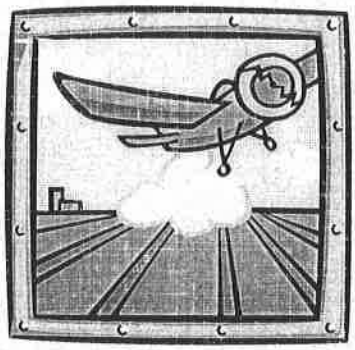
2003
RESEARCH REPORT

Extension Potato Disease Control Project



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Colorado State University

SLV Research Center

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2003 POTATO - EARLY BLIGHT FUNGICIDE TRIALS

Researchers: Richard T. Zink and Andrew Houser, Colorado State University, SLVRC

Location: San Luis Valley Research Center, Center, CO

Cultivar: Russet Norkotah Selection 8, cut seed, 2-4 oz.

Applications: All treatments applied using an R & D CO_2 charged tractor mounted plot sprayer with four XR 8002VS nozzles spaced seventeen inches apart at 60 psi pressure and applying 40 gallons/acre as a broadcast application.

Spray Dates: July 7; July 14; July 21; July 28; August 4; August 11; August 19; August 25

Planted: May 7, 2003
Plot Design: Randomized complete block
Plot Size: 4 - 20 foot rows per treatment per replication, treatments applied to center two rows and data taken on center two rows.
Plant Spacing: 12 inches
Row Spacing: 34 inches
Replications: Four
Irrigation: Solid set sprinkler, rate based on ET
Fertilizer: 80N-60P-40K-25S-2.5Zn, preplant, 10N through sprinkler after tuber set
Herbicide: Matrix, 1.5 oz./A + Eptam, 4.5 pt./A
Insecticide: None
Vine Killer: September 2, 2003
Harvested: September 11 & 12, 2003

DATA:

Disease: Early blight disease incidence based on percent leaves infected, readings taken weekly starting August 6, 2003.
Yield: 2-20 foot rows per treatment per replication, total yield expressed as cwt/A.
Grade: By hand, percent tubers by weight in pounds < 4 oz., 4-10 oz., > 10 oz., US #2's, and culls.

Summary of Results

Thanks to the generous support of the Colorado Potato Administrative Committee (Area II) and several agricultural companies, full season comprehensive fungicide efficacy trials were conducted this past summer at the San Luis Valley Research Center (see protocol). Over the course of the growing season sixteen different fungicide programs were assessed for early blight control (Table 1). The trials depended on natural infection by early blight (*Alternaria solani*). No late blight (*Phytophthora infestans*) occurred in the trial.

The incidence of early blight within the trials was similar to what occurred in commercial potato production across the San Luis Valley. At the time of final disease readings on September 2, early blight incidence had reached 100 percent in the untreated control. AUDPC values provide clear separation among fungicide programs. Early blight disease development was significantly reduced by all treatments over the untreated control. In general, the highest degree of early blight control was achieved in programs where either Quadris or Headline was utilized (Table 2). Suppression of foliar early blight did not, however, translate directly to increased tuber yields (Table 3).

Table 1. Fungicide programs evaluated for early blight control, San Luis Valley, Colorado 2003

Program	Products	Rate	Itinerary/Week	Est. total cost/A*
1	Control, no treatment	-	-	
2	Polyram	2.0 lb./A	1,5	$38.76/A
	Headline (F500)	6.2 oz./A	3,7	
3	Quadris	6.2 fl.oz./A	1,3,5,7	$96.48/A
	Bravo WS	1.25 pt./A	2,4,6,8	
4	Amistar	2.0 oz./A	1,3,5,7	NA
	Bravo WS	1.25 pt./A	2,4,6,8	
5	Quadris/Bravo	1.6 pt./A	1,3,5,7	NA
	Bravo WS	1.25 pt./A	2,4,6,8	
6	Headline (F500)	6.2 oz./A	1,3,5,7	$85.08/A
	Bravo WS	1.25 pt./A	2,4,6,8	
7	Cuprofix MZ	4.0 lb./A	1	NA
	Penncozeb	2.0 lb./A	2,4,6,7,8	
	Headline (F500)	6.1 oz./A	3,5	
	SuperTin	2.5 oz./A	7,8	
8	Cuprofix MZ	4.0 lb./A	1,2	NA
	Penncozeb	2.0 lb./A	3,5	
	Headline (F500)	6.1 oz./A	4,6	
	SuperTin	2.5 oz./A	7,8	
9	Cuprofix MZ	4.0 lb./A	1	NA
	Penncozeb + Microthiol	2.0 lb./A + 2.0 lb./A	2,4,6	
	Headline (F500)	6.1 oz./A	3,5	
	Penncozeb + SuperTin	2.0 lb./A + 2.5 oz./A	7,8	
10	Cuprofix MZ	4.0 lb./A	1	NA
	Penncozeb + Bond	2.0 lb./A + 4.0 oz./A	2,4,6	
	Headline (F500)	6.1 oz./A	3,5	
	Penncozeb + SuperTin	2.0 lb./A + 2.5 oz./A	7,8	
11	BAS 50000F	6.14 fl.oz./A	1,2,3,4,5,6	$78.72/A
12	BAS 50000F	9.2 fl.oz./A	1,2,3,4,5,6	$116.70/A
13	BAS 500 UHF	6.14 fl.oz./A	1,2,3,4,5,6	NA
14	BAS 500 UHF	9.2 fl.oz./A	1,2,3,4,5,6	NA
15	BAS 51004F	2.5 oz./A	1,3,5	NA
	BAS 50000F	6.0 fl.oz./A	2,4	
	SuperTin	2.5 oz./A	6	
16	BAS 51004F	2.5 oz./A	1,3,5	NA
	BAS 50000F	6.0 fl.oz./A	2	
	Acrobat + Polyram	6.4 oz./A +2.0 lb./A	4	
17	Bravo WS	1.25 pt./A	1,3,5	$62.53/A
	Quadris	6.2 fl.oz./A	2,4	
	SuperTin	2.5 oz./A	6	

