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Fungicide Trials for Bean Rust and White Mold Management in the Great Plains: Field Site RE, 1993

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Abstract

Field trials were conducted at the Torrington R/E Center near Torrington. Five foliar fungicide treatments were compared to non-treated control for bean rust and white mold management on pinto beans. All disease development resulted from natural inoculum. White mold, caused by *Sclerotinia sclerotiorum*, was not observed in the treatment plots. Bean rust disease severity data for August 19 showed treatments 2 (Fluazinam 500F 0.393 pounds per acre) and 3 (ASC-67098 3 to 1) significantly reduced the percentage of infected leaflets ($\underline{P}$=0.05). Data for August 31 showed all treatments, except 4 (Ronilan 50 DF), significantly reduced the surface area of leaflets affected by rust ($\underline{P}$<0.05). Treatment 2 (Fluazinam 500F 0.393 pounds per acre) was significantly better than all treatments except treatment 3 (ASC-67098 3 to 1) ($\underline{P}$<0.05). On August 31, treatments 1 (Fluazinam 500F 0.236 pounds per acre), 2 (Fluazinam 500F 0.393 pounds per acre), and 3 (ASC-67098 3 to 1) had significantly less total plant necrosis present in plots when compared with both treatment 4 (Ronilan 50 DF) and the control ($\underline{P}$<0.05). Bean yields were not significantly affected by any of the foliar fungicide treatments ($\underline{P}$<0.05). Although there was a trend of increased yield in treated plots when compared to the control, Ronilan 50DF is **not** reported to have activity for bean rust control. It was merely included as a control treatment for management of other diseases that may have developed in the plot, permitting additional comparisons to be made.

Materials and Methods

Field trials were conducted at the Torrington R/E Center near Torrington, Wyoming. The field plot area was planted with cultivar "UI 114" on May 26, 1993 at the target rate of 65 pounds per acre. Treatment plots were measured and flagged after plant emergence. A randomized complete block design of six treat-ments and four replications was used. Each treatment plot was 25 feet long and four rows wide with a between-row spacing of 30 inches. A 5-foot in-row buffer remained between treatment plots.

Foliar treatments applied during 1993 and the rates used are listed in Table 1. Fungicide applications were made on August 4 and August 13. Products were applied using a backpack sprayer in a total spray volume of 30 gallons per acre at 30 pounds per square inch (psi) boom pressure. The boom was equipped with #8004 HSS tips, and had four nozzles spaced at 20 inches. Fresh product shipped during 1993 was used for all treatments.

All disease severity and yield data were collected from the middle two rows of the four-row treatment plots. The percentage of infected leaflets on three randomly selected plants in each plot was visually estimated on August 11 and August 19 using the Horsfall-Barratt scale (0-11). The percentage of leaflet surface area affected by rust in three plants per plot was estimated on August 19 and August 31 using the Horsfall-Barratt scale (0-11). The percentage of plants dead in each plot was estimated on August 31.

Twenty leaflets were randomly selected from all treatment plots on August 11, August 23 and August 31. Ten leaflets were collected from each the top and bottom half of the plant canopy. The number of rust pustules per leaflet was counted and the average number per leaflet per plot was calculated for collections made August 11 and August 23. The leaflets collected on August 31 were so extensively covered by rust that the percentage of surface area affected by rust was rated rather than pustule numbers.

Bean harvest was done on September 4. Bean vegetation from each plot was placed in burlap bags and air dried prior to threshing. Threshed material was further cleaned in a clipper mill before weighing.

All data were analyzed using the statistical program MSTAT in a two-way Analysis of Variance (ANOVA) of six treatments and four replications per treatment. Mean separation was done using Duncan's Multiple Range Test (MRT) ($\underline{P}$=0.05). Horsfall-Barratt data were converted to percentages for presentation in Table 3.

Results

White mold, caused by *Sclerotinia sclerotiorum*, was not observed in the treatment plots and, therefore, no data was collected. Data in Table 2 show bean yields were not significantly affected by any of the foliar fungicide treatments ($\underline{P}<0.05$).

Bean rust disease severity data are summarized in Table 3. On August 11, seven days after the first fungicide application, the percentage of leaflets infected by rust and the number of pustules per leaflet in all treatment plots was statistically equivalent to the non-treated control ($\underline{P}<0.05$). Data for August 19 show treatments 2 (Fluazinam 500F 0.393 pounds per acre) and 3 (ASC-67098 3 to 1) significantly reduced the percentage of infected leaflets and that treatment 2 was significantly better than all other treatments except treatment 3 ($\underline{P}<0.05$). The number of pustules per leaflet was reduced by all treatments by August 23. However, only treatments 2 and 3 were significantly better than the control and also better than treatment 4 (Ronilan 50 DF) ($\underline{P}<0.05$). Treatment 2 also was significantly better than treatments 1 and 4 ($\underline{P}<0.05$).

Data in Table 3 also show there was no significant difference between the treated and control plots for the percentage of leaflet surface area affected by rust on August 19 ($\underline{P}<0.05$). However, data for August 31 show all treatments, except 4 (Ronilan 50 DF), significantly reduced disease severity relative to the control ($\underline{P}<0.05$). Treatment 2 (Fluazinam 500F 0.393 pounds per acre) was significantly better than all treatments, except treatment 3 (ASC-67098 3 to 1) ($\underline{P}<0.05$). Treatments 1, 2, 3, and 5 were significantly better than both treatment 4 and the control ($\underline{P}<0.05$).

By August 31, essentially every leaflet on every plant contained at least one pustule. Therefore, the percentage of dead plants was estimated instead of the percentage of affected leaflets. Treatments 1 (Fluazinam 500F 0.236 pounds per acre), 2 (Fluazinam 500F 0.393 pounds per acre), and 3 (ASC-67098) had significantly less total necrosis than both treatment #4 (Ronilan 50 DF) and the control ($\underline{P}<0.05$). Treatment 5 (Ronilan 50DF + Bravo 720) was statistically equivalent to all fungicide treatments and to the control ($\underline{P}<0.05$).

Discussion

Bean plants were at the early to mid-bloom stage immediately prior to the first fungicide application. At this time, the field plot area had considerable weed pressure and bean rust was clearly evident. Rust infection appeared most severe in the mid-canopy region.

Treatment 4 (Ronilan 50DF) was consistently the least effective for bean rust control. Although bean rust disease severity data was reported for treatment 4, it should be noted that Ronilan 50DF is **not** reported to have activity for bean rust control. It was merely included as a treatment for management of other diseases (for example, white mold) that may have developed in the plot. This may have permitted additional comparisons to be made. Although treatment effects on yield were not significantly different from the control, it should be noted that yields from all fungicide treatments had greater yields.

Acknowledgements

The assistance of Jack Cecil, Mike Lindquist, and the rest of the field crew at the Torrington R/E Center was appreciated.

Table 1. Foliar fungicide treatments applied to pinto bean for rust and white mold management. (G.D. Franc, et al., 1993, University of Wyoming, Torrington site RE).

Treatment	Product/Acre[1]
1 Fluazinam 500F	0.236 L
2 Fluazinam 500F	0.393 L
3 ASC-67098 3 to 1	0.591 kg
4 Ronilan 50DF	0.907 kg
5 Ronilan 50DF + Bravo 720	0.907 kg + 0.447 L
6 Control	none

[1] Foliar fungicide applications were made on August 4 and August 13, 1993 using a backpack sprayer. Products were applied in a total spray volume of 30 gallons per acre at 30 psi boom pressure. The boom had four nozzles spaced at 20 inches (# 8004 HSS tips).

Table 2. Foliar fungicide treatments applied to pinto bean and their effect on seed yield. (G.D. Franc, et al., 1993, University of Wyoming, Torrington site RE).

Treatment	Yield (Pounds/Acre)
1 Fluazinam 500F	1489.1 A[1]
2 Fluazinam 500F	1339.6 A
3 ASC-67098 3 to 1	1347.1 A
4 Ronilan 50DF	1405.8 A
5 Ronilan 50DF + Bravo 720	1414.9 A
6 Control	1235.3 A

[1] Treatment means followed by different letters differ significantly ($P \leq 0.05$). Duncan's Multiple Range Test was used for mean separation.

Table 3. Effect of foliar fungicide treatments on pinto bean rust incidence and severity. (G.D. Franc, et al., 1993, University of Wyoming, Torrington site RE).

Treatment	Estimated percentage of leaflets rust infected		Average number of rust pustules per leaflet		Estimated percentage of leaflet surface area affected by rust		Estimated percentage of plants dead
	Aug 11	Aug 19	Aug 11	Aug 23	Aug 19	Aug 31	Aug 31
1[1]	67.0 A[2]	95.5 AB	39.0 A	214.6 AB	8.5 A	27.8 BC	46.0 B
2	31.0 A	85.0 C	7.0 A	40.6 C	2.0 A	8.8 D	48.0 B
3	63.0 A	92.5 BC	32.3 A	101.9 BC	4.0 A	18.1 CD	37.0 B
4	63.0 A	97.0 A	23.7 A	293.5 A	13.0 A	55.4 A	73.5 A
5	54.0 A	94.0 AB	15.1 A	167.2 ABC	7.0 A	31.1 B	54.0 AB
6	56.0 A	97.0 A	10.3 A	295.1 A	18.5 A	53.1 A	75.0 A
	$P > 0.05$	$P = 0.002$	$P > 0.05$	$P = 0.02$	$P > 0.05$	$P < 0.001$	$P = 0.011$

[1] See Table 1 for treatment descriptions.
[2] Treatment means followed by different letters differ significantly ($P \leq 0.05$). Duncan's Multiple Range Test was used for mean separation.

Fungicide Trials for Bean Rust and White Mold Management in the Great Plains: Field Site FF, 1993

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Abstract

Field trials were conducted in a commercial field near Torrington. Six foliar fungicide treatments were compared to a non-treated control for bean rust management in pinto bean. Data were also collected for evaluation of white mold control. Data collected August 11, seven days after the first fungicide application, showed the estimated percentage of leaflets with rust symptoms for all fungicide treatments was statistically equivalent to the non-treated control ($\underline{P}<0.05$). By August 19 and August 30, all fungicide treatments significantly reduced rust severity when compared to the control. Data collected August 30 also showed fungicide treatments had a significantly smaller surface area of the leaflet affected by rust relative to the control ($\underline{P}<0.001$). All fungicides tested provided statistically equivalent levels of bean rust disease control ($\underline{P}<0.05$).

Significant treatment effects did not occur with respect to the percentage of plants dead due to white mold ($\underline{P}<0.05$). Bean plants were desiccated and mature at harvest with abundant white mold sclerotia present. Bean yields were not significantly affected by any of the foliar fungicide treatments ($\underline{P}<0.05$).

Materials and Methods

Field trials were conducted in a cooperator's commercial field (site FF), located near Torrington. Treatment plots were measured and flagged after plant emergence. A randomized complete block design of seven treatments and four replications was used. Each treatment plot was 25-feet long by four rows wide with a between-row spacing of 30 inches. A 5-foot non-treated buffer remained in-row between flagged plots.

Foliar fungicide treatments applied during 1993 and rates used are listed in Table 1. Fungicide applications were made on August 4, August 13, and August 23. Products were applied using a backpack sprayer in a total spray volume of 30 gallons per acre at 30 psi boom pressure. The boom was equipped with #8004 HSS tips, and had four nozzles spaced 20 inches apart. Fresh product shipped during 1993 was used for all treatments.

All disease severity and yield data were collected from the two middle rows of the four-row treatment plots. The percentage of plants dead due to white mold (*Sclerotinia sclerotiorum*) was estimated on August 26, August 30, and September 2 using the Horsfall-Barratt scale (0-11). The percentage of rust infected leaflets on three plants in each plot was visually estimated on August 11, August 19, and August 30 using the Horsfall-Barratt scale (0-11). The percentage of leaflet surface area affected by rust for three randomly selected plants per plot was estimated on August 19 and August 30 using the HB scale. Twenty leaflets were randomly selected from treatment plots on August 11, August 23 and August 30; the number of rust pustules per leaflet was counted; and the average number of pustules per leaflet was calculated.

Treatment plots were harvested September 4. All vegetation from the middle two rows of each plot was individually bagged and air dried prior to threshing. Threshed material was further cleaned in a clipper mill before weighing. The total seed yield for each plot was measured.

All data were analyzed in a two-way ANOVA with four replications per treatment. Mean separation was done using Duncan's Multiple Range Test ($\underline{P}=0.05$). Horsfall-Barratt data were converted to percentages for presentation in tables.

Results

Data in Table 2 show the effect of foliar fungicide treatments on white mold disease severity. Significant differences among treatments were not observed on August 26, August 30, or September 2 with respect to the estimated percentage of plants dead due to white mold ($\underline{P}<0.05$). No trends are apparent in the data.

The data in Table 3 show that on August 11, seven days after the first fungicide application, the estimated percentage of leaflets infected for all fungicide treatments was statistically equivalent to the control (non-treated check) ($\underline{P}<0.05$). Data collected on August

19 and August 30, showed all treatments significantly reduced disease severity relative to the control (P<0.05). All fungicides tested provided statistically equivalent levels of disease control (P<0.05).

Data in Table 3 also show the percentage of leaflet surface area affected by rust for all treatments was statistically equivalent to the control on August 19 (P<0.05). By August 30, all fungicide treatments significantly reduced the surface area affected relative to the control; there were no statistically significant differences among treatment means (P<0.001).

There were no statistically significant differences between any of the treatments and the control with regard to the average number of rust pustules per leaflet on August 11 or August 19 (P<0.05). However, by August 30 the number of rust pustules was significantly reduced by all fungicide treatments; fungicide treatment means were equivalent (P<0.001).

Data in Table 4 show bean yields were not significantly affected by the foliar fungicide treatments tested (P<0.05).

Discussion

Bean plants were at the early to midbloom stage immediately prior to the first fungicide application. There was no sign of rust at the time fungicides were first applied, weed density was low, and plant vigor was excellent. Rust infection appeared to be most severe in the mid-canopy region. As the disease progressed, only the youngest leaves, if any, remained unaffected.

During August 19 data collection activities, it was noted that the lower leaves of most plants were yellow. Four days later several dead plants were observed in each plot due to white mold infection. Data was collected on August 26, August 30, and September 2 to estimate white mold severity. Bean plants were desiccated and mature at harvest with abundant white mold sclerotia present. The large percentage of plant death due to white mold probably masked any benefits associated with rust control.

Acknowledgements

Field plot space for this study was kindly provided by Richard Feagler. The assistance of Jack Cecil from the Torrington R/E Center was appreciated.

Table 1. Foliar fungicide treatments applied to pinto bean. (G.D. Franc, et al., 1993, University of Wyoming, Torrington site FF).

Treatment Number	Product Applied/Acre[1]
7. Bravo 720 (low)	0.663 L
8. Bravo 720 (high)	0.946 L
9. Bravo Zn (low)	0.946 L
10. Bravo Zn (high)	1.419 L
11. ASC-66897 SDG (low)	0.771 kg
12. ASC-66897 SDG (high)	1.134 kg
13. Control (check)	none

[1] Foliar fungicide applications were made on August 4, August 13, and August 23, 1993 using a backpack sprayer. Products were applied in a total spray volume of 30 gallons per acre at 30 psi boom pressure. The boom had four nozzles spaced at 20 inches (# 8004 HSS sprayer tips).

Table 2. Effect of foliar fungicide treatments on white mold disease severity. (G.D. Franc, et al., 1993, University of Wyoming, Torrington site FF).

Treatment Number[1]	Percentage of plants dead due to white mold		
	Aug 26	Aug 30	Sep 2
7. Bravo 720 (low)	31.0 A[1]	46.0 A	59.5 A
8. Bravo 720 (high)	37.0 A	56.0 A	69.0 A
9. Bravo Zn (low)	37.0 A	46.0 A	59.5 A
10. Bravo Zn (high)	28.0 A	37.0 A	65.0 A
11. ASC-66897 SDG (low)	31.0 A	40.5 A	65.0 A
12. ASC-66897 SDG (high)	31.0 A	46.0 A	65.0 A
13. Control (check)	31.0 A	40.5 A	65.0 A
	P>0.05	P>0.05	P>0.05

[1] Treatment means followed by different letters differ significantly ($\leq$ 0.05). Duncan's Multiple Range Test was used for mean separation.

Table 3. Effect of foliar fungicide treatments on bean rust disease severity. (G.D. Franc, et al., 1993, University of Wyoming, Torrington site FF).

Treatment Number	Estimated percentage of leaflets rust infected			Percentage of leaflet surface area affected by rust		Average number of rust pustules per lea flet		
	Aug 11	Aug 19	Aug 30	Aug 19	Aug 30	Aug 11	Aug 23	Aug 30
7. B720 (l)	0.2 A[1]	10.5 B	48.0 B	1.8 A	2.5 B	0.0 A	0.5 A	5.4 B
8. B720 (h)	0.0 A	4.5 B	50.0 B	1.6 A	2.0 B	0.0 A	0.2 A	4.8 B
9. BZN (l)	0.0 A	3.0 B	35.0 B	1.2 A	2.0 B	0.0 A	0.7 A	4.7 B
10. BZN (h)	0.2 A	5.5 B	44.0 B	1.6 A	2.0 B	0.0 A	0.9 A	2.0 B
11. ASC (l)	0.0 A	10.5 B	48.0 B	2.0 A	2.0 B	0.0 A	5.0 A	5.0 B
12. ASC (h)	0.2 A	8.5 B	50.0 B	1.8 A	2.0 B	0.1 A	0.9 A	5.2 B
13. CHK	0.2 A	35.0 A	98.2 A	2.5 A	4.5 A	0.1 A	6.7 A	79.7 A
	P>0.05	P=0.006	P<0.001	NSD	P<0.001	P>0.05	P>0.05	P<0.001

[1] Treatment means followed by different letters differ significantly (≤ 0.05). Duncan's Multiple Range Test was used for mean separation.

Table 4. Foliar fungicide treatments and their effect on pinto bean seed yield. (G.D. Franc, et al., 1993, University of Wyoming, Torrington site FF).

Treatment[1]	Yield (Pounds/A)[2]
7. Bravo 720 (low)	1574.3 A[3]
8. Bravo 720 (high)	1512.8 A
9. Bravo Zn (low)	1582.5 A
10. Bravo Zn (high)	1609.2 A
11. ASC-66897 SDG (low)	1568.4 A
12. ASC-66897 SDG (high)	1542.2 A
13. Control	1854.1 A

[1] See Table 1 for descriptions of treatments.

[2] Plots were harvested by hand on September 4, 1993.

[3] Treatment means followed by different letters differ significantly (≤ 0.05). Duncan's Multiple Range Test was used for mean separation.

Fungicide Trials for Bean Rust Management

in the Great Plains: Field Sites RE and ARDEC, 1994

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Abstract

Two research locations were established for bean rust fungicide evaluations during 1994. Thirteen fungicide treatments were compared to a non-treated control for rust management and their effect on seed yield. At the Torrington Center field plot, no significant treatment effects were detected for disease severity on August 17 ($P \leq 0.05$). By August 23, disease progressed in the control from 5.6 to 88.9 lesions per leaflet. Data from this date show all fungicide treatments significantly reduced disease severity when compared to the control ($P \leq 0.05$). However, none of the fungicides applied at the Torrington field site significantly increased yield when compared to the control plots ($P<0.05$). This result was most likely due to the late onset of disease and mild disease pressure during most of the growing season.

