin Corp. P.O. Box 1847, Rocky Ford Rd Valdosta, GA 31603-1847	80 % Triphenyltin Hydroxide
Tanos 50WG	Dupont	Information not provided
Topsin M 70WP	Cerexagri	70 % Thiophanate methyl