*These prices do not include application costs.

Table 2. Effect of fungicide programs on the incidence of early blight in the cultivar Russet Norkotah Selection 8, San Luis Valley, Colorado, 2003; No Late Blight occurred within the trial.

	Percent Leaves Infected					
Treatment	August 6	August 13	August 21	August 27	September 2	AUDPC[a]
1	14.3	35.0	54.6	98.2	100.0	1057.1 a
2	3.7	7.2	16.5	39.2	96.4	570.3 b
3	3.3	8.0	9.7	27.5	75.5	433.6 d
4	3.4	8.2	9.2	30.9	70.0	425.6 d
5	4.1	6.1	11.7	38.5	60.0	421.5 d
6	3.6	10.4	10.1	30.2	67.9	427.7 d
7	4.5	7.2	13.1	33.8	82.9	495.2 bcd
8	3.6	7.4	8.1	33.8	79.6	463.3 d
9	3.5	6.4	17.0	38.3	93.0	553.7 bc
10	3.2	6.1	16.0	33.6	78.7	481.1 cd
11	5.1	11.8	10.1	31.3	80.4	485.2 cd
12	3.9	6.7	10.1	34.2	67.9	429.2 d
13	3.5	7.1	12.0	38.2	77.5	483.6 cd
14	3.3	6.8	11.7	26.9	72.1	422.5 d
15	3.5	6.0	8.6	32.1	74.6	436.2 d
16	4.0	6.7	9.8	37.1	75.9	467.0 d
17	4.1	10.7	11.1	32.1	81.7	488.9 cd
LSD(P=0.05)	3.28	4.64	6.28	12.44	11.99	78.64

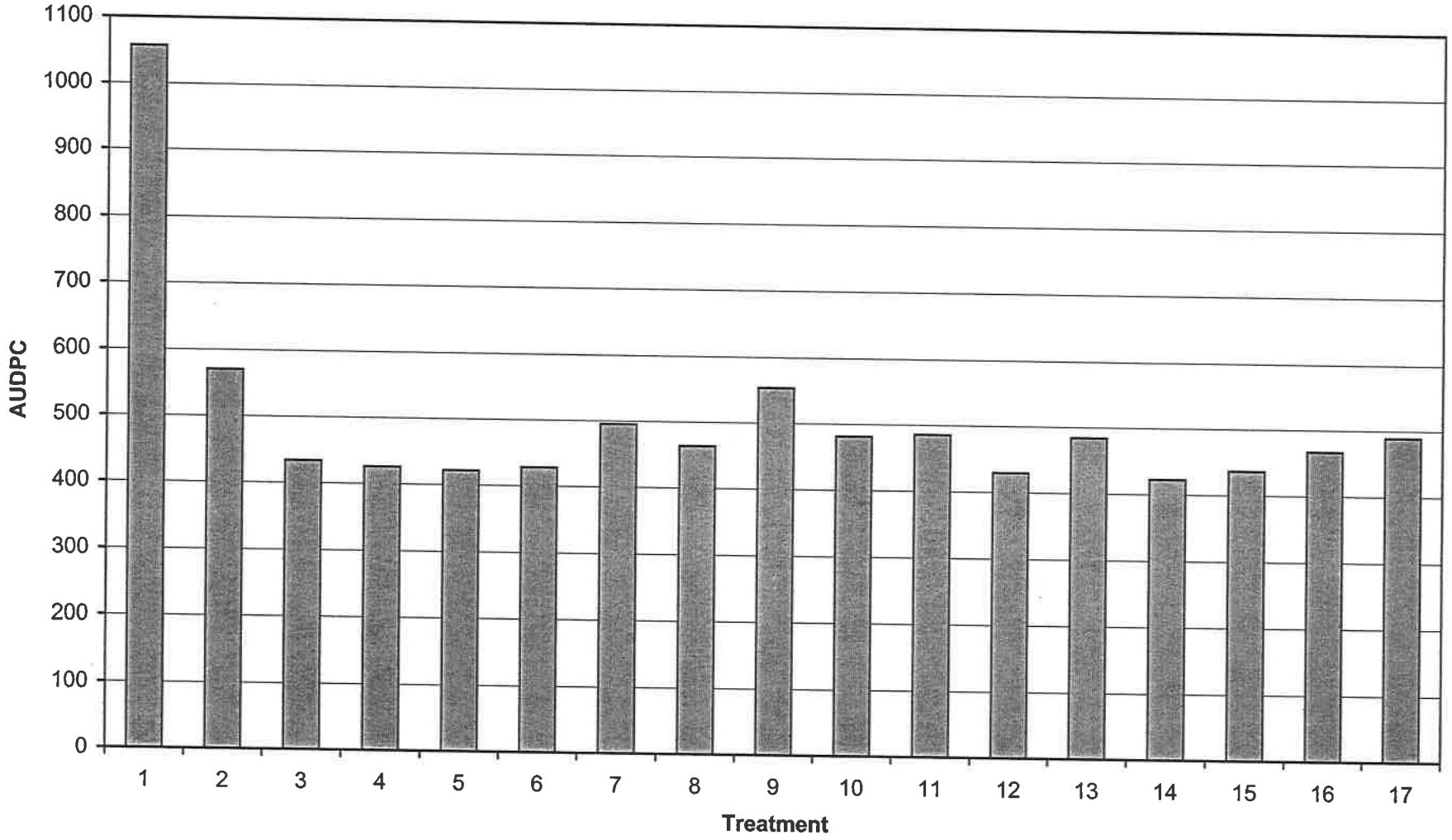
[a]AUDPC is the Area Under the Disease Progress Curve.
Means followed by the same letters are not significantly different at P=0.05 for AUDPC.