Data collected at the Agricultural Research and Demonstration and Education Center (ARDEC) field plot near Fort Collins, Colorado showed all fungicide treatments significantly reduced disease severity when compared to the non-treated control under conditions of severe disease pressure ($P \leq 0.05$). Treatment 13 (Zeneca ICIA5504) provided significantly better control than all other fungicides tested ($P \leq 0.05$). Yield data show all fungicide treatments significantly increased total yield when compared to the control ($P \leq 0.05$). Treatment 13 (Zeneca ICIA5504) had the greatest average yield and seed weight of all

fungicide treatments and was significantly better than treatments 7 (ASC-66897, high rate) and 9 (Bravo C/M) ($P \leq 0.05$).

Materials and Methods

Two research locations were established for bean rust fungicide evaluations during 1994. Field trials were conducted at the University of Wyoming Research and Extension Center near Torrington and at the Colorado State University Agricultural Research, Demonstration and Education Center research facility near Fort Collins, Colorado. Plant infection at the Torrington field site relied upon naturally occurring inoculum for disease development. At ARDEC, spreader rows next to each treatment plot were inoculated with spores and infected plants from the greenhouse also were transplanted into spreader rows. Both plots received overhead irrigation as needed. The same source of fungicide was tested at both locations. Work done at ARDEC was done in cooperation with Howard Schwartz. Additional information about each plot location is listed below.

Torrington Plots: Research plots were planted with variety Bill Z on June 5 at the rate of ca. 62 pounds per acre. The treatment plots were measured and flagged on July 20, after plant emergence. A randomized complete block design of 14 treatments and four replications was used. Each treatment plot was 20 feet long by three rows wide with a between-row spacing of 30 inches. A 5-foot buffer was placed between flagged plots for starting and stopping fungicide applications with the sprayer boom.

Foliar treatments applied during 1994 and the rates used are listed in Table 1. Fungicide applications were made on July 21, August 4 and August 10. Products were applied using a backpack sprayer in a total spray volume of 30 gallons per acre at 30 psi boom pressure. The boom was equipped with #8004 HSS tips, and had four nozzles spaced at 20 inches. Fresh product, shipped during 1994 was used for all treatments.

Disease severity and yield data always were collected from the same two rows of the three-row treatment plots. Ten terminal leaflets were randomly selected from the upper third of the canopy on August 17 and August 23. The number of rust pustules per leaflet was counted and the average number per terminal leaflet per plot was calculated. The center 10 feet by two rows of each plot was harvested on September 6. The plants were sufficiently dried at this time to permit immediate threshing. Threshed material was cleaned in a clipper mill and seeds weighed to determine total yield.

ARDEC Plots: Research plots were planted with variety UI-114 on May 26 at the rate of ca. 63 pounds per acre. The treatment plots were measured and flagged after plant emergence. A randomized complete block design of 14 treatments and four replications was used. Each treatment plot was 10-feet long by one row wide with a between-row spacing of 30 inches. A 3-foot buffer was placed between flagged plots for starting and stopping fungicide applications with the sprayer boom. The treatments used were the same as those applied at the Torrington site.

Fungicide applications were made on July 14, July 25, and August 3 using a backpack sprayer. Treatments were applied in a total spray volume of 21 gallons per acre at 32 psi pressure. The boom was equipped with #8003 nozzles and had two nozzles spaced at 31 inches.

Ten terminal leaflets were randomly selected from the upper third of the canopy on August 13. The leaflets for each treatment plot were placed in a stack and a one centimeter (cm) cork borer was used to remove disks. The number of rust pustules per leaf disk was counted and the average number of pustules per one cm diameter disk (0.785 cm^2) was calculated. The plots were harvested on August 26 and plants were immediately threshed. Threshed seed was air dried for seven days, cleaned in a clipper mill and weighed to determine total yield and the 200 seed weight.

Data Analysis: Data for each location were analyzed using MSTAT in a two-way ANOVA of 14 treatments and four replications per treatment. Mean separation was done using Duncan's Multiple Range Test ($\underline{P}$=0.05).

Results and Discussion

The effect of fungicide treatment on bean rust disease severity and yield is shown in Table 1. At the Torrington field plot, no significant treatment effects were detected for data collected August 17 ($P \leq 0.05$). On this date, disease severity was low with 0.1 to 15.2 lesions (pustules) counted per terminal leaflet. By August 23, disease progressed in the control from 5.6 to 88.9 lesions per leaflet. The data for this date show all fungicide treatments significantly reduced the number of lesions per leaflet when compared to the non-treated control (P≤0.05). Even though disease was significantly greater for the non-treated control when compared with the fungicide-treated plots, the control had significantly greater yield than treatments 9 (Bravo C/M, low rate) and 12 (Dacobre DG, high rate) (P≤0.05). Treatments 1 (Maneb), 4 (Bravo ZN, low rate), 7 (ASC-66897, high rate), and 8 (ASC-67098-X) also had yields significantly greater than treatments 9 and 12 and were statistically equivalent to the non-treated check (P≤0.05). Because disease severity was similar for all fungicide-treated plots, the observed differences in yield are probably not due to rust control and may be due to variability that was unaccounted for in the experimental design. None of the fungicides applied at the Torrington field site significantly increased yield when compared to the non-treated control plots (P≤0.05). This result was most likely due to the late onset of disease in the plots.

Data collected at the ARDEC plot site also showed all fungicide treatments significantly reduced the number of lesions (pustules) per one cm leaf disk when compared to the non-treated control (P≤0.05). Treatment 13 (Zeneca ICIA5504) provided significantly better control than all other fungicides tested (P≤0.05). Yield data show all fungicide treatments significantly increased total yield when compared to the non-treated control (P≤0.05). Treatment 13 had the greatest yield and was significantly better than treatments 4 (Bravo ZN, low rate), 6 (ASC-66897, low rate), 7 (ASC-66897, high rate), 8 (ASC-67098-X), and 10 (Bravo C/M, high rate) (P≤0.05). All fungicide treatments significantly increased the average seed weight (grams/200 seeds) when compared with the non-treated control (P≤0.05). Treatment 13 (Zeneca ICIA5504) had the greatest average seed weight of all fungicide treatments and was significantly better than treatments 7 (ASC-66897, high rate) and 9 (Bravo C/M) (P≤0.05).

Acknowledgements

The assistance of the field crew at the Torrington R/E Center and at the ARDEC research facility was greatly appreciated.

Table 1. Effect of foliar fungicides on bean rust disease severity and seed yield at two field locations. (University of Wyoming, G.D. Franc, et al. 1994).

Treatment	Torrington, WY[1]			ARDEC, CO[1]		
	Lesions/leaflet		Yield	Lesions/1 cm dia. disk	Yield	
	Aug 17	Aug 23	lbs/A		lbs/A	g/200 seeds
1 Maneb 75DF, 1.5 lbs ai/A	2.8 A[2]	1.4 B	3147.2 AB	11.7 CDE	1021.9 ABC	74.93 AB
2 Bravo 720, 2.0 pt/A	0.5 A	1.1 B	2755.1 BCD	15.9 BCDE	1143.7 AB	75.46 AB
3 Bravo Ultrex, 1.8 lbs/A	0.1 A	0.1 B	2962.1 ABCD	12.6 CDE	1019.3 ABC	73.96 AB
4 Bravo ZN, 2.0 pt/A	0.3 A	3.6 B	3179.9 A	17.0 BCD	922.4 BC	72.31 AB
5 Bravo ZN, 2.880 pt/A	3.3 A	2.7 B	2951.2 ABCD	11.3 DE	1013.9 ABC	74.41 AB
6 ASC-66897 SDG, 1.75 lbs/A	1.3 A	1.0 B	2722.5 CD	19.4 B	929.2 BC	72.08 AB
7 ASC-66897 SDG, 2.5 lbs/A	0.4 A	0.8 B	3158.1 AB	10.4 E	922.3 BC	71.10 B
8 ASC-67098-X, 1.3 lb/A	0.2 A	1.1 B	3223.4 A	14.0 BCDE	927.4 BC	72.86 AB
9 Bravo C/M, 4.0 lbs/A	0.3 A	0.2 B	2657.1 D	17.9 BC	959.0 ABC	71.10 B
10 Bravo C/M, 6.0 lbs/A	15.2 A	6.9 B	2885.9 ABCD	15.7 BCDE	868.7 C	72.60 AB
11 Dacobre DG, 4.0 lbs/A	0.3 A	0.6 B	2842.3 ABCD	18.2 BC	1027.3 ABC	72.05 AB
12 Dacobre DG, 6.0 lbs/A	0.3 A	1.5 B	2711.6 D	12.3 CDE	1150.6 AB	75.79 AB
13 Zeneca ICIA5504, 0.125 lbs/A	0.1 A	1.6 B	2896.8 ABCD	3.4 F	1205.2 A	78.49 A
14 Control, None	5.6 A	88.9 A	3123.5 ABC	50.1 A	549.5 D	65.10 C
Analysis Results	P=0.36	$P\leq0.05$	$P\leq0.05$	$P\leq0.05$	$P\leq0.05$	$P\leq0.05$

[1] Research plots were located at the Torrington Research and Extension Center, Torrington, WY and ARDEC near Fort Collins, CO. Lesions (rust pustules) were counted to determine disease severity.

[2] Treatment means followed by different letters differ significantly (P<0.05). Duncan's Multiple Range Test was used for mean separation (P=0.05).

A New Disease of Pinto Bean caused by <u>Aphelenchoides</u> <u>ritzemabosi</u> and its Associated Foliar Symptoms

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Introduction

A new disease of pinto bean caused by *Aphelenchoides ritzemabosi* was recently described in Wyoming (2). Field observations made during August 1992 in north central Wyoming following a cool wet period, revealed pinto bean plants (*Phaseolus vulgaris* L., cultivar Othello) with numerous dark, angular lesions on leaves and, occasionally, a superficial necrosis on the upper surface of the petiole (1). Microscopic examination revealed that a nematode was associated with symptomatic tissue. Koch's postulates were completed with nematodes recovered from symptomatic tissue collected at two field sites.

Results and Discussion

Inoculated unifoliolate and trifoliolate leaves of pinto bean plants (cultivar Othello), grown in a growth chamber, developed angular lesions after ca. 11 days at 22 degrees celcius that were similar in appearance to those observed in the field. The discoloration associated with angular lesions became more obvious 14 to 20 days after inoculation. The expansion of individual angular lesions was limited by leaf veins with most lesions ranging in size from several millimeters to ca. one centimeter. Occasionally, entire inoculated leaves became chlorotic or necrotic within 24 days after inoculation.

The nematode recovered from the original plant material and after two serial transfers through artificially inoculated plants was identified by A.M. Golden (USDA, ARS Nematology Laboratory, Beltsville, MD) as *Aphelenchoides ritzemabosi* (Schwartz, 1911) (Steiner & Buhrer, 1932).

Significance

Diagnosis of this new disease is possible by relying on foliar symptom expression and the presence of the nematode in symptomatic tissue. It is likely that cool, wet environmental conditions increase the risk of infection and subsequent disease development.

Infection of pinto bean by *A. ritzemabosi* is likely to cause some degree of yield loss to growers since photosynthetic area of the leaf is damaged or destroyed by the nematode as it feeds and reproduces. This nematode has routinely been found in association with the alfalfa stem nematode, *Ditylenchus dipsaci* (Kuhn) Filipjev in alfalfa in Wyoming and other western states. Because alfalfa and pinto bean production areas overlap in Wyoming, alfalfa and pinto bean crop rotation provides a mechanism through which the nematode is able to persist. Fields in which affected pinto beans were found had a recent history of alfalfa production.

Key Citations

1. Franc, G.D. and C.M-S. Beaupré. 1994. Foliar Symptoms Associated with Infection of Pinto Bean by *Aphelenchoides ritzemabosi* in Wyoming. Phytopathology 83 to 1 388.
2. Franc, G.D., C.M-S. Beaupré and J.L. Williams. 1993. A New Disease of Pinto Bean Caused by *Aphelenchoides ritzemabosi* in Wyoming. Plant Disease 77:1168.

Potato Seedpiece Fungicide Treatments for Control of Soilborne Disease, 1991

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Abstract

Field trials were conducted at the University of Wyoming R/E Center located at Torrington. Twelve seedpiece treatments were applied to cultivar (cv.) Monona potatoes and compared to a non-treated check for disease management. A significant effect on plant stand due to seedpiece treatment was observed on June 7, June 12, and July 3; while on June 20 all treatments were statistically equivalent ($P<0.05$). The non-treated check had the lowest stand count among treatments on the first two sampling dates. All treatments, except two containing ASC 66903, significantly reduced canker development by *R. solani* when compared to the non-treated check ($P=0.05$). However, data on stem cankering should be interpreted cautiously, as two similar treatments also differed significantly ($P<0.05$). This suggests inoculum was not distributed evenly within the field plot. None of the treatments significantly affected plant height, early blight severity, tuber yield, or grade when compared to the non-treated check ($P=0.05$).

Materials & Methods

Field trials were conducted at the University of Wyoming R/E Center located at Torrington. Treatment plots were 20-feet long and four rows wide. The two outer rows of the 4 row plots were not treated and the two center rows were treated; all data were collected from the center rows. The border rows were continuous and a 5-feet non-planted buffer for the two center rows was left between plots. A randomized complete block design of 13 treatments and four replications was used for the study.

Certified seed (cv. Monona) produced through the Nebraska certified seed program was used for the study. Sclerotia of *Rhizoctonia solani* was present on the surface of some of the seed tubers at the time of planting. Seed tubers for border rows were pre-cut using a commercial cutter and treated with 'P.S.T. Plus Bark' (JR Simplot Co.; containing zinc ion manganese ethylene bisdithiocarbamate at 6 percent). Border rows were planted on May 15 using a two-row iron age planter and treated rows were planted on May 22. All seed was spaced at 12 inches.

Seed used to plant the treated (center) rows was cut by hand and sorted to give a bulk seedlot with a uniform seed piece size of ca. two ounces. Precisely 35 pounds of cut seed was placed into separate large plastic trash bags for each treatment. Treatments formulated for direct application to cut seed were pre-measured, applied to the seed in the bags, and bags were agitated to give uniform coverage. After treatment, 40 seed pieces per treatment for each replication were removed, placed into labeled paper bags and taken to the field for planting. For treatments applied in-row at planting (rather than directly to cut seed), the seed was

exposed immediately after planting by removing soil with a rake, treatments were applied, and the soil replaced. Seed used to plant treated rows was prepared on May 21 and planted on May 22. Foliar fungicide applications were also made later in the growing season. All treatments, including the non-treated check, received foliar applications of Bravo 720, except treatment 7, which received foliar applications of Rovral 4F. All information on seed and foliar treatments is shown in Table 1.

Table 1. Fungicides used for seedpiece treatment studies at Torrington, Wyoming. (G. D. Franc, Univ. of WY, 1991).

SEEDPIECE & FOLIAR TREATMENTS APPLIED

1. Non-treated CHECK*
2. ALIETTE+ROVRAL (5.5 lbs/1000 ft in-row; granular) *
3. ALIETTE+ROVRAL (2.75 lbs/1000 ft in-row; granular) *
4. ALIETTE+ROVRAL (7.35 oz + 5.6 fl oz/1000 ft; 20 gpa band)
5. ALIETTE+ROVRAL (5.2 oz + 4.2 fl oz/1000 ft; 20 gpa band)*
6. ASC 66903 10D (1.0 lbs/cwt)*
7. ASC 66903 10D (1.0 lbs/cwt)**
8. ASC 66903 7.5D (1.0 lbs/cwt)*
9. CGA 173506 [0.2] (0.5 lbs/cwt)*
10. CGA 173506 [0.5] (0.5 lbs/cwt)*
11. CGA 173506 [1.0] (0.5 lbs/cwt)*
12. TOPSIN M 2.5D (1.0 lbs/cwt)*
13. POTATO SEED TREATER (EBDC) + BARK (1.0 lbs/cwt)*

* Plus; Bravo 720 (1.0 pints per acre) applied as a foliar fungicide.

** Plus; Rovral 4F (0.5 pounds per acre) + 0.25 percent Triton CS-7 applied as foliar fungicide.

Foliar treatments were applied in a total volume of 40 gallons per acre at 18 psi boom pressure with #8004 HSS nozzle tips. Applications were made at ca. 10-day intervals on July 19, July 29, August 8, August 19 and August 29.

Total stand counts were taken June 7, June 12, June 20 and July 3. The percentage of stem surface-area cankered by *R. solani* was estimated on July 3 using the Horsfall-Barratt scale (0-11). Data were converted to percentages, after analysis, for presentation in Table 3. Canker development resulted from naturally occurring inoculum present on the seed tubers and/or in soil. Plant height measurements taken on July 29, August 20, and August 29 were done by measuring the length of a single stem from five randomly selected hills per treatment plot. Early blight foliar disease severity was measured by counting the number of lesions per leaflet for collections made on August 20, August 28, and September 3. These lesion counts were done by randomly selecting nine leaves per treatment plot, three each from the top, middle, and bottom third of the plant canopy, and counting the number of early blight lesions visible on up to seven leaflets per leaf. Early blight development was due to naturally occurring inoculum. Tuber harvest was done on September 20 with the aid of a single row harvester. The total tuber yield and grade for each treatment plot was measured on September 21.

Data were analyzed using MSTAT in a two-way ANOVA with four replications and 13 treatments. Mean separation was done using Duncan's MRT ($\underline{P}$ = 0.05).

Results

Plant growth was not affected by the seedpiece treatments (P=0.05). The data showed that none of the treatments in this study significantly affected plant height (Table 2), tuber yield, or grade (Table 4), when compared to the non-treated check (P=0.05).

A significant effect on plant stand due to seedpiece treatment was observed on June 7 June 12, and July 3; while on June 20 all treatments were statistically equivalent (Table 2) (P<0.05). The non-treated check (treatment 1) had the lowest stand count among treatments on the first two sampling dates. Stands for treatments 4, 5, and 9 were significantly better (P<0.05) than the non-treated check on June 7; treatment 5 was significantly better than treatment 12 (P<0.05) on this date. On June 12, treatments 4, 9, and 12 showed significantly better stands (P<0.05) than the non-treated check. On July 3, treatments 7 and 11 had significantly lower stand counts (P<0.03) than those in the check plots. There was no significant difference (P<0.05) between the two commercial seed piece formulations (treatments 12 and 13) and the non-treated check for effect upon stand count at any of the sampling dates, except June 12 when Topsin M was significantly better than the check.

All treatments, except 6 and 8, significantly (P<0.05) reduced canker development by *R. solani* when compared to the non-treated check (Table 3). Treatment 7 reduced canker development significantly better (P<0.05) than did treatment 6, even though they received the same seed treatment and had not received foliar fungicide applications until after this date.

There was no significant difference in early blight disease severity among treatments (Table 3). All treatments, including the non-treated check, received either Bravo or Rovral foliar fungicide applications at ca. 10-day intervals.

Discussion

Early blight disease pressure was relatively low in 1991. This most likely occurred because initial inoculum was reduced at the field site by a long rotation between potato crops and unfavorable weather during the early stages of the epidemic. Therefore, interactions between seedpiece treatments and foliar fungicide treatments, if they existed, may not have been expressed.

The data on stem cankering (Table 3) should be interpreted cautiously because treatments 6 and 7 differed significantly ($P<0.05$), even though they received identical seedpiece treatments (i.e., since the foliar fungicide treatments were not applied until July 19, treatments 6 and 7 were identical on July 3 when stem canker data were collected). Although the treatment means calculated from field data could have differences of this magnitude due to chance, this explanation is not likely at the probability levels used for this study ($P<0.05$). More likely, the inoculum was distributed unevenly through the field or on the seedpieces treated and planted for the study.

Some trends were observed in the data. For instance, the Aliette/Rovral treatments applied as a granular (treatments 2 and 3) always had fewer plants emerged when compared to treatment with Aliette/Rovral applied as a tank mix in a 20 gallons per acre (gpa) band (treatments 4 and 5). Also, increasing CGA 173506 concentration may have slightly reduced emergence early in the season (treatments 9, 10, and 11 in Table 2). This concentration effect may be visible in the plant height measurements taken on July 29, as height was reduced from 53.5 centimeters for treatment 9 to 45.2 ctentimeters for treatment 11. However, as the data in the tables show, these trends were not significant ($P=0.05$).

Acknowledgements

The assistance of Paul Konrad, Steve Knox and the field crew at the Torrington R/E Center was appreciated. The donation of cut seed potatoes by Bob Fornstrom is gratefully acknowledged.

Table 2. The effect of seedpiece and foliar fungicide application on plant stand and height of potato when applied to control Rhizoctonia canker (*R. solani*) and early blight disease (*A. solani*). (G.D. Franc, 1991 Torrington, Wyoming).

TREATMENT NUMBER[1]	PLANT STAND (40 MAXIMUM)				HEIGHT (cm)	
	JUNE 7	JUN 12	JUN 20	JUL 3	JUL 29	AUG 20
1	3.3 D[2]	18.0 C	30.8 A	37.0 A	50.2 A	62.6 A
2	6.8 ABCD	21.5 BC	31.0 A	33.5 AB	48.7 A	58.5 A
3	6.8 ABCD	25.5 ABC	32.8 A	35.3 AB	50.9 A	59.4 A
4	10.8 AB	28.3 AB	36.5 A	37.3 A	51.8 A	59.2 A
5	11.3 A	26.3 ABC	33.3 A	35.5 AB	51.0 A	57.8 A
6	4.0 CD	20.8 BC	30.0 A	33.3 AB	51.8 A	60.3 A
7	4.8 CD	21.5 BC	29.5 A	32.5 B	52.3 A	61.8 A
8	4.3 CD	22.0 BC	32.0 A	34.0 AB	51.1 A	56.5 A
9	8.8 ABC	32.3 A	36.8 A	37.8 A	53.5 A	57.7 A
10	7.3 ABCD	24.5 ABC	33.8 A	37.3 A	51.9 A	54.5 A
11	6.8 ABCD	24.0 BC	30.5 A	32.3 B	45.2 A	58.9 A
12	6.0 BCD	28.3 AB	33.5 A	35.5 AB	56.5 A	64.5 A
13	7.5 ABCD	26.3 ABC	34.8 A	37.8 A	49.8 A	59.7 A
ANALYSIS	P=0.01	P=0.02	NSD	P=0.03	NSD	NSD

[1] See Table 1 for complete descriptions of the treatments.

[2] Treatment means with different letters differ significantly. Duncan's Multiple Range Test was used for mean separation (P=0.05).

Table 3. The effect of seedpiece and foliar fungicide application on disease severity of Rhizoctonia Canker (*R. solani*) and Early Blight (*A. solani*) of potato. (G.D. Franc, 1991 Torrington, Wyoming).

Treatment Number[1]	Estimated % Stem Cankered by Rhizoctonia	Early Blight Disease Severity (Lesions/Leaflet)		
	JUL 3	AUG 20	AUG 28	SEP 3
1	4.5 A[2]	0.1 A	1.0 A	1.1 A
2	1.6 CDE	0.0 A	1.0 A	2.6 A
3	2.5 BC	0.1 A	1.4 A	2.4 A
4	0.8 DE	0.1 A	0.9 A	1.8 A
5	0.5 E	0.2 A	1.5 A	2.0 A
6	5.0 A	0.2 A	1.0 A	2.1 A
7	1.8 CDE	0.1 A	0.9 A	1.4 A
8	4.0 AB	0.3 A	1.0 A	1.5 A
9	1.2 CDE	0.1 A	0.8 A	1.9 A
10	0.6 DE	0.3 A	1.1 A	1.3 A
11	0.8 DE	0.1 A	1.5 A	1.5 A
12	1.2 CDE	0.1 A	1.4 A	1.4 A
13	1.8 CD	0.1 A	1.1 A	2.2 A
ANALYSIS	$P<0.001$	NSD	NSD	NSD

[1] See Table 1 for complete descriptions of the treatments.

[2] Treatment means with different letters differ significantly. Duncan's Multiple Range Test was used for mean separation ($\underline{P}$=0.05).

Table 4. The effect of seedpiece and foliar fungicide application on potato tuber yield and grade. (G.D. Franc, 1991 Torrington, Wyoming).

Treatment Number[1]	Yield & Grade (cwt/A)					
	US #1>10 OZ	US #1<10 OZ	US #2	B SIZE	CULLS	TOTAL
1	93.5 A[2]	171.2 A	29.3 A	11.9 A	1.7 A	307.6 A
2	74.4 A	182.1 A	28.5 A	10.7 A	0.8 A	296.6 A
3	69.2 A	199.0 A	32.1 A	11.5 A	2.0 A	313.9 A
4	74.8 A	224.0 A	20.4 A	13.1 A	1.6 A	334.0 A
5	81.5 A	186.1 A	31.3 A	11.9 A	1.1 A	312.0 A
6	93.1 A	191.0 A	27.3 A	9.1 A	1.9 A	322.3 A
7	92.0 A	183.3 A	27.3 A	8.3 A	0.6 A	311.5 A
8	80.7 A	189.0 A	33.7 A	11.5 A	1.8 A	316.7 A
9	103.6 A	225.2 A	24.8 A	9.9 A	1.8 A	365.4 A
10	90.9 A	223.6 A	23.6 A	9.9 A	1.6 A	349.6 A
11	87.8 A	194.2 A	25.2 A	8.7 A	1.4 A	317.3 A
12	104.8 A	212.7 A	20.0 A	11.1 A	2.4 A	351.0 A
13	66.9 A	189.8 A	36.1 A	9.5 A	2.1 A	304.5 A
ANALYSIS	NSD	NSD	NSD	NSD	NSD	NSD

[1] See Table 1 for complete descriptions of the treatments.

[2] Treatment means with different letters differ significantly. Duncan's Multiple Range Test was used for mean separation (P=0.05).

Potato Seedpiece Fungicide Treatments for Control of Soilborne Disease, 1992

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Abstract

Field trials were conducted at the University of Wyoming R/E Center located at Torrington. Thirteen seedpiece fungicide treatments were applied to cut seed (cv. Norgold Russet "M") potatoes and compared to a non-treated check. On June 4, Rovral 4F treatments 11, 12, 13, and 14 were applied as an in-furrow band, and seedpiece treatment 4 (ASC 67090) had stand counts significantly higher than the non-treated check (P=0.05). The standard "PST + Bark" (treatment 2) was significantly better than treatment 10 (ASC 67096) and was statistically equivalent to all other treatments and the non-treated check (P=0.05). As the growing season progressed, treatment effects on stand were no longer observed. On July 9, treatments 2, 11, and 12 were significantly more vigorous than the non-treated check (P=0.05). Addition of Aliette 80WDG to Rovral 4F (treatment 14) significantly reduced early plant vigor when compared to the lower rates of Rovral 4F applied alone (treatments 11 and 12) (P=0.05). The standard "PST + Bark" (treatment 2) was significantly more vigorous than the non-treated check and treatment 7 (ASC 67093) (P=0.05). Seedpiece treatment did not significantly affect the estimated percentage of the stem cankered by R. solani (P=0.05). Treatment 7 (ASC 67093) had a significantly lower total tuber yield than ASC treatments 4, 6, 8, and 9, and Rovral 4F treatments 11 and 12 (P=0.05). The proportion of total yield in each grade category was not significantly affected by seedpiece treatment (P=0.05).

Materials & Methods

Seed Preparation and Treatment: Field trials were conducted at the University of Wyoming R/E Center located at Torrington. Treatment plots were 20-feet long by four rows wide. The two outer rows of treatment plots were non-treated border rows and the two center rows were treated with one of the products listed in Table 1. All data were collected from the center rows. The border rows were continuous across the field and a 5-foot non-planted buffer for the two center rows was left between treatment plots. A randomized complete block design of 14 treatments and four replications was used for the study.

Certified seed (cv. Norgold Russet "M" G-IV) produced through the Nebraska certified seed program was used for the study. Seed tubers for border rows were pre-cut using a commercial cutter and treated with 'P.S.T. Plus Bark' (a JR Simplot Co. product containing zinc ion manganese ethylene bisdithiocarbamate at 6 percent). All border rows and treatment rows were planted on May 8 using a two-row iron age planter. All seed was spaced at 12 inches within the row with a 36 inch between-row spacing.

Seed used to plant the treated (center) rows was cut by hand and sorted to give a bulk seedlot with a uniform seedpiece size of ca. two ounces. Precisely 30 pounds of cut seed was placed into separate large plastic trash bags for each treatment. Treatments formulated for direct application to cut seed were pre-measured, applied to the seed in the bags and the bags agitated to give uniform coverage. For all treatments, exactly 40 seedpieces with at least one eye, per treatment per replication were removed, placed into labeled paper bags, and taken to the field for planting. For treatments 11-14 which were applied in-row at planting rather than directly to cut seed, the following procedure was used. The seed was exposed after planting (four hours or less) by removing soil with a rake, precise volumes of each treatment was applied with a hand-held "misting" bottle, and the soil immediately replaced. All seed used to plant treated rows was cut on May 7 and planted on May 8, 1992. The seedpiece fungicide treatments tested are listed in Table 1.

Data Collection and Analysis: Total stand counts were taken June 4, June11, June 25 and July 18. The maximum stand possible, equal to the number of seedpieces planted, was 40 plants per treatment plot. Plant height measurements taken on July 9, July 22 and July 29 were done by measuring the length of a single stem from five randomly selected hills per treatment plot. Plant vigor ratings, relative to the non-treated check, were done on July

9, July 22 and July 29 using a scale of zero to 10 (10=best). All treatments within a replication were compared to the non-treated check, which was arbitrarily assigned an intermediate rating of "5."

The percentage of stem surface-area cankered by *R. solani* was estimated on July 9 and July 22 using the Horsfall-Barratt scale (0-11). A single stem from five randomly-selected hills per treatment plot was rated on each date. Canker development resulted from naturally occurring inoculum present on the seed tubers and/or in soil. The percentage of necrotic foliage was estimated for each treatment plot on August 6 using the same scale (0-11). Data were converted to percentage after analysis for presentation in Table 3. Tuber harvest was done on September 24 with the aid of a single-row harvester. The total tuber yield and grade for each treatment plot was measured and the proportion of total tuber yield present in each grade category was calculated.

Data were analyzed using MSTAT in a two-way ANOVA with four replications and 14 treatments. Mean separation was done using Duncan's MultipleRange Test (P=0.05).

Results

The stand count data in Table 2, columns 2-5, show several seedpiece treatments increased early plant emergence. A significant treatment effect on plant stand was observed on June 4 (27 days after planting; P=0.002) and by June 11, as plants continued to emerge, all treatments became statistically equivalent (P=0.05). Even though early stand counts were affected, the data in columns 6-8 show no treatment effect on plant height was detected (P=0.05).

On June 4 (Table 2, column 2), Rovral 4F treatments 11, 12, 13, and 14 applied as an in-furrow band, and seedpiece treatment 4 (ASC 67090) had stand counts significantly better than the non-treated check (P=0.05). The three rates of Rovral 4F tested in treatments 11, 12, and 13 were significantly better than ASC formulations present in treatments 5, 9, and 10 but not better than ASC formulations present in treatments 3, 4, 6, 7, and 8 or the standard, treatment 2, "PST + Bark" (P=0.05). All ASC-containing treatments (treatments 3-10) were statistically equivalent except treatments 5 (ASC 67091) and 10 (ASC 67096), which had significantly less stand than treatment 4 (ASC 67090); treatment 10 also had significantly less stand than treatment 8 (ASC 67094) (P=0.05). The standard "PST + Bark" (treatment 2) was significantly better than treatment 10 and was statistically equivalent to all other treatments and the non-treated check (P=0.05).

Table 1. List of seedpiece fungicide treatments used during 1992 field trials. (G. D. Franc, et al., Torrington, Wyoming).

Treatment #	Rate	Amount Required
1. (non-treated) CHECK	NO TREATMENT	NONE
2. PST + BARK	@ 1.0 LB/CWT	136 g/30 lb seed
3. ASC 67089 20%	@ 0.5 LB/CWT	68 g/30 lb seed
4. ASC 67090 20%	@ 0.5 LB/CWT	68 g/30 lb seed
5. ASC 67091 25%	@ 0.5 LB/CWT	68 g/30 lb seed
6. ASC 67092 20%	@ 0.5 LB/CWT	68 g/30 lb seed
7. ASC 67093 5%	@ 0.5 LB/CWT	68 g/30 lb seed
8. ASC 67094 15%	@ 0.5 LB/CWT	68 g/30 lb seed
9. ASC 67095 20%	@ 0.5 LB/CWT	68 g/30 lb seed
10. ASC 67096 0%	@ 0.5 LB/CWT	68 g/30 lb seed
11.*ROVRAL 4F	@ 5.0 FL OZ/1000 FT ROW*	5.9 ml + 98.4 ml water/40 ft
12.*ROVRAL 4F	@ 7.4 FL OZ/1000 FT ROW*	8.8 ml + 95.5 ml water/40 ft
13.*ROVRAL 4F	@ 8.8 FL OZ/1000 FT ROW*	10.4 ml + 93.9 ml water/40 ft
14.*ROVRAL 4F + ALIETTE 80WDG	@ 5.0 FL OZ + 7.0 FL OZ/1000 FT ROW*	5.9 ml + 7.9 g + 98.4 ml water/40 ft

* Treatments 11-14 were applied in a 12-inch band to the open furrow and furrow shoulders shortly after planting (within ca. four hour). A rake was used to remove soil and expose the seedpieces planted in the furrow, chemical was applied, and the soil immediately replaced. These treatments were applied in a 30 gallons per acre band (104.3 militer spray per 40-foot plot).

Data in Table 3, columns 2-4, show a significant difference in plant vigor among treatment means was detected early in the growing season (July 9) and was not detected later (July 22 and July 29). On July 9, the standard "PST + Bark" in treatment 2 and the lower rates of Rovral 4F (treatments 11 and 12) were significantly more vigorous than the non-treated check (P=0.05). All in-row Rovral 4F banding treatments 11, 12, and 13 (5.0, 7.4, and 8.8 fluid ounces per 1000 feet, respectively) were statistically equivalent at this time (P=0.05). However, addition of Aliette 80WDG to Rovral 4F (treatment 14) significantly reduced early plant vigor when compared to the lower rates of Rovral 4F applied alone (treatments 11 and 12) (P=0.05). All ASC treatments (treatments 3-10) were statistically equivalent except treatment 7 (ASC 67093), which had significantly less vigor than ASC 67090 in treatment 4 (P=0.05). The standard "PST + Bark" (treatment 2) was significantly more vigorous than the non-treated check and treatment 7 (ASC 67093) and was statistically equivalent to all other fungicide treatments (P=0.05).

Seedpiece treatment did not significantly affect the estimated percentage of the stem cankered by *R. solani* or the amount of necrotic foliage present (Table 3, columns 5-7) (P=0.05).

The data in Table 4 show that all treatments were statistically equivalent for total yield, except for treatment 7 (ASC 67093), which had a significantly lower total yield than treatments 2, 4, 6, 8, 9, 11, and 12 (P=0.05). Although not significant, treatments 3 and 7 had total yields less than the non-treated check while all other treatments had total yields greater than the non-treated check. The data in Table 5 show that the proportion of total yield in each grade category was not significantly affected by seedpiece treatment (P=0.05).

Discussion

Early blight disease severity observed in the seedpiece treatment plots during 1992 was much greater than during 1991. Although this was partially due to the use of a cultivar with greater susceptibility and also because inoculum levels were probably greater (potatoes were planted in the field plots during two consecutive years), early blight still progressed at an unusually rapid rate during 1992. Plants were noticeably defoliated by mid-August. Data was not collected to determine if there was an interaction between seedpiece treatment and foliar early blight severity.

Early plant emergence was significantly affected by the seedpiece treatments (P=0.05). Although the improved stand count with the in-furrow Rovral 4F treatments may have been due to manual removal and replacement of soil during treatment application, seedpiece treatment 4, for which soil removal and replacement was not done, also gave comparable early stand results. As the growing season progressed and additional plants emerged, all treatments became equivalent.

Early plant emergence often results in more vigorous plants. This trend was not seen during 1992. Addition of Aliette 80WDG to Rovral 4F (treatment 14) significantly reduced early plant vigor when compared to the same rate of Rovral 4F applied alone (treatment 11) (P=0.05). The data show that average plant height and total tuber yield for treatment 14, although not significantly different, were reduced approximately 12 percent when compared to treatment 11. Therefore, weak evidence suggests use of Aliette in-row with Rovral 4F may adversely affect plant growth and yield. Data from other test plots may show if this trend is real.

Acknowledgements

The assistance of Steve Knox and the field crew at the Torrington R/E Center was greatly needed and appreciated. The cut seed potatoes, provided by Bob Fornstrom of Lodgepole Farms, Pine Bluffs is gratefully acknowledged.

Table 2. The effect of seedpiece fungicide treatments on cv. Norgold Russet "M" stand counts and plant height. (G. D. Franc, et al., 1992, Torrington, Wyoming).

Treatment #[1]	Stand Count[2]				Average Plant Height (cm)[3]		
	6/04	6/11	6/25	7/18	7/9	7/22	7/29
1. Non-treated CHECK	30 CD[4]	38A	38A	37A	39.6A	41.7A	45.2A
2. PST + BARK (1.0 LB/CWT)	33ABC	37A	38A	38A	40.4A	46.5A	47.7A
3. ASC 67089 20% (0.5 LB/CWT)	32ABCD	38A	38A	38A	38.0A	42.0A	42.7A
4. ASC 67090 20% (0.5 LB/CWT)	35AB	39A	38A	38A	41.0A	44.7A	46.8A
5. ASC 67091 25% (0.5 LB/CWT)	29 CD	37A	38A	38A	40.2A	44.6A	46.0A
6. ASC 67092 20% (0.5 LB/CWT)	33ABCD	39A	39A	39A	42.5A	45.9A	49.5A
7. ASC 67093 5% (0.5 LB/CWT)	33ABCD	38A	38A	38A	37.0A	42.5A	44.6A
8. ASC 67094 15% (0.5 LB/CWT)	33ABC	38A	39A	39A	42.8A	47.3A	50.4A
9. ASC 67095 20% (0.5 LB/CWT)	30 BCD	37A	37A	36A	40.8A	46.7A	48.7A
10. ASC 67096 0% (0.5 LB/CWT)	28 D	36A	36A	36A	39.3A	42.9A	43.3A
11. ROVRAL 4F (5.0 FL OZ/1K FT)	36A	39A	39A	39A	43.4A	47.0A	49.2A
12. ROVRAL 4F (7.4 FL OZ/1K FT)	37A	38A	38A	38A	44.1A	46.5A	49.6A
13. ROVRAL 4F (8.8 FL OZ/1K FT)	36A	38A	38A	38A	40.3A	43.5A	41.3A
14. ROVRAL 4F + ALIETTE 80WDG (5.0 + 7.0 FL OZ/1K FT)	35AB	38A	38A	37A	37.3A	41.5A	42.9A
Analysis Results	P=.002	NSD	NSD	NSD	NSD	NSD	NSD

[1] See Table 1 for a complete description of seedpiece treatments

[2] Data shown is for the average of four replications. Maximum (100 percent) stand is 40 plants .

[3] Five stems per treatment plot were measured from the ground to stem apex.

[4] Treatment means followed by different letters differ significantly (P=0.05). Duncan's Multiple Range Test was used for mean separation.