Table 3. Effect of fungicide programs on tuber yield and quality in the cultivar Russet Norkotah Selection 8, San Luis Valley, Colorado, 2003

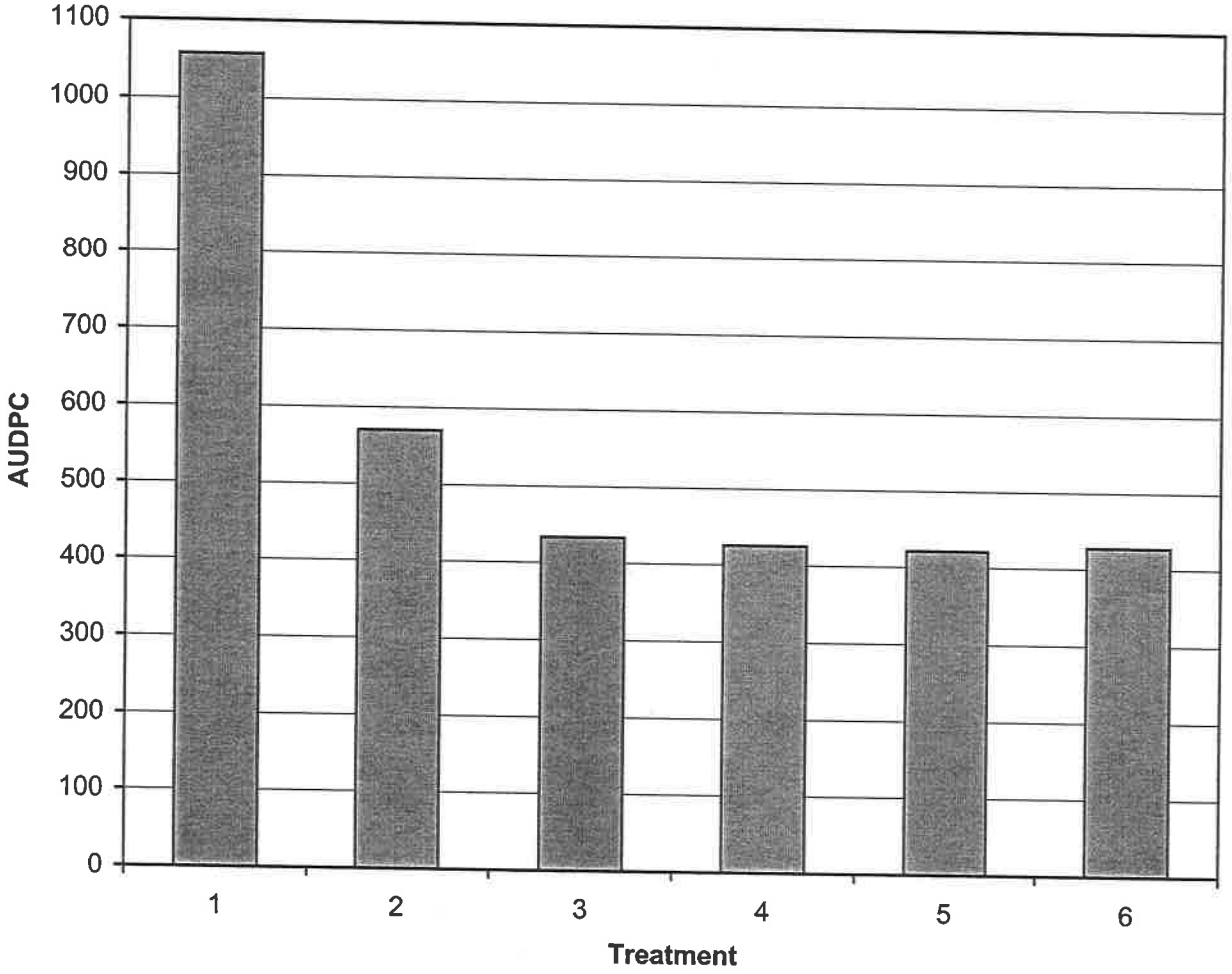
	Percent[a]					
Treatment	< 4 oz.	4-10 oz.	> 10 oz.	US #2s	Culls	Cwt/A[b]
1	5.3	41.3	57.2	1.9	0.4	399.4
2	6.5	41.6	59.2	1.2	1.2	412.6
3	6.7	40.6	42.3	1.8	1.9	344.8
4	6.4	37.3	55.7	0.4	0.8	382.3
5	7.7	41.3	50.7	1.6	0.6	383.5
6	7.0	39.1	46.2	2.6	0.7	354.8
7	7.9	39.9	54.3	1.6	1.4	392.3
8	6.4	37.7	54.3	4.2	1.8	378.5
9	5.7	36.0	57.8	1.0	0.3	382.9
10	6.0	39.5	55.2	1.9	0.2	387.3
11	7.1	43.9	57.8	2.4	0.8	418.5
12	5.4	35.9	51.0	1.6	1.0	355.1
13	5.7	43.6	60.2	2.1	0.6	421.2
14	4.9	39.8	56.9	1.2	0.7	391.0
15	5.9	43.5	46.3	1.0	0.6	368.3
16	5.0	40.7	53.8	1.6	0.7	382.9
17	6.0	41.0	47.7	1.5	1.3	364.0
LSD(P=0.05)	NS	NS	NS	NS	NS	NS