Table 3. Effect of seedpiece fungicide treatment on Norgold Russet "M" plant vigor, estimated percentage of stem cankered by <u>Rhizoctonia solani</u> and the estimated percentage of foliage necrotic. (G. D. Franc, et al., 1992 Torrington, Wyoming).

Treatment #[1]	Average Plant Vigor [2]			Estimated % of Stem Cankered [3]		Estimated % of Foliage Necrotic [3]
	7/09	7/22	7/29	7/9	7/22	7/29
1. Non-treated CHECK	5 DE[4]	5A	5A	23.5A	34.0A	12.0A
2. PST + BARK (1.0 LB/CWT)	7ABC	6A	6A	38.5A	27.3A	13.0A
3. ASC 67089 20% (0.5 LB/CWT)	6 BCDE	5A	5A	19.5A	28.0A	26.5A
4. ASC 67090 20% (0.5 LB/CWT)	6ABCD	5A	5A	25.8A	22.0A	28.0A
5. ASC 67091 25% (0.5 LB/CWT)	6 BCDE	6A	5A	25.0A	25.0A	15.0A
6. ASC 67092 20% (0.5 LB/CWT)	6ABCDE	6A	6A	37.0A	33.0A	15.0A
7. ASC 67093 5% (0.5 LB/CWT)	5 E	5A	6A	42.0A	40.5A	21.0A
8. ASC 67094 15% (0.5 LB/CWT)	6ABCDE	5A	6A	19.5A	31.0A	11.5A
9. ASC 67095 20% (0.5 LB/CWT)	6ABCDE	5A	6A	26.5A	28.0A	14.0A
10. ASC 67096 0% (0.5 LB/CWT)	6 BCDE	6A	6A	28.0A	46.0A	22.0A
11. ROVRAL 4F (5.0 FL OZ/1K FT)	7AB	6A	6A	35.0A	31.0A	17.0A
12. ROVRAL 4F (7.4 FL OZ/1K FT)	7A	6A	6A	22.0A	38.5A	22.0A
13. ROVRAL 4F (8.8 FL OZ/1K FT)	6ABCDE	5A	5A	23.5A	31.0A	35.0A
14. ROVRAL 4F + ALIETTE 80WDG (5.0 + 7.0 FL OZ/1K FT)	5 CDE	5A	6A	18.5A	35.0A	21.0A
Analysis Results	P<.01	NSD	NSD	NSD	NSD	NSD

[1] See Table 1 for a complete description of seedpiece treatments.
[2] Treatment plots were rated on a scale of one to 10 (10=best). All treatments, within a replication, were compared to the non-treated check, which was always assigned a rating of "5".
[3] Percentages were estimated visually using the Horsfall-Barratt scale (0-11).
[4] Treatment means followed by different letters differ significantly (P=0.05). Duncan's Multiple Range test was used for mean separation.

Table 4. Effect of seedpiece fungicide treatment on Norgold Russet "M" tuber yield and grade. (G. D. Franc, et al., 1992 Torrington, Wyoming).

Treatment #[1]	Tuber Yield and Grade (cwt/A)							
	US #1 <10 OZ	US #1 >10 OZ	US #1 Total	US #2 Total	US #1 + US #2	B Size	Culls	Total
1. Non-treated CHECK	179.5A[2]	50.6A	230.0A	25.2A	255.3A	15.1A	0.6A	271.0AB
2. PST + BARK	213.5A	87.2A	300.6A	21.8A	322.5A	11.1A	0.8A	334.4A
3. ASC 67089 20%	177.2A	58.8A	236.0A	16.1A	252.1A	13.6A	1.0A	266.6AB
4. ASC 67090 20%	204.9A	64.3A	269.3A	21.6A	290.9A	17.5A	0.0A	308.5A
5. ASC 67091 25%	196.9A	66.9A	263.8A	13.9A	277.8A	15.8A	1.4A	295.0AB
6. ASC 67092 20%	212.4A	70.8A	283.2A	16.9A	300.1A	15.7A	0.6A	316.3A
7. ASC 67093 5%	164.3A	29.8A	194.1A	16.1A	210.2A	16.9A	0.2A	227.3 B
8. ASC 67094 15%	221.3A	66.2A	287.4A	21.1A	308.6A	12.3A	0.9A	321.7A
9. ASC 67095 20%	208.8A	67.2A	276.0A	18.5A	294.5A	14.3A	0.3A	309.0A
10. ASC 67096 0%	200.4A	49.5A	249.9A	26.5A	276.5A	11.3A	1.0A	288.8AB
11. ROVRAL 4F @ 5.0 fl oz	208.2A	75.4A	283.6A	21.4A	305.1A	19.1A	2.3A	326.5A
12. ROVRAL 4F @ 7.4 fl oz	218.3A	67.4A	285.7A	25.1A	310.9A	15.6A	2.3A	328.8A
13. ROVRAL 4F @ 8.8 fl oz	195.8A	52.5A	248.2A	21.4A	269.6A	13.4A	2.7A	285.8AB
14. ROVRAL 4F+ALIETTE 80WDG	197.0A	62.3A	259.3A	13.7A	273.0A	14.9A	0.7A	288.7AB
Analysis Results	NSD	NSD	P=0.06	NSD	P=0.07	NSD	NSD	P=0.05

[1] See Table 1 for a complete description of seedpiece treatments.

[2] Treatment means followed by different letters differ significantly (P=0.05). Duncan's Multiple Range Test was used for mean separation.

Table 5. Effect of seedpiece treatment on the proportion of total tuber yield in each grade category for Norgold Russet "M". (G. D. Franc, et al., 1992 Torrington, Wyoming).

Treatment #[1]	Proportion of Total Yield in Each Grade Category						
	US #1 <10 OZ	US#1 >10 OZ	US #1 Total	US #2 Total	US #1 + US #2	B Size	Culls
1. Non-treated CHECK	0.669A[2]	0.167A	0.836A	0.091A	0.927A	0.071A	0.002A
2. PST + BARK	0.642A	0.255A	0.898A	0.066A	0.964A	0.034A	0.002A
3. ASC 67089 20%	0.668A	0.215A	0.884A	0.061A	0.945A	0.052A	0.004A
4. ASC 67090 20%	0.667A	0.206A	0.873A	0.070A	0.943A	0.057A	0.000A
5. ASC 67091 25%	0.681A	0.214A	0.896A	0.044A	0.940A	0.056A	0.004A
6. ASC 67092 20%	0.677A	0.217A	0.894A	0.053A	0.947A	0.052A	0.002A
7. ASC 67093 5%	0.724A	0.125A	0.848A	0.073A	0.921A	0.079A	0.001A
8. ASC 67094 15%	0.692A	0.199A	0.891A	0.067A	0.958A	0.039A	0.002A
9. ASC 67095 20%	0.672A	0.222A	0.894A	0.060A	0.954A	0.045A	0.001A
10. ASC 67096 0% (0.5 LB/CWT)	0.697A	0.167A	0.864A	0.092A	0.956A	0.041A	0.004A
11. ROVRAL 4F @ 5.0 fl oz	0.638A	0.234A	0.872A	0.061A	0.933A	0.061A	0.007A
12. ROVRAL 4F @ 7.4 fl oz	0.670A	0.201A	0.871A	0.075A	0.946A	0.047A	0.008A
13. ROVRAL 4F @ 8.8 fl oz	0.684A	0.185A	0.870A	0.074A	0.943A	0.047A	0.010A
14. ROVRAL 4F + ALIETTE 80WDG	0.683A	0.211A	0.893A	0.049A	0.943A	0.054A	0.002A
Analysis Results	NSD	NSD	NSD	NSD	NSD	NSD	NSD

[1] See Table 1 for a complete description of seedpiece treatments.

[2] Treatment means followed by different letters differ significantly (P=0.05). Duncan's Multiple Range Test was used for mean separation.

Potato Seedpiece Fungicide Treatments for Control of Soilborne Diseases, 1993

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Abstract

Field trials were conducted at the University of Wyoming R/E Center located at Torrington. Four seedpiece fungicide treatments were applied to cut seed potatoes (cv. Norgold Russet) and compared to a non-treated check. Seedpiece treatments did not significantly affect plant stand, height, vigor, or disease development during 1993 ($P \leq 0.05$). Tuber yield and the proportion of tuber yield in each grade category was not significantly affected by treatment ($P \leq 0.05$). Breakdown of irrigation equipment resulted in water stress that severely reduced tuber yields and may have masked treatment effects. Total replacement of the irrigation system later in the growing season was not sufficient to reverse the effects of the earlier stress, even though uniform and timely irrigation applications were resumed.

Materials & Methods

Seed Preparation and Treatment: Field trials were conducted at the University of Wyoming R/E Center located at Torrington. Treatment plots were 20-feet long by four rows wide. The two outer rows of treatment plots were border rows and the two center rows were treated with one of the products listed in Table 1. All data were collected from the two center rows. The border rows were continuous across the field; a 5-foot unplanted buffer for the two center rows was left between treatment plots. A randomized complete block design of five treatments and four replications was used for the study.

Certified seed (cv. Norgold Russet) produced through the Nebraska certified seed program was used for the study. Seed used for border rows was a mix of pre-cut and single-drop seed treated with 'P.S.T. Plus Bark' (a JR Simplot Co. product containing zinc ion manganese ethylene bisdithiocarbamate at 6 percent). All border rows and treatment rows were planted on May 6, 1993 using a two-row iron age planter. All seed was spaced at 12 inches within the row with a 36-inch between-row spacing.

Seed used to plant the treated (center) rows was cut by hand and culled to give a bulk seedlot with a uniform seedpiece size of ca. two ounces. Precisely 30 pounds of cut seed was placed into separate large plastic trash bags for each treatment. Treatments formulated for direct application to cut seed were pre-measured, applied to the seed in the bags and the bags agitated to give uniform coverage. For all treatments, exactly 40 seedpieces with at least one eye, per treatment per replication, were placed into labeled paper bags and taken to the field for planting. For treatments 1 and 2, which were applied 'in row' at planting, applications were made by hand and the seed immediately covered with soil. All seed used to plant treated rows was cut on May 5 and planted on May 6, 1993. The seedpiece fungicide treatments tested are listed in Table 1.

Data Collection and Analysis: Total stand counts were taken June 4, June 16 and June 21. The maximum stand possible, equal to the number of seedpieces planted, was 40 plants per treatment plot. Plant height measurements taken on July 15 by measuring the length of a single stem from five randomly selected hills per treatment plot. Plant vigor ratings were made on July 15 relative to the non-treated check using a scale of zero to 10 (10=best, check=5).

The percentage of stem surface-area cankered by *R. solani* was estimated on July 15 using the Horsfall-Barratt scale (0-11). A single stem from 10 randomly-selected hills per treatment plot was rated on each date. Canker development resulted from naturally occurring inoculum present on the seed tubers and in soil. The percentage of foliage necrotic was estimated for each treatment plot on August 4 and August 25 using the same scale (0-11). Data were converted to percentage, after analysis, for presentation in Table 2. Tuber harvest was done on September 2 with the aid of a single-row harvester. The total tuber yield and grade for each treatment plot was measured and the proportion of total tuber yield present in each grade category was calculated for presentation in Tables 3 and 4.

Data were analyzed using MSTAT in a two-way AOV with four replications and five treatments. Mean separation was done using Duncan's Multiple Range Test ($\underline{P}$=0.05). As stated above, Horsfall-Barratt scale data were converted to percentages before presentation in the tables.

Table 1. List of seedpiece fungicide treatments used during 1993 field trials. (G. D. Franc, et al., Torrington, Wyoming).

Treatment #	Application Rate	Amount Required
1. EXP10377A *	7.4 oz/1000 ft row	8.4 g/40 FT
2. ROVRAL 4F *	@ 6.6 fl oz/1000 ft row in a 20 gpa band	7.8 ml + 61.1 ml water/40 ft
3. PST + BARK	@ 1.0 lbs/cwt	136 g/30 lbs seed
4. TOPSIN	@ 1.0 lbs/cwt	136 g/30 lbs seed
5. NON-TREATED	N/A	N/A

* Treatment 1 was applied by hand as a granular to the opened furrow. Treatment 2 was applied in a 12-inch band to the open furrow and furrow shoulders shortly after planting. Treated seed was immediately covered with soil.

Results & Discussion

Seedpiece treatments did not significantly affect plant stand, height, vigor or disease development during 1993 ($P \leq 0.05$; table 2). Tuber yield and the proportion of tuber yield in each grade category was not significantly affected by treatment ($P \leq 0.05$; tables 3 and 4).

Breakdown of irrigation equipment resulted in water stress that severely reduced tuber yields and may have masked treatment effects. Total replacement of the irrigation system later in the growing season was not sufficient to reverse the effects of the earlier stress, even though uniform and timely irrigation applications were resumed.

Acknowledgements

The assistance of Jack Cecil, Mike Lindquist, and the rest of the field crew at the Torrington R/E Center was greatly needed and appreciated. The seed potatoes, provided by Bob Fornstrom of Lodgepole Farms, Pine Bluffs is gratefully acknowledged.

Table 2. Effect of seedpiece fungicide treatments on potato (cv. Norgold Russet) emergence, plant height, vigor, Rhizoctonia stem-canker and foliar necrosis. (G.D. Franc, et. al., University of Wyoming, Torrington, Wyoming, 1993).

Treatment #	Total Stand			Plant Height (cm)	Plant Vigor	% of Stem Cankered[1]	% of Foliage Necrotic	
	Jun 4	Jun 16	Jun 21	Jul 15	Jul 15	Jul 15	Aug 4	Aug 25
1. EXP10377A	34 A[2]	37 A	38 A	20.8 A	4.4 A	9.0 A	59.5 A	94.0 A
2. Rovral 4F	33 A	36 A	37 A	22.5 A	4.8 A	8.0 A	59.5 A	94.0 A
3. PST + Bark	33 A	38 A	38 A	21.5 A	4.4 A	21.0 A	59.5 A	94.0 A
4. Topsin	35 A	38 A	39 A	23.8 A	4.4 A	10.5 A	59.5 A	98.0 A
5. Non-treated	36 A	40 A	40 A	23.5 A	5.0 A	8.5 A	59.5 A	88.0 A

[1] The estimated percentage of stem surface-area cankered due to Rhizoctonia was estimated using the Horsfall-Barratt scale (0-11).

[2] Treatment means followed by different letters differ significantly ($P \leq 0.05$). No significant differences were observed for data collected during 1993 .

Table 3. Effect of seedpiece fungicide treatments on yield and grade of cv. Norgold Russet potato tubers. (G.D. Franc, et. al., University of Wyoming, Torrington, Wyoming, 1993).

Treatment #	Tuber Yield (cwt/A)							
	US1 > 10 oz	US1 < 10 oz	Total US1	Total US2	US1 + US2	B size	Culls	Total yield
1. EXP10377A	0.0 A[1]	34.5 A	34.5 A	8.2 A	42.7 A	37.2 A	3.5 A	83.4 A
2. Rovral 4F	0.8 A	37.0 A	37.8 A	10.6 A	48.5 A	40.6 A	2.3 A	91.4 A
3. PST + Bark	0.0 A	27.4 A	27.4 A	8.4 A	35.8 A	32.3 A	1.7 A	69.7 A
4. Topsin	0.0 A	35.1 A	35.1 A	9.4 A	44.5 A	41.6 A	2.5 A	88.6 A
5. Non-treated	0.0 A	36.8 A	36.8 A	11.2 A	48.0 A	41.9 A	4.2 A	94.1 A

[1] Treatment means followed by different letters differ significantly ($P \leq 0.05$).

Table 4. Effect of potato seedpiece fungicide treatments on the proportion of total tuber yield present in each grade category (cv. Norgold Russet). (G.D. Franc, et. al., University of Wyoming, Torrington, Wyoming, 1993).

Treatment #	Proportion of Total Tuber Yield in each Grade Category [1]						
	US1 > 10 oz	US1 < 10 oz	Total US1	Total US2	US1 + US2	B size	Culls
1. EXP10377A	0.00 A[2]	0.41 A	0.41 A	0.10 A	0.51 A	0.44 A	0.04 A
2. Rovral 4F	0.01 A	0.41 A	0.41 A	0.12 A	0.53 A	0.44 A	0.02 A
3. PST + Bark	0.00 A	0.40 A	0.40 A	0.12 A	0.52 A	0.46 A	0.02 A
4. Topsin	0.00 A	0.39 A	0.39 A	0.10 A	0.49 A	0.48 A	0.03 A
5. Non-treated	0.00 A	0.38 A	0.38 A	0.11 A	0.49 A	0.47 A	0.04 A

[1] The proportion of total tuber yield in each grade category will total 1.0 (allowing for rounding error). To convert to percentages, multiply each data point by 100 percent.

[2] Treatment means followed by different letters differ significantly ($P \leq 0.05$).

Foliar Fungicides for Potato Early Blight Management, 1991

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Abstract

Field trials were conducted at the University of Wyoming R/E Center located at Torrington. Eight fungicide treatments were compared to a non-treated check for control of potato early blight, caused by *Alternaria solani*, on cv. Monona. Fungicide treatments did not significantly affect plant height (P=0.05). Significant differences in disease severity did not become evident until late in the growing season; data collected September 3 showed all fungicide treatments had significantly less disease than the non-treated check with all treatments providing statistically equivalent levels of disease control (P=0.05). Yields were not significantly affected by treatments except for application of ASC66518, which significantly increased the number of B size (small) tubers (P=0.05). Although not statistically significant, plots receiving ASC66518 also had the smallest plants late in the growing season and the lowest yield of tubers weighing more than 10 ounces.

Materials & Methods

Field trials were conducted at the University of Wyoming R/E Center located at Torrington. The field plots were planted by the UW farm crew on May 15 using a two-row iron age planter. Certified seed potatoes (cv. Monona) produced through the Nebraska certified seed program were used for the study. The seed was pre-cut using a commercial seed cutter and treated with 'P.S.T. Plus Bark' (JR Simplot Co.; containing zinc ion manganese ethylene bisdithiocarbamate at 6 percent).

Treatment plots were measured and flagged after plant emergence. A randomized complete block design of nine treatments and three replications was used for the study. Each treatment plot was 25-feet long and four rows wide with a row spacing of 38 inches. A 5-foot buffer was placed between plots. Foliar treatments were applied to the center rows in a total volume of 40 gallons per acre at 18 pounds per square inch boom pressure using a four nozzle (#8004 HSS tips) boom with 20-inch spacings.

Foliar treatments 4-9 were applied on July 19, July 29, August 8, August 19, and August 29 at ca. 10-day intervals. Treatments 2 and 3 were applied at 20-day intervals with applications made on July 19, August 8, and August 29. Fungicides treatments applied and their respective rates are listed in Table 1.

Table 1. Foliar fungicide treatments used for potato early blight control; Torrington, WY, G.D. Franc, University of Wyoming, 1991.

Treatment Applied*	Interval
1. Non-treated CHECK	N/A
2. ROVRAL (0.5 LBS AI/A) + CS-7 (0.25% V/V)	20 DAY
3. ROVRAL (0.75 LBS AI/A) + CS-7 (0.25% V/V)	20 DAY
4. ROVRAL (0.75 LBS AI/A) + CS-7 (0.25% V/V)	10 DAY
5. BRAVO 720 (1.5 PT/A)	10 DAY
6. BRAVO 720 (1.0 PT/A)	10 DAY
7. ASC 66518 (0.9 LBS/A)	10 DAY
8. ASC 66897 (1.0 PT/A)	10 DAY
9. ASC 66897 (1.5 PT/A)	10 DAY

* Treatments were applied in a total volume of 40 gallons per acre at 18 psi boom pressure.

All data were collected from the middle two rows of the four row treatment plots. Plant height measurements were taken on August 20 and August 29; a single stem from five randomly selected hills per treatment plot was measured. Disease severity was measured by counting the number of early blight lesions per leaflet for leaves collected on August 20, August 28, and September 3. Lesion counts were done by randomly selecting nine leaves per treatment plot, three each from the top, middle, and bottom of the plant canopy, and by counting the number of early blight lesions visible on up to seven leaflets per leaf. Disease development was due to naturally occurring inoculum. Tuber harvest was done on September 20 with the aid of a single row harvester. The total tuber yield and grade for each treatment plot was measured on September 21.

Data were analyzed using MSTAT in a two-way ANOVA with three replications and nine treatments. Mean separation was done using Duncan's MRT (P=0.05).

Results

Repeated fungicide application did not significantly affect plant height (P=0.05). Although not significant, treatment 7 had the shortest plants on both evaluation dates: 48.2 centimeters on August 20 and 48.9 centimeters on August 29. For comparison, the average plant height on August 20 and August 29 for all treatments combined was 51.5 centimeters and 53.9 centimeters, respectively.

Differences in disease severity were not evident until late in the growing season (Table 2). Significant differences among treatment means for the number of lesions per leaflet did not occur for collections made on August 20 and August 29, but did occur on September 3 (P=0.05). Ratings done on September 3 showed all fungicide treatments had significantly fewer lesions per leaflet than the non-treated check, and that all fungicide treatments provided statistically equivalent levels of disease control (P=0.05). On September 3, the highest rates of Bravo 720 and Rovral applied at the 10-day application interval, had the lowest levels of disease with 2.7 and 3.0 lesions per leaflet, respectively.

Fungicide treatment did not significantly affect yields, except for the B size (small tuber) grade (P=0.05). The data showed that treatment 7 (ASC66518) significantly increased the number of B size tubers when compared to the check (P=0.05). All other fungicide treatments were statistically equivalent to the check.

Discussion

Due to unusually heavy rains during the early portion of the season, uneven stands resulted in portions of the field. The resultant loss of plot space made it necessary to eliminate some of the lower priority treatments originally planned for the study. Disease pressure was relatively low in 1991, presumably because initial inoculum was reduced at the field site by a long rotation between potato crops and unfavorable weather during the early stages of the epidemic.

All fungicide treatments performed similarly in the field trials. However, results for application of ASC66518 (Treatment 7) suggest that a slight effect on plant growth may have occurred since plant size was reduced (not significantly) and yield of B size (small) tubers was significantly increased (P=0.05). Additionally, data for treatment 7 showed yield of premium grade tubers (US #1 greater than 10 ounces) was the lowest for all treatments while yield of smaller premium grade tubers (US #1 less than 10 ounces) was the second highest of all treatments. This further supports the observation that tubers from plants treated with ASC66518 were reduced in size. Although uneven parts of the field were avoided when staking out plots, randomization of the treatments may have resulted in treatment 7 plots containing proportionally more small plants than the other treatments.

Acknowledgements

The assistance of Paul Konrad, Steve Knox, and the field crew at the Torrington R/E Center was appreciated. The donation of cut seed potatoes by Bob Fornstrom of Lodgepole Farms at Pine Bluffs is gratefully acknowledged.

Table 2. The effect of foliar fungicide application on potato early blight (*Alternaria solani*) disease severity, tuber yield, and grade. (G.D. Franc, 1991 Torrington, Wyoming).

Treatment # Interval	Lesions per leaflet			Yield (cwt/A)					
	AUG 20	AUG 29	SEP 3	US #1 >10 OZ	US #1 <10 OZ	US #2	B SIZE	CULLS	TOTAL
1. CHECK (non-treated)	2.0 A[1]	4.6 A	9.7 A	66.1 A	139.3 A	13.9 A	8.2 BC	0.7 A	228.2 A
2. ROVRAL .50 lbs 20 day	0.2 A	3.7 A	5.1 B	75.1 A	154.3 A	17.0 A	6.9 BC	1.6 A	254.9 A
3. ROVRAL .75 lbs 20 day	0.6 A	3.3 A	4.4 B	69.1 A	141.5 A	20.0 A	9.5 AB	0.4 A	240.6 A
4. ROVRAL .75 lbs 10 day	0.5 A	2.6 A	3.0 B	77.9 A	138.5 A	18.3 A	8.6 BC	2.5 A	245.9 A
5. BRAVO 720 1.5 pt 10 day	0.7 A	2.1 A	2.7 B	91.0 A	143.3 A	17.0 A	7.8 BC	0.6 A	259.6 A
6. BRAVO 720 1.0 pt 10 day	0.3 A	3.0 A	5.0 B	84.2 A	156.4 A	19.2 A	6.0 C	2.4 A	268.2 A
7. ASC66518 0.9 lbs 10 day	0.4 A	3.0 A	5.1 B	50.2 A	156.9 A	20.0 A	11.7 A	0.6 A	239.4 A
8. ASC66897 1.0 pt 10 day	1.6 A	3.3 A	4.2 B	66.4 A	170.0 A	18.7 A	8.2 BC	2.2 A	265.6 A
9. ASC66897 1.5 pt 10 day	0.7 A	2.8 A	4.2 B	65.3 A	137.1 A	12.6 A	8.2 BC	0.3 A	223.6 A
ANALYSIS RESULTS	NSD	NSD	P=.015	NSD	NSD	NSD	P=.022	NSD	NSD

[1] Treatment means with different letters differ significantly (P=0.05). Duncan's Multiple RangeTest was used for mean separation.

Foliar Fungicides for Potato Early Blight Management, 1992

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Abstract

Field trials were conducted at the University of Wyoming R/E Center located at Torrington, Wyoming. Ten fungicide treatments were compared to a non-treated check for control of potato early blight caused by *Alternaria solani*. Tests were done using cv. Norgold Russet "M" grown under sprinkler irrigation. These field trials were conducted under conditions of extreme early blight pressure. Significant differences in disease severity due to fungicide application did not become evident until August 12, shortly before defoliation of plants by early blight ($\underline{P}<0.05$). Data for August 12 showed all fungicide treatments, except Rovral 4F, significantly reduced disease when compared to the non-treated check (P=0.05). All fungicide treatments provided statistically equivalent levels of disease control except for EXP10385A-4SC (1.5 pounds active ingredient acre), which was significantly better than Rovral 4F (P=0.05). Tuber yield and grade and the proportion of total tuber yield in each grade category were not significantly affected by foliar fungicide applications (P=0.05).

Materials & Methods

Field trials were conducted at the University of Wyoming R/E Center located at Torrington. The field plots were planted on May 8, 1992 using a two-row iron age planter. Certified seed potatoes (cv. Norgold Russet "M" GIV) produced through the Nebraska Certified Seed program were used for the study. The seed was pre-cut using a commercial seed cutter and treated with 'P.S.T. Plus Bark' (a JR Simplot Co. product containing zinc ion manganese ethylene bisdithiocarbamate at 6 percent). The treatment plots received overhead irrigation.

Treatment plots were measured and flagged after plant emergence. A randomized complete block design of 11 treatments and three replications was used for the study. Each treatment plot was 25-feet long by four rows wide with a between row spacing of 36 inches. A 5-foot buffer was placed between plots. Foliar treatments were delivered to the four row treatment plots in a total volume of 40 gallons per acre at 18 pounds per square inch boom pressure.

Foliar treatments applied during 1992 and the rates used are listed in Table 1. Treatment numbers 1-6 were applied a total of four times with applications made at seven day intervals. Applications were made on July 23, July 30, August 6, and August 13. Two applications of treatments 7-10 were made at 14-day intervals on July 23 and August 6. Fresh product shipped during 1992 was used for all treatments except for treatment 6 (Bravo 825), which used product that remained after the 1991 field studies.

Table 1. Foliar fungicide treatments used for potato early blight control. (Torrington, WY, G.D. Franc, et al., Univ. of Wyoming, 1992).

Treatment Applied*	Interval
1. BRAVO 720 (1.0 PT/A)	7 d
2. BRAVO 720 (1.5 PT/A)	7 d
3. BRAVO 720 (1.0 PT + 0.075 LBS Zn/A)	7 d
4. ASC 66897 (1.5 PT/A)	7 d
5. ASC 66897 (2.125 PT/A)	7 d
6. BRAVO 825 (1.4 LBS/A)	7 d
7. ROVRAL 4F (0.75 LBS AI/A) + CS-7 0.125% V/V	14 d
8. EXP10387A-4SC 1.0 LBS AI/A + CS-7 0.125% V/V	14 d
9. EXP10386A-4SC 1.5 LBS AI/A + CS-7 0.125% V/V	14 d
10. EXP10385A-4SC 1.5 LBS AI/A + CS-7 0.125% V/V	14 d
11. Non-treated CHECK	N/A

* Treatments were applied in a total volume of 40 gallons per acre at 18 psi boom pressure with #8004 HSS nozzle tips. Intervals are "days."

All disease severity and yield data were collected from the middle two rows of the four-row treatment plots. Disease severity was measured by counting the number of early blight lesions per leaflet for collections made on August 5 and August 12. On August 5, nine leaves were randomly selected from all treatment plots - three each from the top, middle, and bottom third of the plant canopy. Because early blight had caused extensive defoliation of plants by August 12, especially on lower leaves, only eight leaves were selected during the second collection - four leaves each from the top and middle third of the plant canopy. The number of early blight lesions visible on up to seven leaflets per leaf was counted for both collection dates. The average number of lesions per leaflet (per leaf, unweighted means) is presented in Table 2. All disease development was the result of naturally occurring inoculum.

Tuber harvest was done on September 24 with the aid of a single row mechanical harvester. The total tuber yield and grade for each treatment plot was measured.

All data were analyzed using MSTAT in a two-way AOV with three replications and 11 treatments. Mean separation was done using Duncan's MRT ($\underline{P}$=0.05).

Results

The data in Table 2 show that on August 5, the number of lesions per leaflet for all foliar fungicide applications was statistically equivalent to the non-treated check (P=0.05). By August 12, the incidence of early blight lesions was significantly reduced by all foliar fungicide treatments except for treatment 7 (Rovral 4F), which remained statistically equivalent to the non-treated check (P=0.05). Although treatment 7 was statistically equivalent to the check for data collected August 12, Rovral 4F did reduce the number of lesions and was equivalent to all other foliar fungicide treatments except treatment 10 (P=0.05). Treatment 10 (EXP10385A-4SC) had the lowest number of lesions, and was significantly better than treatment 7 (P=0.05).

The data in Table 3 show tuber yield and grade were not significantly affected by the foliar fungicide treatments tested (P=0.05). The data in Table 4 also show that the proportion of total tuber yield present in each grade category was not significantly affected by fungicide application (P=0.05).

Table 2. The effect of foliar fungicide application on potato early blight (*Alternaria solani*) disease severity. (G. D. Franc, et al., 1992, Torrington, Wyoming).

Treatment #	Interval	Lesions per leaflet	
		AUG 05	AUG 12
1. BRAVO 720 (1.0 PT/A)[1]	7 day	18.7 A[2]	28.2 BC
2. BRAVO 720 (1.5 PT/A)	7 day	20.7 A	25.8 BC
3. BRAVO 720 (1.0 PT/A + ZINC)	7 day	23.6 A	25.0 BC
4. ASC 66897 (1.5 PT/A)	7 day	23.4 A	26.0 BC
5. ASC 66897 (2.125 PT/A)	7 day	27.8 A	26.1 BC
6. BRAVO 825 (1.4 LBS/A)	7 day	19.9 A	26.1 BC
7. ROVRAL 4F (0.75 LBS AI/A)	14 day	28.7 A	32.7 AB
8. EXP10387A-4SC (1.0 LBS AI/A)	14 day	25.1 A	26.4 BC
9. EXP10386A-4SC (1.5 LBS AI/A)	14 day	28.5 A	26.9 BC
10. EXP10385A-4SC (1.5 LBS AI/A)	14 day	21.7 A	20.9 C
11. Non-treated CHECK	N/A	21.2 A	37.3 A
ANALYSIS RESULTS		NSD	P = 0.04

[1] Treatments were applied in a total volume of 40 gallons per acre at 18 psi boom pressure.

[2] Treatment means followed by different letters differ significantly (P=0.05). Duncan's Multiple Range Test was used for mean separation.

Discussion

Early blight disease pressure observed in the treatment plots was much greater in 1992 than in 1991. Although this was partially due to the use of a cultivar with greater susceptibility and because inoculum levels were probably greater (potatoes were planted in the field plots during two consecutive years), early blight still progressed at an unusually rapid rate during 1992. Even though the **first** lesions appeared in the field at approximately the same time during both years (ca. mid July), the non-treated check for 1992 had 21.2 and 37.3 lesions per leaflet present on August 5 and August 12, respectively, versus the 1991 non-treated check, which had only 9.7 lesions per leaflet present on September 3.

Fungicide treatments were initiated after early blight lesions were visible in the plots. If fungicide applications had been initiated closer to the time of first lesion appearance, greater differences among treatment means would probably have resulted because the best treatments would have protected susceptible foliage from the earliest infections, slowed the rate of disease development, and delayed defoliation to a greater extent. Instead, the epidemic developed so rapidly from the primary lesions that the time available for meaningful foliar data collection was compressed to approximately one week.

Data in Table 2 shows differences in disease severity, expressed as the number of lesions per leaflet, which was not evident until August 12. At the time of the August 5 collection, treatments 1-6 had been applied two times (July 23 and July 30) and treatments 7-10 had been applied once (July 23). By the August 12 collection, treatments 1-6 had been applied three times (July 23, July 30, and August 6) and treatments 7-10 had been applied twice (July 23 and August 6).

The fact that treatment 10 had the least amount of early blight present but had fewer applications made suggests that its residual activity may be superior to some of the other treatments or that systemic activity exists. This, of course, assumes the differences among treatment means shown in Table 2 are due to treatments and not due to chance (P=0.04). Norgold Russet has determinate vine-growth characteristics and does not continuously produce new foliage that requires constant fungicide re-application for protection. If residual activity of EXP10385A-4SC is superior, this desirable quality may be less evident when using data collected from an indeterminate cultivar like Russet Burbank or when disease pressure is not as severe as during 1992.

Acknowledgements

The assistance of Steve Knox, Jim Krall, and the field crew at the Torrington R/E Center was greatly needed and appreciated. The cut seed potatoes, provided by Bob Fornstrom of Lodgepole Farms, Pine Bluffs is gratefully acknowledged.

Table 3. The effect of foliar fungicide application for potato early blight (*Alternaria solani*) control on potato tuber quality (grade) and yield. (G. D. Franc, et al., 1992 Torrington, Wyoming).

Treatment #	Yield in Each Grade Category (cwt/A)							
	US #1 <10 OZ	US #1 >10 OZ	US #1 Total	US #2 Total	US #1 + US #2	B Size	Culls	Total
1. BRAVO 720 (1.0 PT/A)[1]	199.8A[2]	44.4A	244.2A	18.2A	262.4A	13.4A	1.1A	276.8A
2. BRAVO 720 (1.5 PT/A)	184.9A	57.7A	242.6A	20.6A	263.2A	11.8A	0.0A	275.0A
3. BRAVO 720 (1.0 PT/A + Zn)	231.7A	53.4A	285.1A	16.9A	302.0A	14.1A	0.3A	316.4A
4. ASC 66897 (1.5 PT/A)	187.7A	39.4A	227.1A	11.5A	238.6A	12.9A	0.0A	251.5A
5. ASC 66897 (2.125 PT/A)	227.4A	46.0A	273.3A	15.2A	288.5A	12.4A	0.0A	300.9A
6. BRAVO 825 (1.4 LBS/A)	212.0A	65.2A	277.2A	20.5A	297.7A	13.9A	0.0A	311.6A
7. ROVRAL 4F (0.75 LBS AI/A)	187.2A	41.0A	228.2A	13.2A	241.5A	16.5A	0.3A	258.3A
8. EXP10387A-4SC (1.0 LBS)	176.0A	44.7A	220.7A	14.7A	235.5A	12.5A	0.8A	248.8A
9. EXP10386A-4SC (1.5 LBS)	200.9A	38.9A	239.8A	19.0A	258.8A	16.9A	0.2A	275.9A
10. EXP10385A-4SC (1.5 LBS)	199.3A	67.1A	266.4A	22.5A	288.9A	16.6A	0.0A	305.4A
11. Non-treated CHECK	188.8A	48.5A	237.2A	14.9A	252.2A	17.4A	1.3A	270.8A
ANALYSIS RESULTS	NSD	NSD	NSD	NSD	NSD	NSD	NSD	NSD

[1] Treatments were applied in a total volume of 40 gallons per acre at 18 psi boom pressure.

[2] Treatment means followed by different letters differ significantly (P=0.05). Duncan's Multiple Range Test was used for mean separation.

Table 4. The effect of foliar fungicide application for potato early blight (*Alternaria solani*) control on the proportion of total tuber yield present in each grade category. (G. D. Franc, et al., 1992 Torrington, Wyoming).

Treatment #	Proportion of Total Yield in Each Grade Category						
	US #1 <10 OZ	US #1 >10 OZ	US #1 Total	US #2 Total	US #1 + US #2	B Size	Culls
1. BRAVO 720 (1.0 PT/A)[1]	0.72A[2]	0.15A	0.88A	0.07A	0.95A	0.05A	0.00A
2. BRAVO 720 (1.5 PT/A)	0.69A	0.20A	0.87A	0.07A	0.96A	0.05A	0.00A
3. BRAVO 720 (1.0 PT/A + Zn)	0.73A	0.17A	0.90A	0.05A	0.96A	0.04A	0.00A
4. ASC 66897 (1.5 PT/A)	0.75A	0.16A	0.90A	0.05A	0.95A	0.05A	0.00A
5. ASC 66897 (2.125 PT/A)	0.76A	0.15A	0.91A	0.05A	0.96A	0.04A	0.00A
6. BRAVO 825 (1.4 LBS/A)	0.70A	0.20A	0.89A	0.06A	0.95A	0.05A	0.00A
7. ROVRAL 4F (0.75 LBS AI/A)	0.73A	0.16A	0.88A	0.05A	0.93A	0.07A	0.00A
8. EXP10387A-4SC (1.0 LBS)	0.71A	0.18A	0.89A	0.06A	0.95A	0.05A	0.00A
9. EXP10386A-4SC (1.5 LBS)	0.73A	0.14A	0.87A	0.07A	0.94A	0.06A	0.00A
10. EXP10385A-4SC (1.5 LBS)	0.66A	0.22A	0.87A	0.07A	0.95A	0.06A	0.00A
11. NON-TREATED CHECK	0.70A	0.17A	0.87A	0.06A	0.93A	0.07A	0.01A
ANALYSIS RESULTS	NSD	NSD	NSD	NSD	NSD	NSD	NSD

[1] Treatments were applied in a total volume of 40 gallons per acre at 18 psi boom pressure.

[2] Treatment means followed by different letters differ significantly (P=0.05). Duncan's Multiple Range Test was used for mean separation.