[a] Based on tuber weight in pounds, mean of four replications.
[b] Total yield expressed as hundred weight per acre, 2-20 foot rows per treatment per replication, mean of four replications.

Area Under the Disease Progress Curve for Early Blight
2003 Fungicide Trial, Colorado State University
San Luis Valley Research Center, Center, CO

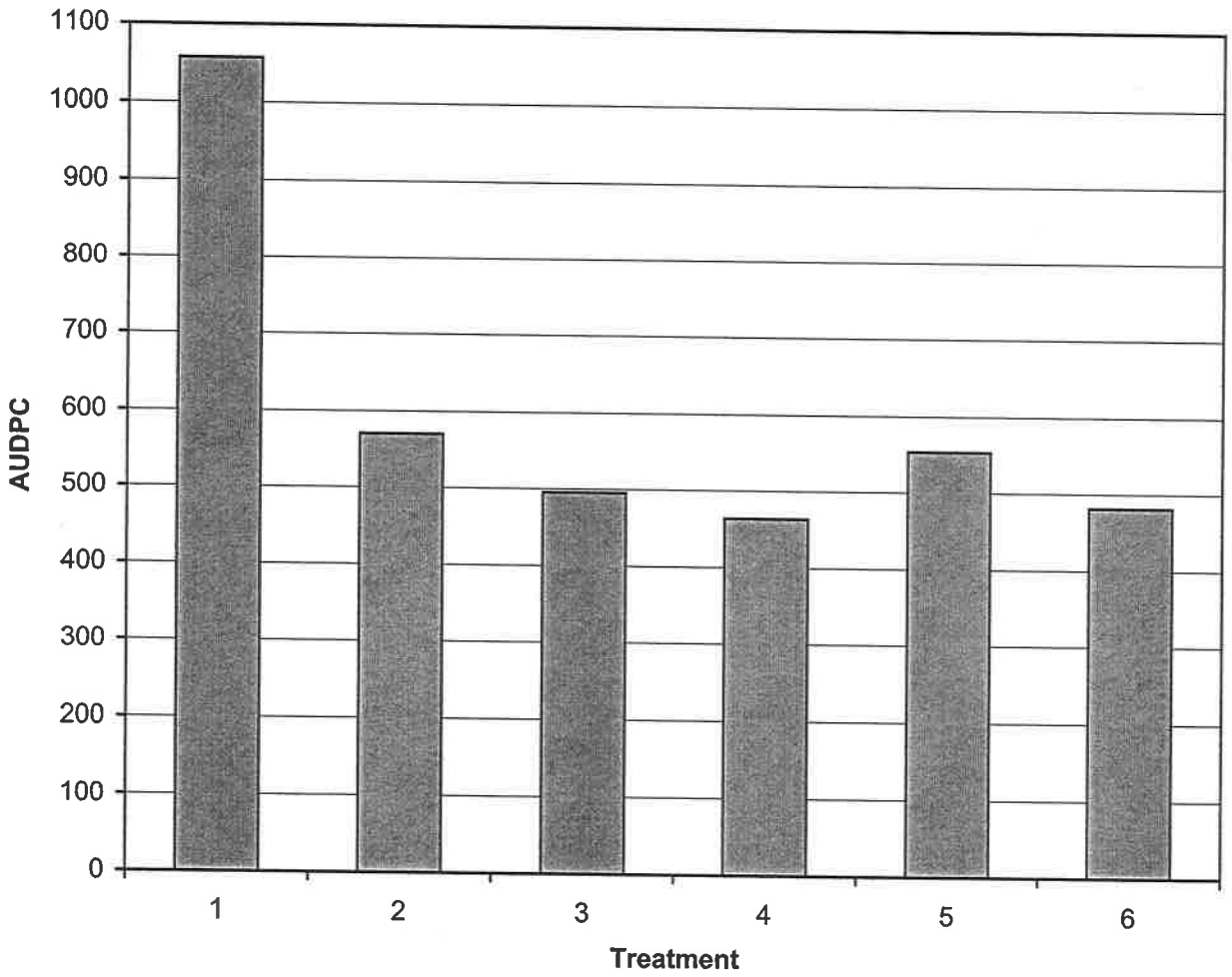


Area Under the Disease Progress Curve for Early Blight
2003 Fungicide Trial, Colorado State University
San Luis Valley Research Center, Center, CO



1. Control, no treatment
2. Polyram @ 2.0 lb./A (1,5) + Headline @ 6.2 oz./A (3,7)
3. Quadris @ 6.2 fl.oz./A (1,3,5,7) + Bravo WS @ 1.25 pt./A (2,4,6,8)
4. Amistar @ 2.0 oz./A (1,3,5,7) + Bravo WS 1.25 @ pt./A (2,4,6,8)
5. Quadris/Bravo @ 1.6 pt./A (1,3,5,7) + Bravo WS @ 1.25 pt./A (2,4,6,8)
6. Headline @ 6.2 oz./A (1,3,5,7) + Bravo WS @ 1.25 pt./A (2,4,6,8)

Area Under the Disease Progress Curve for Early Blight
2003 Fungicide Trial, Colorado State University
San Luis Valley Research Center, Center, CO



1. Control, no treatment

2. Polyram @ 2.0 lb./A (1,5) + Headline @ 6.2 oz./A (3,7)

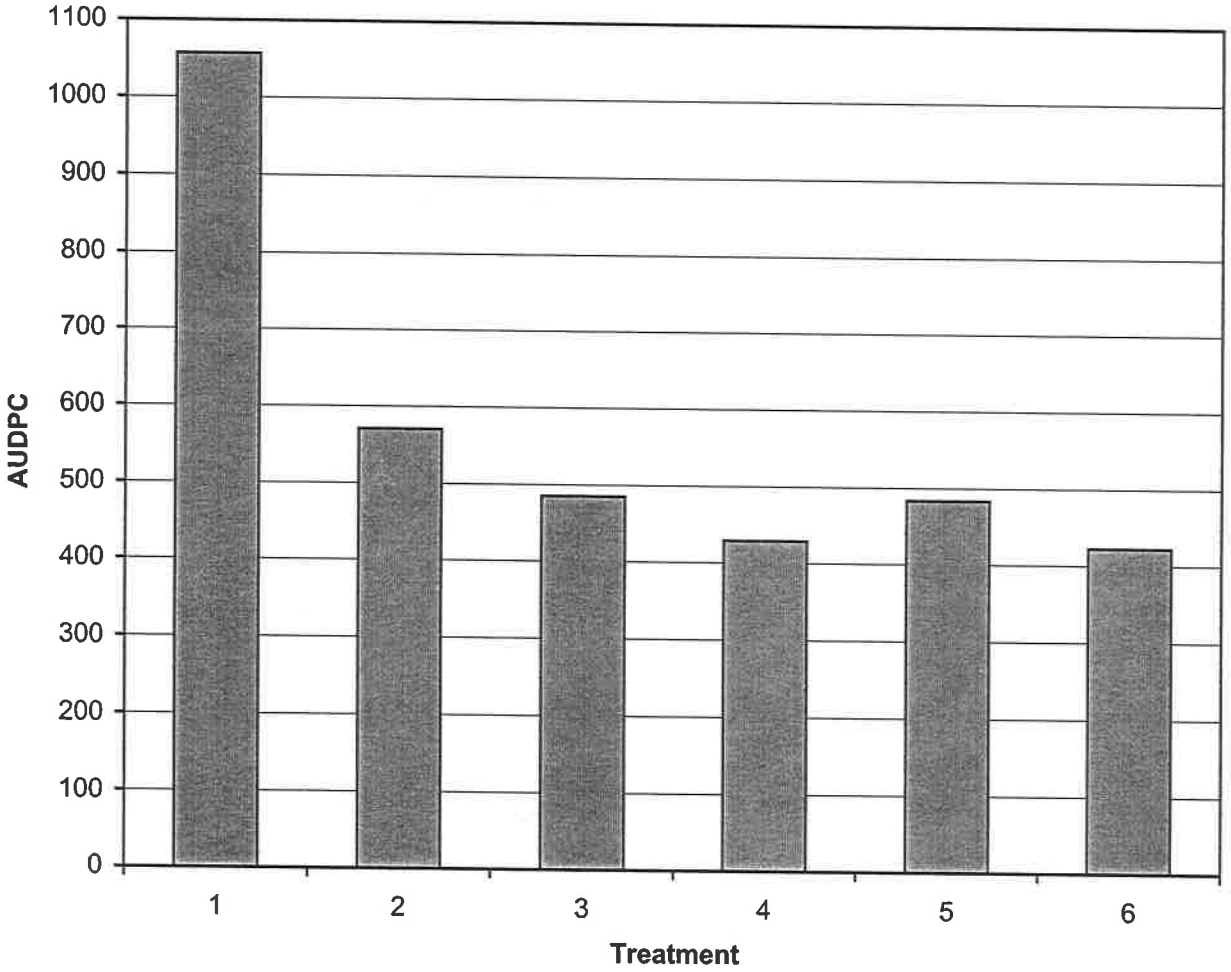
3. Cuprofix MZ @ 4.0 lb./A (1) + Penncozeb @ 2.0 lb./A (2,4,6,7,8) + Headline @ 6.1 oz./A (3,5) + SuperTin @ 2.5 oz./A (7,8)