Foliar Fungicides for Potato Early Blight Management, 1993

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Abstract

Field trials were conducted at a cooperator's farm located near Albin, Wyoming. The field plot area was planted with cultivar "Wischip," which is grown under sprinkler irrigation. Eleven fungicide treatments were compared to a control (non-treated check) for management of potato early blight caused by *Alternaria solani*. All fungicide treatments were statistically equivalent for ratings made on August 16 ($P<0.05$). However, treatments 3 (Bravo 720 1.5 pints per acre), 8 (Kocide DF), 10 (EXP10370B 50WG), 11 (EXP10386B 4SC), and #12 (EXP10385B 4SC) significantly reduced the percentage of leaflets infected when compared to the control ($\underline{P}<0.05$). Ratings made on August 31 showed all treatments except 2 (Bravo 1 pint per acre), 8 (Kocide DF), and 9 (Rovral 4F + Triton CS7) significantly reduced early blight ($\underline{P}<0.05$). On August 31, treatment 11 (EXP10386B 4SC) had the lowest percentage of leaflets infected and was significantly better than all other fungicide treatments except for treatment 4 (Bravo 825) ($\underline{P}<0.05$). Data for August 31 also showed the number of early blight lesions per leaflet was significantly reduced by all fungicides except treatment 5 (ASC 66897 1.5 pints per acre) and 8 (Kocide DF) ($\underline{P}<0.05$). Tuber yield and grade were not significantly affected by the treatments tested ($\underline{P}<0.05$). However, data for "total yield" and "total US 1" categories showed the trend that yield for all plots receiving fungicide exceeded those of the control.

Materials and Methods

Field trials were conducted at a cooperator's farm located near Albin, Wyoming. The field was planted with cultivar "Wischip" and normal cultural practices were followed. All fungicide treatments were superimposed over the cultural practices of the cooperator. The field plots were irrigated by center pivot.

Treatment plots were measured and flagged after plant emergence. A randomized complete block design of 12 treatments and four replications was used for the study. Each treatment plot was 25-feet long by four rows wide with a between row spacing of 36 inches. A 5-foot non-treated in-row buffer existed between plots.

Foliar treatments applied during 1993 and the rates used are listed in Table 1. Applications were made on July 28, August 10, and August 20 using a portable backpack sprayer. Products were applied in a total spray volume of 30 gallons per acre at 30 psi boom pressure. The boom was equipped with #8004 HSS tips, and had four nozzles spaced 20 inches apart. Fresh product, received during 1993, was used for all treatments. Treatment 1 (control) was sprayed with water on treatment application days to minimize traffic damage differences between the control and treated plots.

All disease severity and yield data were collected from the middle two rows of each treatment plot. Two independent measures of early blight disease severity were employed. On August 3, August 16, and August 31 the percentage of leaflets infected in the top, middle, and bottom third of the plant canopy was visually estimated for three randomly selected locations in each plot. Ratings were made using the Horsfall-Barratt scale (0-11). In addition, nine randomly selected leaves were collected from each treatment plot (three each from the top, middle, and bottom third of the canopy). The number of early blight lesions per leaflet was determined for up to seven leaflets from each leaf. The first foliar data was collected at the mid to late bloom growth stage.

Tuber harvest took place on September 30 with the aid of a double row mechanical harvester. The total tuber yield and grade for each treatment plot was measured. A subsample of ca. 50 pounds from each plot was graded to determine the yield of each grade category. The percentage of total yield in each grade category was calculated.

All data were analyzed using MSTAT in a two-way ANOVA with four replications and 12 treatments. Mean separation was accomplished using Duncan's Multiple Range Test ($\underline{P}$=0.05). Horsfall-Barratt data were converted to percentages for presentation in Table 2.

Results

Disease severity data are summarized in Table 2. The percentage of leaflets infected for all treatments was statistically equivalent to the control (non-treated check) on August 3 ($P<0.05$) which was only six days after the first fungicide applications were made. Data for disease ratings made on August 16 and August 31 showed all treatments reduced the percentage of infected leaflets when compared to the control. Although all fungicide treatments were statistically equivalent when ratings were made on August 16, treatments 3 (Bravo 720 1.5 pints per acre), 8 (Kocide DF), 10 (EXP10370B 50WG), 11 (EXP10386B 4SC), and 12 (EXP10385B 4SC) significantly reduced disease when compared to the control ($P<0.05$). On August 31, all treatments except 2 (Bravo 1 pint per acre), 8 (Kocide DF), and 9 (Rovral 4F + Triton CS7) signifi-cantly reduced disease compared to the control ($P<0.05$). On August 31, treatment 11 (EXP10386B 4SC) had the lowest percentage of leaflets infected and was significantly better than all other fungicide treatments except for treatment 4 (Bravo 825) ($P<0.05$).

The data in Table 2 also show that the number of lesions per leaflet for all treatments was statistically equivalent to the control on August 3 and August 16 ($P<0.05$). Data for August 31 show the number of early blight lesions was significantly reduced by all fungicides except treatment 5 (ASC 66897 1.5 pints per acre) and 8 (Kocide DF) when compared to the control ($P<0.05$). Although statistically equivalent to the control on August 31, treatment 5 also was not significantly worse than any of the other foliar fungicides ($P<0.05$). Treatment 8 (Kocide DF) had significantly more early blight lesions than the treatments 6 (ASC 66897 2.125 pints per acre), 11 (EXP10386B 4SC), and 12 (EXP10385B 4SC) ($P<0.05$).

The data in Table 3 show tuber yield and grade were not significantly affected by the treatments tested ($P<0.05$). However, data for "total yield" and "total US #1" categories showed the trend that yield for all fungicide treatments exceeded yields of the control. The control also had more culls than plots receiving fungicide. The data in Table 4 show that the proportion or percentage of total tuber yield present in each grade category was not significantly affected by fungicide application ($P<0.05$). Trends in the data show the control had the lowest percentage of total yield present in the "US #1 + US #2" grade category and a greater percentage of its yield present in the "B size" and "cull" grades, when compared to most fungicide treatments (except for treatment 11).

Discussion

During the August 10 fungicide application, treatment 10 (EXP10370B 50WG) partially restricted flow through all four boom nozzles. On August 20, it clogged all four nozzles and treatment 7 (Manzate 200 DF) partially restricted flow through one of the nozzles. Efforts were made to clean nozzles and to achieve uniform application of product.

Treatment plots received ample water throughout the growing season. Irrigation water was applied nearly every other day throughout the growing season. The soil was never completely dry on days when fungicides were applied or when data were collected. Plant vigor was good for the duration of the study and insect damage was not observed.

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Table 1. Foliar fungicide treatments applied to potato (cv. Wischip) for the control of foliar early blight (*Alternaria solani*). (G.D. Franc, et. al., 1993, University of Wyoming).

Treatment #[1]	Product/Acre
1 Control	None (water only)
2 Bravo 720	1.0 pt
3 Bravo 720	1.5 pt
4 Bravo 825	1.4 lbs
5 ASC 66897 (LIQUID)	1.5 pts
6 ASC 66897 (LIQUID)	2.125 pts
7 Manzate 200 DF	2.0 lbs
8 Kocide DF	4.0 lbs
9 Rovral 4F + Triton CS7	1.5 pt + 0.25% v/v
10 EXP 10370B 50WG	1.5 lbs + 0.25% v/v
11 EXP 10386B 4SC	3.0 pt + 0.25% v/v
12 EXP 10385B 4SC	3.0 pt + 0.25% v/v

[1] Foliar applications were made on July 28, August 10, and August 20 using a portable backpack sprayer. Products were applied in a total spray volume of 30 gallons per acre at 30 psi boom pressure. The boom was equipped with #8004 HSS tips, and had four nozzles spaced 20 inches apart.

Table 2. Effect of foliar fungicide applications on early blight disease severity (cv. Wischip). (G.D. Franc, et. al., 1993, University of Wyoming).

Treatment Number	Estimated % Leaflets Infected			Number of Lesions/Leaflet		
	Aug 3	Aug 16	Aug 31	Aug 3	Aug 16	Aug 31
1 Control	1.6 A[1]	25.0 A	95.0 A	1.5 A	7.9 A	28.1 A
2 Bravo 720	3.0 A	22.0 AB	93.0 AB	1.9 A	8.4 A	14.4 BC
3 Bravo 720	2.5 A	15.0 B	89.5 BCD	1.7 A	5.0 A	11.6 BC
4 Bravo 825	3.0 A	22.0 AB	85.0 DE	1.5 A	6.7 A	12.2 BC
5 ASC 66897 (LIQUID)	2.0 A	17.0 AB	90.0 BCD	1.6 A	6.4 A	18.8 ABC
6 ASC 66897 (LIQUID)	2.0 A	21.0 AB	88.0 CD	0.8 A	4.9 A	10.2 C
7 Manzate 200 DF	3.5 A	21.0 AB	90.0 BCD	1.4 A	5.4 A	14.5 BC
8 Kocide DF	1.8 A	16.0 B	91.5 ABC	0.9 A	6.0 A	21.4 AB
9 Rovral 4F + Triton CS7	3.0 A	19.5 AB	92.0 ABC	1.4 A	4.2 A	15.9 BC
10 EXP 10370B 50WG	2.0 A	15.0 B	88.0 CD	1.3 A	4.3 A	12.8 BC
11 EXP 10386B 4SC	1.8 A	16.0 B	79.0 E	1.9 A	4.1 A	10.0 C
12 EXP 10385B 4SC	2.5 A	15.0 B	88.0 CD	1.8 A	8.8 A	10.2 C

[1] Treatment means followed by different letters differ significantly ($P \leq 0.05$).

Table 3. Effect of foliar fungicide applications for early blight control on yield and grade of cv. Wischip potato tubers. (G.D. Franc, et. al., 1993, University of Wyoming).

Treatment #	Yield (cwt/A)							
	US 1 > 10 oz	US 1 < 10 oz	Total US 1	Total US 2	US 1 + US 2	B Size	Culls	Total yield
1 Control	60.6 A[1]	177.2 A	237.9 A	11.9 A	249.8 A	11.1 A	14.8 A	275.4 A
2 Bravo 720	66.8 A	176.0 A	242.8 A	14.8 A	257.6 A	9.7 A	10.9 A	278.1 A
3 Bravo 720	63.2 A	196.6 A	259.8 A	11.5 A	271.2 A	9.1 A	6.7 A	287.0 A
4 Bravo 825	55.9 A	193.6 A	249.5 A	16.6 A	266.1 A	11.3 A	9.8 A	287.1 A
5 ASC 66897 (LIQUID)	60.2 A	204.2 A	264.3 A	13.1 A	277.5 A	8.2 A	5.2 A	290.8 A
6 ASC 66897 (LIQUID)	75.3 A	194.7 A	270.0 A	19.0 A	288.9 A	5.5 A	6.8 A	301.2 A
7 Manzate 200 DF	54.6 A	201.3 A	255.9 A	19.3 A	275.2 A	8.4 A	5.8 A	289.4 A
8 Kocide DF	60.1 A	185.1 A	245.2 A	18.5 A	263.7 A	8.3 A	12.6 A	284.5 A
9 Rovral 4F + Triton CS7	53.1 A	203.3 A	256.4 A	21.1 A	277.5 A	9.1 A	12.7 A	299.3 A
10 EXP 10370B 50WG	75.3 A	201.7 A	277.0 A	18.7 A	295.8 A	6.2 A	11.9 A	313.2 A
11 EXP 10386B 4SC	81.3 A	177.6 A	258.9 A	32.2 A	291.1 A	15.5 A	8.4 A	315.0 A
12 EXP 10385B 4SC	52.8 A	220.1 A	272.9 A	9.6 A	282.6 A	6.8 A	13.4 A	302.7 A

[1] Treatment means followed by different letters differ significantly ($P \leq .05$).

Table 4. Effect of foliar fungicide applications for early blight control on the percentage of total yield in each grade category (cv. Wischip). (G.D. Franc, et. al., 1993, University of Wyoming).

Treatment #	Percentage Total Yield in each Grade Category						
	> 10 oz	< 10 oz	US 1	US 2	US 1 + US 2	B size	Culls
1 Control	21.9 A[1]	64.7 A	86.6 A	4.1 A	90.7 A	4.2 A	5.2 A
2 Bravo 720	24.1 A	63.3 A	87.4 A	5.0 A	92.4 A	3.6 A	4.0 A
3 Bravo 720	21.7 A	69.0 A	90.6 A	3.8 A	94.5 A	3.2 A	2.3 A
4 Bravo 825	19.3 A	67.5 A	86.8 A	5.8 A	92.6 A	4.0 A	3.5 A
5 ASC 66897 (LIQUID)	21.1 A	69.5 A	90.7 A	4.6 A	95.2 A	3.0 A	1.8 A
6 ASC 66897 (LIQUID)	25.1 A	64.3 A	89.5 A	6.4 A	95.9 A	1.8 A	2.3 A
7 Manzate 200 DF	18.8 A	69.7 A	88.4 A	6.6 A	95.1 A	2.9 A	2.0 A
8 Kocide DF	21.3 A	64.9 A	86.1 A	6.3 A	92.4 A	3.0 A	4.6 A
9 Rovral 4F + Triton CS7	17.8 A	67.8 A	85.6 A	7.1 A	92.7 A	3.0 A	4.3 A
10 EXP 10370B 50WG	23.7 A	65.0 A	88.7 A	5.7 A	94.5 A	2.1 A	3.6 A
11 EXP 10386B 4SC	26.1 A	56.4 A	82.5 A	10.1 A	92.6 A	4.8 A	2.6 A
12 EXP 10385B 4SC	17.1 A	72.8 A	89.8 A	3.2 A	93.0 A	2.5 A	4.6 A

[1] Treatment means followed by different letters differ significantly ($P \leq 0.05$).

Foliar Fungicides for Potato Early Blight Management, 1994

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Abstract

Field trials were conducted at the University of Wyoming Research and Extension Center at Torrington. Twenty-two fungicide treatments were compared to a non-treated check for control of potato early blight on cv. Snowden. All disease resulted from naturally occurring inoculum. Results showed that, by August 17, all fungicide treatments significantly reduced the number of early blight lesions per leaflet when compared to the non-treated check ($P<0.05$). Also, treatment 10 (Bravo Zn) had significantly fewer lesions per leaflet than treatments 2 (TD-2350, low rate), and 18 (EXP10386B, low rate) but was not significantly different from the remaining fungicide treatments ($P<0.05$). Treatments 2 and 18 were statistically equivalent to all other fungicide treatments on August 17 ($P<0.05$). By September 16, 24 days after the last fungicide application, none of the treatments had significantly less disease than the non-treated check ($P<0.05$). None of the fungicide treatments significantly affected total tuber yield and grade ($P<0.05$).

Materials and Methods

Field trials were conducted at the University of Wyoming Research and Extension Center at Torrington. Field plots were planted with potato cultivar Snowden on June 2, using a two-row iron age planter. Snowden is a late maturing, round white potato, primarily used for processing. Plots were watered as needed during the growing season with overhead irrigation, and insecticide was periodically applied for aphid and Colorado potato beetle control.

Treatment plots were measured and flagged after plant emergence. A randomized complete block design of 23 treatments and four replications was used for the study. Each treatment plot was 20-feet long by three rows wide, with an in-row spacing of 12 inches and a between-row spacing of 36 inches. A 5-foot buffer remained between plots. Foliar treatments were applied to the treatment plots in a total volume of 30 gallons per acre at 30 pounds per square inch boom pressure (#8004 HSS tips) with the aid of a back-pack sprayer.

Foliar treatments and rates applied during 1994 are listed in Table 1. Most treatments were applied five times (July 12, July 21, August 3, August 10, and August 23) at ca. 10-day intervals. Treatments 16 (Rovral) and 17 (EXP1037A) were applied four times (July 12, July 26, August 10 and August 23) at ca. 14-day intervals.

Disease development in the field resulted from naturally occurring inoculum. All disease severity and yield data were collected from the same two rows of the treatment plots. Disease severity was measured by counting the number of early blight lesions per leaflet for collections made on August 17, September 6, and September 16. On August 17 and September 6, nine leaves were randomly selected from all treatment plots - three each from the top, middle, and bottom third of the plant canopy. On September 16, nine leaves were randomly selected from all treatment plots - four from the top and five from the mid-portion of the plant canopy. The number of early blight lesions on up to seven leaflets per leaf was counted for all three collection dates. However, the lesion count data from September 6 was not analyzed because numerous data were missing due to damage of the samples during refrigerated storage.

Tuber harvest was done on September 29 with the aid of a single-row mechanical harvester. The total tuber yield and grade for each treatment plot was measured.

All data were analyzed using MSTAT in a two-way AOV with four replications and 23 treatments. Mean separation was done using Duncan's MRT ($\underline{P}$=0.05).

Results and Discussion

Early blight lesions first appeared ca. July 11, and were found throughout the plots by July 26. The plots were flagged out and pre-rated to eliminate non-uniform areas in the field before randomly assigning treatments. Potato plant stand was good with a moderate weed infestation, and insect pressure from Colorado potato beetles and aphids made periodic insecticide application necessary.

The data in Table 1 show that by August 17, all fungicide treatments significantly reduced the number of early blight lesions per leaflet when compared to the non-treated check ($P<0.05$). Also, on August 17, treatment 10 (Bravo Zn) had significantly fewer lesions per leaflet than treatments 2 (TD-2350, low rate) and 18 (EXP10386B, low rate) but was not significantly different from the remaining fungicide treatments ($P<0.05$). Treatments 2 and 18 were also statistically equivalent to all other fungicide treatments on August 17, ($P<0.05$).

By September 16, 24 days after the last fungicide application, none of the treatments had significantly less disease than the non-treated check ($P<0.05$). However, treatment 11 (ASC-67098-Z) had significantly fewer lesions per leaflet than did treatments 2 (TD-2350, low rate), 3 (TD-2350, high rate), 16 (Rovral), and 19 (EXP10386B, high rate) ($P<0.05$). The low rate of EXP10386B (treatment 18) was not significantly different from treatment 11 ($P<0.05$). Therefore, this suggests that the differences measured between treatments 11, 18, and/or 19 may not be real. These data also suggest that treatment 11 may have a longer residual effect on early blight control when compared with some of the other fungicide treatments.

The data in Table 2 show none of the fungicide treatments significantly affected total tuber yield and grade ($P<0.05$). However, data in Table 3 show the proportion of the total tuber yield in the "U.S. #1 < 10 ounce" grade category was greater for treatment 15 (Kocide) when compared to the non-treated control. This difference was significant at slightly greater than the standard five percent probability level (i.e., significant at $P=0.051$). Kocide showed no significant foliar early blight control when final evaluations were done September 16. Therefore, control of other yield-affecting factors may have occurred or treatment effects were due to chance and are not real. Additional trends in the data can be seen in Table 3. Mean separation was done to facilitate comparison among treatments even though differences were not significant at $P<0.05$.

Acknowledgements

We gratefully acknowledge Bob Fornstrom of Lodgepole Farms, Pine Bluffs, for providing seed potatoes used for the study. The assistance of the field crew at the Torrington R/E Center also was greatly appreciated.

Table 1. The effect of foliar fungicides on potato early blight disease severity. (G. D. Franc, et al. 1994, Torrington, Wyoming).

Treatment #	Lesions per leaflet[2]	
	Aug 17	Sep 16
1 Non-treated check [1]	1.69 A[2]	25.72 ABC
2 TD-2350 50DF (0.5 lbs ai/A)	0.90 B	27.83 AB
3 TD-2350 50DF (1.0 lbs ai/A)	0.60 BC	27.73 AB
4 TD-2343 33.6F (1.125 lbs ai/A)	0.21 BC	16.26 BC
5 TD-2343 33.6F (1.5 lbs ai/A)	0.16 BC	16.62 BC
6 Maneb 75DF (1.5 lbs ai/A)	0.11 BC	25.81 ABC
7 Penncozeb 75DF (1.5 lbs ai/A)	0.34 BC	18.99 BC
8 Bravo 720 (1.5 pt/A)	0.12 BC	21.45 ABC
9 Bravo Ultrex B825 (1.4 lbs/A)	0.13 BC	19.03 BC
10 Bravo ZN (2.125 pt/A)	0.02 C	16.84 BC
11 ASC-67098-Z (1.275 lbs/A)	0.11 BC	11.55 C
12 ASC-66897 SDG (1.875 lbs/A)	0.23 BC	14.40 BC
13 Terranil 6L (1.5 pt/A)	0.16 BC	20.36 BC
14 Zeneca 504 (0.1 lbs ai/A)	0.16 BC	15.15 BC
15 Kocide 50DF (4.0 lbs/A)	0.35 BC	17.35 BC
16 Rovral (0.75 lbs ai/A)+Triton (0.25% V:V)	0.69 BC	28.44 AB
17 EXP1037A (0.75 lbs ai/A)+Triton (0.25%V:V)	0.50 BC	21.93ABC
18 EXP10386B 4.5 SC (42.7 fl oz/A) + Triton (0.25% V:V)	0.89 BC	26.13ABC
19 EXP10386B 4.5 SC (64.0 fl oz/A) + Triton (0.25% V:V)	0.33 BC	36.14 A
20 EXP10566A (43.6 fl oz/A)	0.22 BC	22.67ABC
21 EXP10554A (53.3 fl oz/A)	0.19 BC	17.12 BC
22 Rovral (0.5 lbs ai/A) + Penncozeb (1.0 lbs ai/A) + Triton (0.25% V:V)	0.14 BC	15.77 BC
23 Bravo 720 (0.56 lbs ai/A pre-vine closure/1.125 lb ai/A post-closure)	0.25 BC	18.21 BC
Analysis Results	P=0.003	P=0.051

[1] Treatments were applied in a total volume of 30 gallons per acre at 30 psi boom pressure.

[2] Treatment means followed by different letters differ significantly (P=0.05). Duncan's Multiple Range Test was used for mean separation.

Table 2. The effect of foliar fungicide application for potato early blight (*Alternaria solani*) control on potato tuber quality (grade) and yield. (G. D. Franc, et al., 1994, Torrington, Wyoming).

Treatment #	Yield in Each Grade Category (cwt/A)							
	US #1 >10 oz	US #1 <10 oz	US #1 Total	US #2 Total	B Size	US #1 + US #2	Culls	Total
1 Non-treated check (none)[1]	45.1A[2]	225.0A	270.1A	16.0A	22.0A	308.0A	13.3A	321.4A
2 TD-2350 50DF (0.5 lb	45.9A	218.5A	264.3A	16.0A	17.8A	298.2A	9.3A	307.5A
3 TD-2350 50DF (1.0 lbs)	36.0A	246.0A	282.1A	17.6A	26.0A	325.7A	9.8A	335.5A
4 TD-2343 33.6F (1.125 lbs)	42.8A	204.6A	247.5A	16.3A	23.0A	286.8A	7.3A	294.0A
5 TD-2343 33.6F (1.5 lbs)	38.6A	261.7A	300.4A	13.2A	23.8A	337.3A	10.8A	348.1A
6 Maneb 75DF (1.5 lbs)	62.6A	246.2A	308.7A	12.7A	20.0A	341.5A	10.6A	352.0A
7 Penncozeb 75DF (1.5 lbs)	49.5A	262.1A	311.6A	13.6A	19.6A	344.8A	13.8A	358.6A
8 Bravo 720 (1.5 pt)	44.0A	240.5A	284.5A	10.0A	20.4A	314.9A	10.4A	325.2A
9 Bravo Ultrex B825 (1.4 lbs)	37.2A	216.5A	253.7A	8.6A	26.8A	289.2A	8.4A	297.5A
10 Bravo ZN (2.125 pt)	60.7A	174.6A	235.3A	10.9A	21.3A	267.5A	8.0A	275.5A
11 ASC-67098-Z (1.275 lbs)	34.4A	211.7A	246.1A	14.7A	29.2A	290.0A	7.1A	297.1A
12 ASC-66897 SDG (1.875 lbs)	35.0A	224.9A	259.8A	13.7A	23.3A	296.7A	5.8A	302.5A
13 Terranil 6L (1.5 pt)	42.3A	239.4A	281.8A	12.9A	25.4A	320.1A	9.2A	329.2A
14 Zeneca 504 (0.1 lbs)	38.1A	233.1A	271.2A	8.2A	16.6A	296.0A	6.7A	302.7A
15 Kocide 50DF (4.0 lbs)	16.0A	211.5A	227.6A	7.6A	21.6A	256.8A	3.5A	260.4A
16 Rovral (0.75 lbs) + Triton (0.25%)	30.5A	246.1A	276.6A	9.4A	25.5A	311.5A	13.1A	324.6A

Table 2. (continued)

Treatment #	Yield in Each Grade Category (cwt/A)							
	US #1 >10 oz	US #1 <10 oz	US #1 Total	US #2 Total	B Size	US #1 + US #2	Culls	Total
17 EXP1037A (0.75 lbs) + Triton (0.25%)	57.5A	248.9A	306.4A	13.5A	19.3A	339.1A	7.8A	346.9A
18 EXP10386B 4.5 SC (42.7 fl oz) + Triton (0.25%)	43.5A	244.3A	287.9A	4.9A	18.9A	314.6A	7.8A	319.4A
19 EXP10386B 4.5 SC (64.0 fl oz/) + Triton (2.5%)	31.2A	247.2A	278.4A	7.4A	17.3A	303.2A	9.3A	312.4A
20 EXP10566A (43.6 fl oz)	36.1A	218.6A	254.7A	10.9A	20.1A	285.7A	7.2A	292.8A
21 EXP10554A (53.3 fl oz)	55.5A	246.2A	301.6A	10.7A	19.9A	332.1A	10.3A	342.4A
22 Rovral (0.5 lbs) Penncozeb (1.0 lbs) + Triton (0.25%)	53.5A	232.2A	285.7A	15.6A	23.1A	324.4A	11.4A	335.8A
23 Bravo 720 (0.56 lbs) Bravo 720 (1.125 lbs)	31.8A	241.5A	273.3A	21.1A	22.3A	316.6A	3.7A	320.3A
Analysis Results	NSD	NSD	NSD	NSD	NSD	NSD	NSD	NSD

[1] Treatments were applied in a total volume of 30 gallons per acre at 30 psi boom pressure.

[2] Treatment means followed by different letters differ significantly (P=0.05). Duncan's Multiple Range Test was used for mean separation.

Table 3. The effect of foliar fungicide application for potato early blight (*Alternaria solani*) control on the proportion of total tuber yield present in each grade category. (G. D. Franc, et al., 1994, Torrington, Wyoming).

Treatment #	Yield in Each Grade Category (cwt/A)						
	US #1 >10 oz	US #1 <10 oz	US #1 Total	US #2 Total	B Size	US #1 + US #2	Culls
1 Non-treated check (none)[1]	14.1A[2]	69.7 BCD[3]	83.8A	5.1A	6.8A	95.7A	4.3A
2 TD-2350 50DF (0.5 lbs)	14.4A	71.9ABCD	86.3A	5.1A	5.8A	97.2A	2.8A
3 TD-2350 50DF (1.0 lbs)	10.9A	73.1ABC	83.9A	5.3A	7.8A	97.1A	3.0A
4 TD-2343 33.6F (1.125 lbs)	15.1A	68.9 CD	83.9A	5.7A	7.9A	97.6A	2.5A
5 TD-2343 33.6F (1.5 lbs)	11.0A	75.0ABC	86.0A	4.0A	6.9A	96.9A	3.0A
6 Maneb 75DF (1.5 lbs)	17.7A	69.9 BCD	87.6A	3.7A	5.7A	97.0A	3.0A
7 Penncozeb 75DF (1.5 lbs)	13.9A	73.1ABC	86.9A	3.8A	5.4A	96.2A	3.8A
8 Bravo 720 (1.5 pt)	13.1A	74.6ABC	87.8A	2.8A	6.3A	96.9A	3.1A
9 Bravo Ultrex B825 (1.4 lbs)	12.9A	71.9ABCD	84.8A	2.9A	9.5A	97.2A	2.8A
10 Bravo ZN (2.125 pt)	22.4A	62.9 D	85.3A	3.9A	7.8A	97.0A	3.0A
11 ASC-67098-Z (1.275 lbs)	11.1A	71.3ABCD	82.4A	5.2A	10.0A	97.6A	2.4A
12 ASC-66897 SDG (1.875 lbs)	11.5A	74.3ABC	85.8A	4.5A	7.8A	98.1A	2.0A
13 Terranil 6L (1.5 pt)	12.6A	72.8ABCD	85.4A	3.9A	7.8A	97.2A	2.8A
14 Zeneca 504 (0.1 lbs)	12.6A	77.0ABC	89.7A	2.6A	5.4A	97.8A	2.2A
15 Kocide 50DF (4.0 lbs)	5.6A	80.8A	86.5A	3.4A	8.7A	98.5A	1.5A
16 Rovral (0.75 lbs) + Triton (0.25%)	9.1A	76.1ABC	85.2A	2.9A	7.9A	96.0A	4.0A

Table 3. (continued)

Treatment #	Yield in Each Grade Category (cwt/A)						
	US #1 >10 oz	US #1 <10 oz	US #1 Total	US #2 Total	B Size	US #1 + US #2	Culls
17 EXP1037A (0.75 lbs) + Triton (0.25%)	16.4A	71.8ABCD	88.1A	3.9A	5.7A	97.7A	2.3A
18 EXP10386B 4.5 SC (42.7 fl oz) + Triton (0.25%)	13.4A	76.5ABC	89.9A	1.6A	6.1A	97.7A	2.3A
19 EXP10386B 4.5 SC (64.0 fl oz) + Triton (2.5%)	10.0A	79.1AB	89.1A	2.4A	5.5A	97.1A	2.9A
20 EXP10566A (43.6 fl oz)	11.6A	75.5ABC	87.1A	3.6A	7.0A	97.8A	2.3A
21 EXP10554A (53.3 fl oz)	16.1A	71.9ABCD	88.0A	3.2A	5.9A	97.1A	2.9A
22 Rovral (0.5 lbs) Penncozeb (1.0 lbs) + Triton (0.25%)	16.3A	68.7 CD	85.0A	4.7A	7.0A	96.6A	3.4A
23 Bravo 720 (0.56 lbs) Bravo 720 (1.125 lbs)	9.9A	75.6ABC	85.5A	6.2A	7.2A	98.8A	1.1A
Analysis Results	NSD	P=0.051	NSD	NSD	NSD	NSD	NSD

[1] Treatments were applied in a total volume of 30 gallons per acre at 30 psi boom pressure.

[2] Treatment means followed by different letters differ significantly (P=0.05). Duncan's Multiple Range Test was used for mean separation.

[3] Treatment means followed by different letters differ significantly (P=0.051). Duncan's Multiple Range Test was used for mean separation.

Potato Vine Desiccant Efficacy and Tuber Quality Effects, 1994

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Abstract

Potato vine desiccation field trials were conducted at the University of Wyoming Research and Extension Center at Torrington. Eleven treatments were compared to a non-treated control for pre-harvest defoliation of potato vines, cultivar 'Snowden'. All treatments were applied August 17 when vines were green and vigorous. Therefore, this was a rigorous test of vine desiccant activity. DES-I-CATE, Diquat and Gramoxone Extra (paraquat) provided the greatest degree of desiccation and Flair 2E did not show strong activity. The addition of ammonium sulfate to the Flair 2E tank mix did not consistently result in additional vine desiccant activity. Vascular (stem end) discoloration of tubers was not significantly affected by treat-ments ($P<0.05$). Paraquat is not labeled for use as a vine kill agent for a seed potato crop or for use on potatoes that will be stored. It was included as a positive check.

Materials and Methods

Field trials were conducted at the University of Wyoming Research and Extension Center at Torrington. Field plots were planted with potato cultivar 'Snowden' on June 2 using a two-row iron age planter. Potato plant stand was good and plots were watered as needed during the growing season with overhead irrigation. A moderate weed infestation was present and insect pressure from Colorado potato beetles and aphids made periodic insecticide application necessary.

Treatment plots were measured and flagged after plant emergence. The plots were initially rated to eliminate non-uniform areas in the field before randomly assigning treatments. A randomized complete block design of 12 treatments and four replications was used for the study. Each plot was 10 feet long by three rows wide with a between-row spacing of 36 inches. A 2 foot non-treated buffer remained between plots. Foliar treatments were applied in a total volume of 30 gallons per acre at 30 pounds per square inch boom pressure (#8004 HSS tips) with the aid of a back-pack sprayer.

Treatments were applied on August 17, 1994 at the application rates listed in Table 1. Data was collected by rating vines for foliar necrosis using the Horsfall-Barratt scale on August 17, August 23, and August 25, and on September 6 and September 16, 1994 (Table 1). The percentage of stems dead was also rated on September 16, 1994 (Table 1). Tuber harvest was on September 29, 1994. A random tuber sample of at least 10 tubers was taken from the center four hills of each plot and stored at ca. 4 degrees Celcius. After storage, vascular tissue discoloration (stem-end discoloration) of 10 tubers for each treatment plot were rated using the Horsfall-Barratt (0-11) scale on February 27, 1995 (Table 1).

All data were analyzed using MSTAT in a two-way ANOVA with four replications and 12 treatments. Analysis of variance and mean separation was done using Duncan's Multiple Range Test at $\underline{P}=0.05$. Horsfall-Barratt data were converted to percentage values using conversion tables prior to presentation in Table 1.

Results

All data are summarized in Table 1. The data show that within eight hours after treatments were applied on August 17, treatments 11 (Diquat 2E, 0.25 pounds active ingredient per acre) and 12 (Gramoxone 0.47 pounds active ingredient per acre) had significantly more dead foliage (necrotic) than the other treatments and the non-treated control (treatment 1) ($P<0.05$). All other treatments were not significantly different from the non-treated control ($P<0.05$).

Data for August 23 show treatment 12 was significantly better (had more foliar necrosis) than all other treatments except 4 (Flair 2E, 1.25 pounds active ingredient per acre), 10 (DES-I-CATE, 1.04 pounds active ingredient per acre) and 11 ($P<0.05$). Data for August 23 also show that treatment 12 was the only treatment significantly different from the non-treated control ($P<0.05$). On August 23, treatment 6 (Flair 2E, 0.75 pounds active ingredient per acre + Ammonium sulfate) was significantly worse (had less foliar necrosis) than treatments 10, 11, and 12, although it did not differ significantly from the other treatments ($P<0.05$).

On August 25, only treatments 10, 11, and 12 were significantly better than the non-treated control ($P<0.05$). Although treatment 12 had the most foliar necrosis, it was not significantly better than treatments 4, 10, and 11 ($P<0.05$). Treatment 4 (Flair 2E, 1.25 pounds active ingredient per acre) was significantly better than treatments 3 (Flair, 1.00 pounds active ingredient per acre), 5 (Flair 2E, 1.50 pounds active ingredient per acre), and 6 (Flair 2E, 0.75 pounds active ingredient per acre + Ammonium sulfate) ($P<0.05$). Although significant differences among treatments 3, 4, 5, and 6 were not observed for data collected two days earlier ($P<0.05$), the same relative trends in the data are readily apparent. On August 25, treatments 3, 5, and 6 had the lowest level of defoliation, although not significantly different from any other treatments except 4, 10, 11, and 12 ($P<0.05$).

Data for September 6 show all treatments were statistically equivalent to the non-treated control ($P<0.05$). There was a slight decline in the foliar necrosis measured in the plots from August 25 to September 6, indicating that some regrowth may have occurred for treatments 10, 11, and 12. In contrast, data for all other treatments and the non-treated control showed the amount of foliar necrosis continued to increase for all data collection dates, indicating that natural senescence and foliar death was occurring. Data for September 16 show that the non-treated control had greater than 75 percent of the foliage necrotic due to natural senescence and that none of the treatments differed significantly ($P<0.05$).

Data estimating the percentage of stems dead was collected on September 16. This data shows only treatments 3, 4, and 6 had significantly less stem death than the non-treated control ($P<0.05$). Treatments 9, 10, 11, and 12 were significantly better (had greater stem death) than treatment 6 ($P<0.05$).

Data for vascular (stem end) discoloration of tubers showed all treatments were statistically equivalent and did not differ from the non-treated control ($P<0.05$).

Discussion

Treatment plots were planted late (June 2) and vines were unusually green and vigorous at the time of foliar treatment application. Therefore, this was a rigorous test of vine desiccant activity. Some foliar regrowth may have occurred following treatment applications.

The DES-I-CATE, Diquat and Gramoxone Extra (paraquat) treatments provided the greatest degree of desiccation. Flair 2E did not show consistent strong activity as a vine desiccant in these field trials. Addition of ammonium sulfate to the Flair 2E tank mix did not give consistent additional vine desiccant activity. Paraquat is not labelled for use as a vine kill agent for seed potatoes or for use on potatoes that will be stored. It was included as an additional treatment.

Acknowledgements

Bob Fornstrom of Lodgepole Farms, Pine Bluffs provided the seed potatoes used for this study. The assistance of the field crew at the Torrington R/E Center also was greatly appreciated.

Table 1. Effect of vine desiccation treatments on defoliation, stem death, and tuber quality. (G.D. Franc, et al. 1994, University of Wyoming, Torrington, Wyoming).

Treatment[1]	Rate ai/A (lbs)	Estimated percentage[2] of:						
		Foliage Necrotic					Stems dead	Vascular tissue discolored
		Aug 17	Aug 23	Aug 25	Sep 06	Sep 16	Sep 16	
1 Control	0	3.5 B	12.0 BC	12.0 DE	40.5 A	76.5 A	40.5 A	12.0 A
2 Flair 2E	0.75	3.0 B	12.0 BC	15.0 DE	40.5 A	76.5 A	23.5 ABC	8.5 A
3 Flair 2E	1.00	4.0 B	12.0 BC	9.0 E	23.5 A	59.5 A	12.0 BC	10.5 A
4 Flair 2E	1.25	3.0 B	23.5 ABC	38.5 ABCD	40.5 A	76.5 A	12.0 BC	11.5 A
5 Flair 2E	1.50	2.5 B	12.0 BC	9.0 E	23.5 A	59.5 A	23.5 ABC	14.0 A
6 Flair 2E + Ammonium sulfate	0.75	3.0 B	6.0 C	8.0 E	23.5 A	59.5 A	12.0 C	16.0 A
7 Flair 2E + Ammonium sulfate	1.00	3.5 B	12.0 BC	15.0 DE	40.5 A	59.5 A	23.5 ABC	8.0 A
8 Flair 2E + Ammonium sulfate	1.25	3.0 B	12.0 BC	17.0 CDE	23.5 A	59.5 A	23.5 ABC	10.5 A
9 Flair 2E + Ammonium sulfate	1.50	4.0 B	12.0 BC	21.0 BCDE	40.5 A	59.5 A	23.5 AB	10.5 A
10 DES-I-CATE	1.04	4.0 B	23.5 AB	48.0 ABC	40.5 A	76.5 A	23.5 AB	10.5 A
11 Diquat 2E + X77 @ 0.125% V:V	0.25	13.0 A	23.5 AB	52.0 AB	40.5 A	59.5 A	23.5 AB	10.0 A
12 Gramoxone Extra + X77 @ 0.125% V:V	0.47	11.5 A	40.5 A	65.0 A	59.5 A	59.5 A	23.5 AB	10.0 A

[1] Treatments were applied in a total volume of 30 gallons per acre at 30 psi boom pressure. All treatment applications were made on August 17, 1994. The ammonium sulfate application rate was 10 pounds product per acre. **Note: Gramoxone Extra is not labeled for use on potatoes to be stored after harvest or on seed potatoes. This treatment was included in this study as a positive check.**

[2] Treatment means followed by different letters differ significantly (P=0.05). Duncan's Multiple Range Test was used for mean separation of corresponding Horsfall-Barratt values (Scale 0-11).