4. Cuprofix MZ @ 4.0 lb./A (1,2) + Penncozeb @ 2.0 lb./A (3,5) + Headline @ 6.1 oz./A (4,6) + SuperTin @ 2.5 oz./A (7,8)

5. Cuprofix MZ @ 4.0 lb./A (1) + Penncozeb @ 2.0 lb./A & Microthiol @ 2.0 lb./A (2,4,6) + Headline @ 6.1 oz./A (3,5) + Penncozeb @ 2.0 lb./A & SuperTin @ 2.5 oz./A (7,8)

6. Cuprofix MZ @ 4.0 lb./A (1) + Penncozeb @ 2.0 lb./A & Bond @ 4.0 oz./A (2,4,6) + Headline @ 6.1 oz./A (3,5) + Penncozeb @ 2.0 lb./A & SuperTin @ 2.5 oz./A (7,8)

Area Under the Disease Progress Curve for Early Blight
2003 Fungicide Trial, Colorado State University
San Luis Valley Research Center, Center, CO



1. Control, no treatment
2. Polyram @ 2.0 lb./A (1,5) + Headline @ 6.2 oz./A (3,7)
3. BAS 50000F @ 6.14 fl.oz./A (1,2,3,4,5,6)
4. BAS 50000F @ 9.2 fl.oz./A (1,2,3,4,5,6)
5. BAS 500UHF @ 6.14 fl.oz./A (1,2,3,4,5,6)
6. BAS 500UHF @ 9.2 fl.oz./A (1,2,3,4,5,6)

Area Under the Disease Progress Curve for Early Blight
2003 Fungicide Trial, Colorado State University
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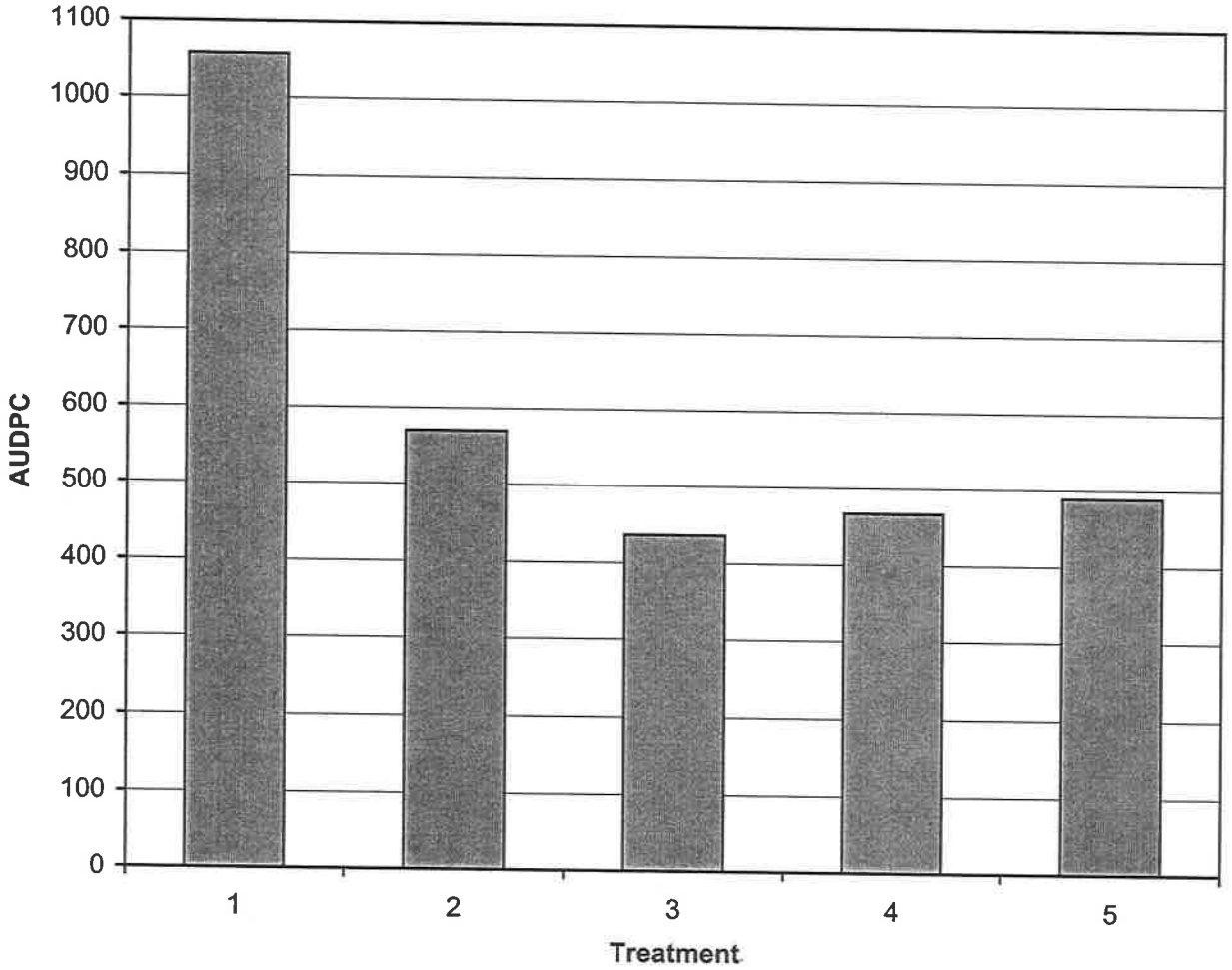


1. Control, no treatment

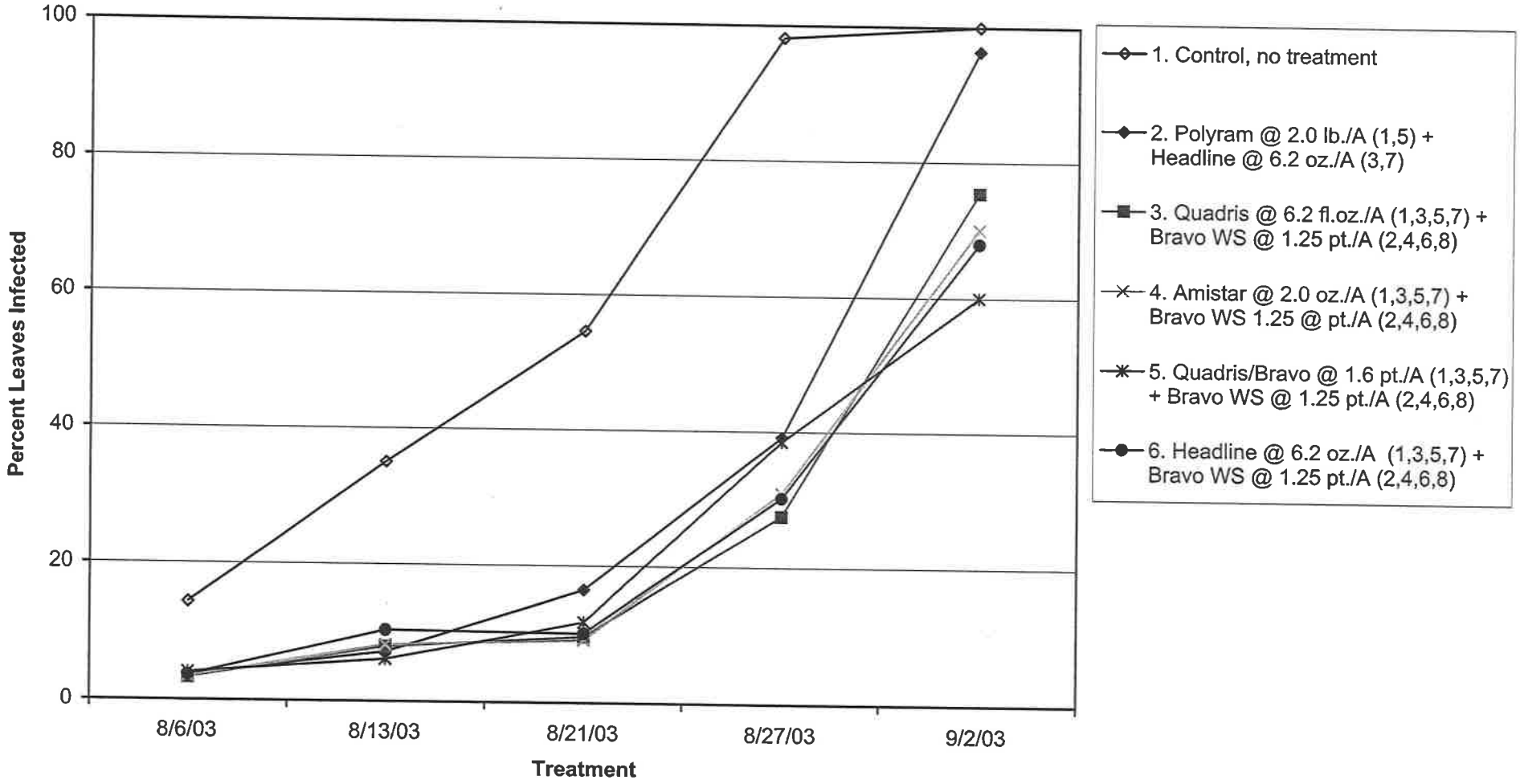
2. Polyram @ 2.0 lb./A (1,5) + Headline @ 6.2 oz./A (3,7)