Post-harvest Fungicides for Early Blight Tuber Decay Management

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Abstract

Seven compounds were tested for their ability to reduce infection of freshly wounded tubers (cv. Wischip) inoculated with the early blight fungus. None of the compounds tested are currently labeled for application to tubers. Results showed there were no significant differences among treatment means for the number of lesions per tuber, the tuber volume decayed per lesion, and the total volume decayed per tuber ($P<0.05$). However, trends showed all treatments reduced the lesion number compared to the misted non-treated control (treatment 2). Treatment 5 (EXP 10412A) had the fewest (1.26) lesions per tuber when compared to 2.67 lesions per tuber for treatment 2. Treatment 10 contained captan, known to control early blight tuber infection, and had more lesions per tuber than any compound tested. All treatments, except treatment 4 (EXP 10370B, high rate), reduced the volume of tuber decay per lesion when compared to the control. All treatments reduced the total volume decayed per tuber (number of lesions per tuber by volume decayed per lesion) when compared to the control. Treatment 5, once again, gave the best disease control when compared with the other treatments.

Introduction

The early blight fungus infects tubers at injury sites that occur during harvest. Therefore, cultural practices that provide for skin set and/or reduce bruising injury during harvest will reduce infection and the amount of tuber decay that develops in storage. Application of fungicide to tuber surfaces immediately after harvest can effectively reduce losses from early blight tuber decay. This report summarizes work done on several different fungicide formulations.

Materials and Methods

Tubers used in the study were harvested from a commercial field near Albin. On September 30, approximately 550 pounds of tubers (cv. Wischip) were immediately collected by hand following the growers' mechanical harvester. The tubers were bagged and placed in 4 degrees Celcius storage within 48 hours of harvest. On October 26, tubers were injured, inoculated with the early blight fungus and post harvest fungicide treatments were applied.

Tubers were injured by rolling 30 pound subsamples down a wooden six-foot slope, four times, until all tubers were uniformly bruised. A 6-foot by 3-foot by 6-inch wooden box (with 4-inch wide bottom slats spaced at 0.5 inches) previously disinfested with 10 percent household bleach was used for this purpose. This bruising injury was done to simulate the harvest-related injury necessary for infection of tubers by the early blight fungus. Immediately after injury, tubers were inoculated with the early blight fungus by dipping in an *Alternaria solani* spore suspension (ca. 1,000 spores per milliliter) for 30 seconds. An assay of the suspension showed 96 percent potential spore germination. Tubers were air dried and randomly divided into 50 pound subsamples prior to treatment application.

Tubers received the treatments listed in Table 1. Treatments were applied with a hand-held mister bottle at the rate of 6.4 fluid ounces per 50 pound subsample (12.8 fluid ounces spray per hundred weight). During treatment, tubers were turned at least three times to ensure uniform treatment application. The treated tubers were divided into four replications, placed in sterilized burlap bags and stored at 4 degrees Celcius. Burlap bags were periodically rearranged during storage to minimize non-random storage effects.

Tubers were evaluated on March 4 to determine the average number of early blight lesions per tuber, average volume decayed per lesion, and average volume decayed per tuber. Eighty tubers per treatment (20 per replication) were rated. A two-way ANOVA was conducted using MSTAT software to determine if treatment effects were significant ($P<0.05$).

Results

All data is shown in Table 1. The data show there were no significant differences among treatment means for the number of lesions per tuber, the tuber volume decayed per lesion, and the total volume decayed per tuber ($P<0.05$).

However, trends in the data showed all treatments reduced the lesion number compared to the misted non-treated control (treatment 2). Treatment 5 (EXP 10412A) had the fewest (1.26) lesions per tuber when compared to 2.67 lesions per tuber for treatment 2. Treatments 3 (EXP 10370B, low dose) and 4 (EXP 10370B, high dose) gave the same general disease control range as treatments 6-9. Treatment 10 contained captan, known to control early blight tuber infection, and had more lesions per tuber than any compound tested.

All treatments, except treatment 4 (EXP 10370B, high rate), reduced the volume of tuber decay per lesion when compared to treatment 2. However, the amount of tuber decay per lesion for all treatments only ranged from 125.14 mm^3 to 194.64 mm^3, with no obvious trends evident. All treatments reduced the total volume decayed per tuber (number of lesions per tuber by volume decayed per lesion) when compared to treatment 2. Treatment 5, once again, gave the best control when compared with the other treatments. None of the compounds tested are currently labeled for application to tubers.

Acknowledgements

The tubers used in this study were provided by Larson-Forrester farms, Albin.

Table 1. Effects of post-harvest tuber treatments on storage decay by the early blight fungus, Alternaria solani. (G.D. Franc, et.al., University of Wyoming).

Treatment # [1]	Number [2] of Lesions/Tuber	Volume [2] of Tuber Decayed	
		Per Lesion	Per Tuber
1 Non-treated (nothing)	2.16 A [3]	147.63 A	310.13 A
2 Non-treated (water only)	2.67 A	172.20 A	446.94 A
3 EXP 10370B (1 lb ai/100 gal)	1.58 A	146.30 A	233.75 A
4 EXP 10370B (2 lb ai/100 gal)	1.71 A	194.64 A	321.70 A
5 EXP 10412A (0.75 lb ai/100 gal)	1.26 A	141.23 A	169.13 A
6 CINL (0.1%) + Tween (0.1%)	1.69 A	125.14 A	202.21 A
7 METL (0.1%) + Tween (0.1%)	1.70 A	126.54 A	241.94 A
8 SAHD (0.1%)+ Tween (0.1%)	1.65 A	141.34 A	212.70 A
9 BAHD (0.1%)+ Tween (0.1%)	1.59 A	129.01 A	195.18 A
10 Captan 50W (1.23 lb ai/100 gal)	1.91 A	144.03 A	281.98 A
Probability	NSD	NSD	NSD

[1] Treatment means followed by different letters differ significantly ($P<0.05$). All treatments were applied in a total spray volume of 12.8 fluid oounces per hundred weith cv. Wischip. Concentrations for treatments 6-9 are on a volume to volume basis.

[2] Data represent averages of four replications by 20 tubers per replication.

[3] Treatment means followed by different letters differ significantly ($P<0.05$).

Survey for Potato Virus Y - Necrotic Strain in Wyoming-produced Seed Potatoes

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Abstract

The objective of this research was to conduct a survey of Wyoming certified potato seedlots, for the presence of PVY-N during the 1992 growing season. Survey results show this virus was not detected in Wyoming certified potato seedlots.

Materials and Methods

This survey was done following the *PVY-N Survey Plan* guidelines supplied by USDA APHIS PPQ for seedlot selection, sample collection, and testing. All fields (seedlots) tested in Wyoming met *Selection Criterium D* (risk of exposure to PVY-N is unknown), with none meeting *Selection Criteria A-C*. Shepody, Russet Burbank, Russet Norkotah, and Atlantic seedlots entered for certification were tested, for a total of six seedlots tested. Certification records were provided by Gary Leever, Manager of the Potato Certification Association of Nebraska, which is the agency that certifies both Wyoming and Nebraska-grown seed potatoes.

The youngest fully-expanded leaf was collected from 1000 individual plants for each seedlot tested. All leaf samples were collected on July 10, 1992 and returned to the laboratory. A single leaflet was removed from each leaf, stacked in piles of 10, and a cork borer used to extract a uniform composite sample from the 10 leaflets. The composite sample was then placed into gauze-lined plastic bags and extraction buffer (PBS + 1 percent Tween-20) was added (1 to 20 w:v) on July 14.

Samples were homogenized and extracted sap was assayed by das-ELISA double-antibody sandwich indirect enzyme-linked immunosorbent assay (das-ELISA) using the AGDIA F-260 monoclonal antibody. Two known PVY-N positive checks and a negative check (buffer only) were included in each ELISA test plate. All samples were homogenized and deposited into the ELISA test wells on July 15, 1992.

Substrate addition was done on July 16, 1992. The PVY-N positive checks each had a visibly detectable reaction within five minutes at room temperature. All ELISA plates were read visually and by an automated plate absorbency reader after 45-60 minute reaction times. At this time, positive check reactions were very strong and background reactions for survey-sample wells were negligible and readily distinguished from the positive checks.

Results

All seedlots tested were negative for PVY-N, indicating the virus was not detected in any of the 6,000 leaves collected. The absence of any positive potato samples collected during the survey made it unnecessary to perform additional bioassay.

Table 1. General field and seedlot information for Wyoming PVY-N survey. Leaves (1000) were tested for each seedlot.

Sample # * and Grower	Field # from Certification Map	Cultivar	Location
1. Lodgepole	1000-A	Atlantic G-V (SSF 92)	T14NRO61W20
2. Lodgepole	1002	Shepody G-V (SSF 92)	T14NRO60W19
3. L-F Farms	1003-A	Norkotah G-II (DHF 92)	T12NRO63W3
4. L-F Farms	1003-B	Norkotah G-III (DHF 92)	T12NRO63W3
5. Brown	1010-A	Norkotah G-IV (Kamp. 91)	T14NRO60W8
6. Brown	1010-C	Norkotah G-IV (Kamp. 92)	T14NRO60W8

* The sample number corresponds to the observation number reported to NAPIS.

Effects of Tillage Practices and Barley Straw Management on Rhizoctonia Root Rot of Sugar Beet

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Abstract

Root and crown rot of sugar beet caused by *Rhizoctonia solani* AG2-2 is one of the most important chronic diseases of sugar beet in Wyoming and surrounding states. The Western Sugar Company's Joint Research Committee approved and funded a proposal by Paul Vincelli, Ph.D. and Colette Beaupré in 1989 to study the effects of various cultural and chemical practices on the disease. A report for that year was presented to the Joint Research Committee in December 1989, with continued support granted in January 1990. Funding for the 1991 season was not requested due to a delay in the 1990 progress report (following Vincelli's departure from the University of Wyoming). The project was continued during 1990, and modified in 1991 with intent of completion under the direction of Gary Franc, Ph.D. Presented here is our final report.

Objectives for 1990 were:

1. Evaluate development of Rhizoctonia root rot of sugar beet and population dynamics of *R. solani* with conventional and reduced tillage systems under continuous sugar beet cropping and sugar beet/corn rotation.
2. Examine effects of incorporation, burning, and removal of barley straw on development of Rhizoctonia root rot in subsequent sugar beet plantings and on soil populations of *R. solani*. Accomplishments over 1990 and 1991 are provided separately for each of the two objectives.

OBJECTIVE 1. Evaluate development of Rhizoctonia root rot of sugar beet and population dynamics of *R. solani* under conventional tillage and reduced tillage systems with continuous sugar beet cropping and sugar beet/corn rotation.

Materials and Methods

1989 Plots: A two-acre area at the University of Wyoming Research and Extension Center in Torrington was planted to sugar beet (cv. 'Monohikari') and the soil was infested with *R. solani* in 1989. Soil was infested and plants were infected by broadcasting infested grain into the crowns of young sugar beet plants over the entire experimental area. The resulting diseased sugar beet crop remained in the field to establish the pathogen in the soil. That fall, conventional-till plots were chiseled and moldboard plowed, and reduced-till plots were left undisturbed to establish the two tillage treatments. This work, was reported to the Joint Research Committee on January 11, 1990 ("Effects of Tillage Practices, Barley Straw Management, Fungicides, and Applications of Phosphorous Acid on Rhizoctonia Root Rot of Sugar Beet").

1990 Plots: Plots were roller-packed and planted on May 2, 1990. Plots were cultivated for weed control, and occasionally weeded by hand. Plots were arranged in a randomized complete block design, as proposed in 1989 (Figure 1). Crop rotation treatments were:

(1) corn rotation (sugar beet to be planted in 1991)

(2) continuous sugar beet (no rotation)

(3) sugar beet (corn to be planted in 1991)

Emergence was normal in all plots; but shortly after, the sugar beet stand was severely reduced due to *R. solani* disease. As a result of the poor stand, weed pressure in the sugar beet plots was high throughout the 1990 season.

1991 Plots: The experimental design had to be modified to better facilitate field preparation and tillage operations by the farm crew. The modification reduced the number of replications because tillage treatments had to be extended over the length of the experimental area (Figure 2). Plots were planted May 16, 1991, with crop rotation and tillage treatments continued as planned. The weed pressure was also severe in 1991 because of poor sugar beet stands.

1990 and 1991 Data Collection: Data collected were for stand count, yield, percent sugar content, nitrate rating at harvest, and *R. solani* population counts (CFU/G; colony-forming units per gram dry soil) at 0-4 inches and 4-8 inch depths. Stand counts were from 10 and 20 feet of row in 1990 and 1991, respectively; and 1990 counts were adjusted to 20 feet for analysis and presentation in Table 1. Data were analyzed separately for the two years using ANOVA for a split-plot design with two factors (tillage treatments nested within crop rotation treatments) using MSTAT FACTOR.

Results and Discussion

Analysis of variance did not detect a significant ($P \leq 0.05$) interaction between crop rotation and tillage treatments for sugar beet stand, yield, and *R. solani* soil populations. There were no significant differences ($P \leq 0.05$) among observations due to crop rotation.

However, a significant trend ($P \leq 0.05$) was observed with soil populations of *R. solani* (Table 1). The data showed that plots receiving the reduced-till treatment had consistently greater *R. solani* soil populations than plots receiving the conventional-till treatment. This increase ranged from 1.7 to 3.6 times the soil population estimated for plots receiving conventional tillage.

Table 1. Effect of crop rotation and tillage practice upon sugar beet stand, yield, and soil population of R. solani.

Crop rotation	Tillage	Stand[a]	Yield[b]	CFU/G[c]
1990 Data				
Sugar beet 90/ Corn 91	Conventional	7.50	14.06	0.05
	Reduced	5.50	10.60	0.18
Continuous Sugar beet	Conventional	13.50	40.00	0.07
	Reduced	8.00	14.10	0.20
Corn 90/ Sugar beet 91	Conventional	NA	NA	NA
	Reduced	NA	NA	NA
1991 Data				
Corn 90 Sugar beet 91	Conventional	1.0	8.8	4.43
	Reduced	13.5	59.9	7.70
Continuous sugar beet	Conventional	5.0	22.1	2.19
	Reduced	1.0	7.1	5.68
Sugar beet 90 Corn 91	Conventional	NA	NA	1.86
	Reduced	NA	NA	4.72

[a] Number of beets per 20 feet of row at harvest.
[b] Total weight (lbs) of beets harvested per 20 feet of row.
[c] Colony forming units per gram (CFU/G) of dry soil for collections made on May 2, 1990 and June 20,1991.

OBJECTIVE 2. Examine the effects of incorporation, burning, and removal of barley straw on development of Rhizoctonia root rot in subsequent sugar beet plantings and on populations of *R. solani* in soil.

In 1990, sugar beet was superimposed over the previous season's barley plots at Worland, Wyoming. The residue had been either incorporated, burned, or removed the previous fall as stated in an earlier report (see 1989 Research Progress Report, "Effects of

Tillage Practices, Barley Straw Management, Fungicides, and Applications of Phosphorous Acid on Rhizoctonia Root Rot of Sugar Beet").

Before late-season soil microbe counts could be taken from the sugar beet field, all plots were irreparably damaged by the cooperator. This action terminated the study prematurely, and no conclusions were possible.

Conclusions and Further Work

Results suggest that *R. solani* soil populations increased when reduced tillage practices were followed. However, the extent of the increase did not result in measurable effects on stand and yield in our study ($P \leq 0.05$). Therefore, further work is needed to determine the effect of *R. solani* soil population on sugar beet stand and yield and crop rotation effects on soil populations of *R. solani*. Also, it is recommended that, due to field variability, the number of replications in the experimental design be increased. We were limited in the number of replications for the study reported here because of difficulty applying different tillage treatments to small plots.

Weed pressure was severe from middle to late season during both years because poor sugar beet stands reduced competition. The weed competition for light, nutrients, and water probably masked disease effects on sugar beet stand and yield. Selecting a partially-resistant sugar beet cultivar may aid future studies where disease pressure is severe by providing an early stand.

Kerr and Watkins (1980) demonstrated that a crop rotation of sugar beet/corn/dry edible bean/sugar beet successfully reduced *Rhizoctonia* disease in sugar beet. Therefore, future studies of crop rotation to reduce disease might include a legume as it would also replenish soil nitrogen before returning to sugar beet.

Sumner and Minton (1989) observed that *R. solani* AG2-2 caused yield reduction in irrigated corn, even at low inoculum levels. Therefore, it would be prudent to monitor soil population, disease level and yield in the rotation crops in future studies.

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Movement of the Rhizomania Vector in Water and Wind-blown Soil

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Introduction

Rhizomania is caused by beet necrotic yellow vein virus (BNYVV). This virus is carried by both resting spores and motile spores of the soil-borne fungus, *Polymyxa betae*. Although rhizomania is believed to spread via movement of viruliferous spores in irrigation water and in wind-blown soil, published reports are not available. Therefore, surveys were done in eastern Wyoming and western Nebraska to determine the potential for movement of *P. betae*, the vector of BNYVV and other sugar beet viruses, in flowing surface water and wind-blown soil. Results from these studies will help determine the potential for spread of rhizomania in sugarbeet production areas.

Materials and Methods

Monthly water collections were made from the North Platte River during a one-year survey period. Five sites, representing locations on the river upstream from agricultural areas to downstream sites, were repeatedly sampled. Collection sites were located (A) 8 miles east of Guernsey, Wyoming (near Whalen Dam); (B) nera the Holly Factory in Torrington; (C) near the Wyoming-Nebraska border in Henry, Nebraska; (D) 7 miles east of Scottsbluff in Minatare, Nebraska; and (E) 38 miles east of Scottsbluff in Bridgeport, Nebraska. Particulates in water samples were concentrated by filtration through celite. After filtration, the celite was air dried and tested in a greenhouse bioassay for *P. betae*. Therefore, detection of only resting spores was possible because motile spores are readily desiccated and rendered non-viable by this procedure.

Aerosol samples, which included wind-blown particulates, were collected on cellulose air filters with the aid of high volume aerosol samplers. Samples were collected over a 12-month period at two sample sites. After exposure, filters were aseptically cut into ca. 2.5

centimeter squares, which were then used to amend previously steamed sand. The resulting sand-filter mixture was tested via a greenhouse bioassay for *P. betae*.

Results

Results showed that *P. betae* could be detected in surface water throughout the survey period. Detectable levels of *P. betae* were present in 23 percent (41 of 180) samples. However, the two upstream sites had detectable levels of *P. betae* present only 33 percent of the time while the three downstream sites had detectable levels present ca. 75 percent of the time. Results for the water collection series are shown in Table 1.

A total of 124 filter samples were collected throughout the survey period. Results for bioassays showed that 42 percent (38 of 90) and 59 percent (20 of 34) of the filter samples had detectable levels of *P. betae* present for western Nebraska and eastern Wyoming collection sites, respectively. Overall survey results show that resting spores of *P. betae* were readily detected in both flowing surface water and wind-blown particulates.

Table 1. North Platte water survey results for detection of *P. betae*.

Date	# *P. betae* (+)[1]	Collection Sites Positive[2]
April	7	A C D E
May	5	A B C D E
June	5	A C D
July	4	C E
August	1	E
September	3	A B D
October	2	B D
November	1	D
December	1	C
January	4	D E
February	4	C D E
March	4	B C E

[1] Fifteen samples were collected per month (five sites by three replications).
[2] Collection sites were; (A) near Guernsey; (B) Torrington; (C) Henry, Nebraska; (D) Minatare, Nebraska; and (E) Bridgeport, Nebraska.