3. BAS 51004F @ 2.5 oz./A (1,3,5) + BAS 50000F @ 6.0 fl.oz./A (2,4) + SuperTin @ 2.5 oz./A (6)

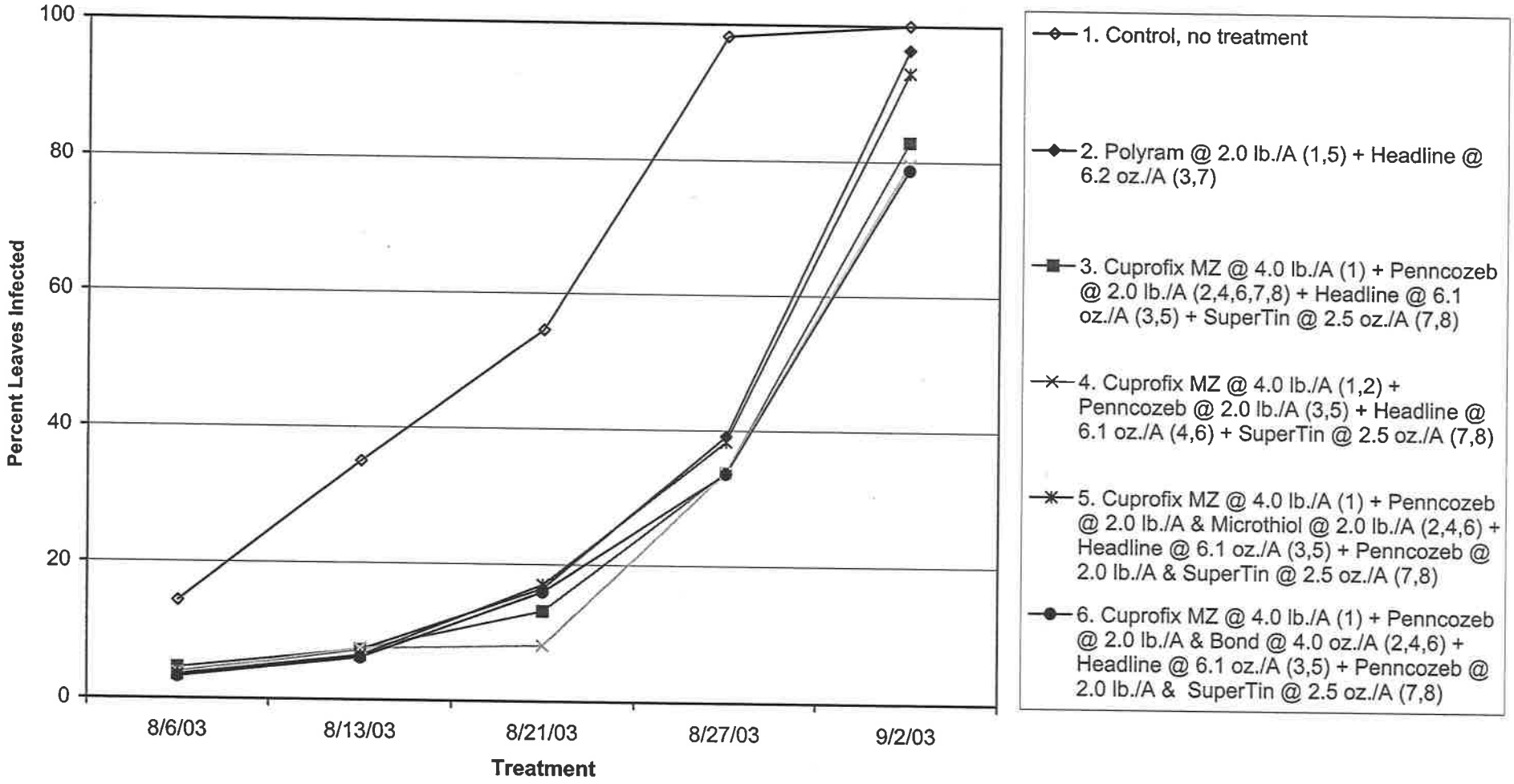
4. BAS 51004F @ 2.5 oz./A (1,3,5) + BAS 50000F @ 6.0 fl.oz./A (2) + Acrobat @ 6.4 oz./A & Polyram @ 2.0 lb./A (4)

5. Bravo WS @ 1.25 pt./A (1,3,5) + Quadris @ 6.2 fl.oz./A (2,4) + SuperTin @ 2.5 oz./A (6)

Disease Progress Curve for Early Blight
2003 Fungicide Trial, Colorado State University
San Luis Valley Research Center, Center, CO



Disease Progress Curve for Early Blight
2003 Fungicide Trial, Colorado State University
San Luis Valley Research Center, Center, CO



Disease Progress Curve for Early Blight
2003 Fungicide Trial, Colorado State University
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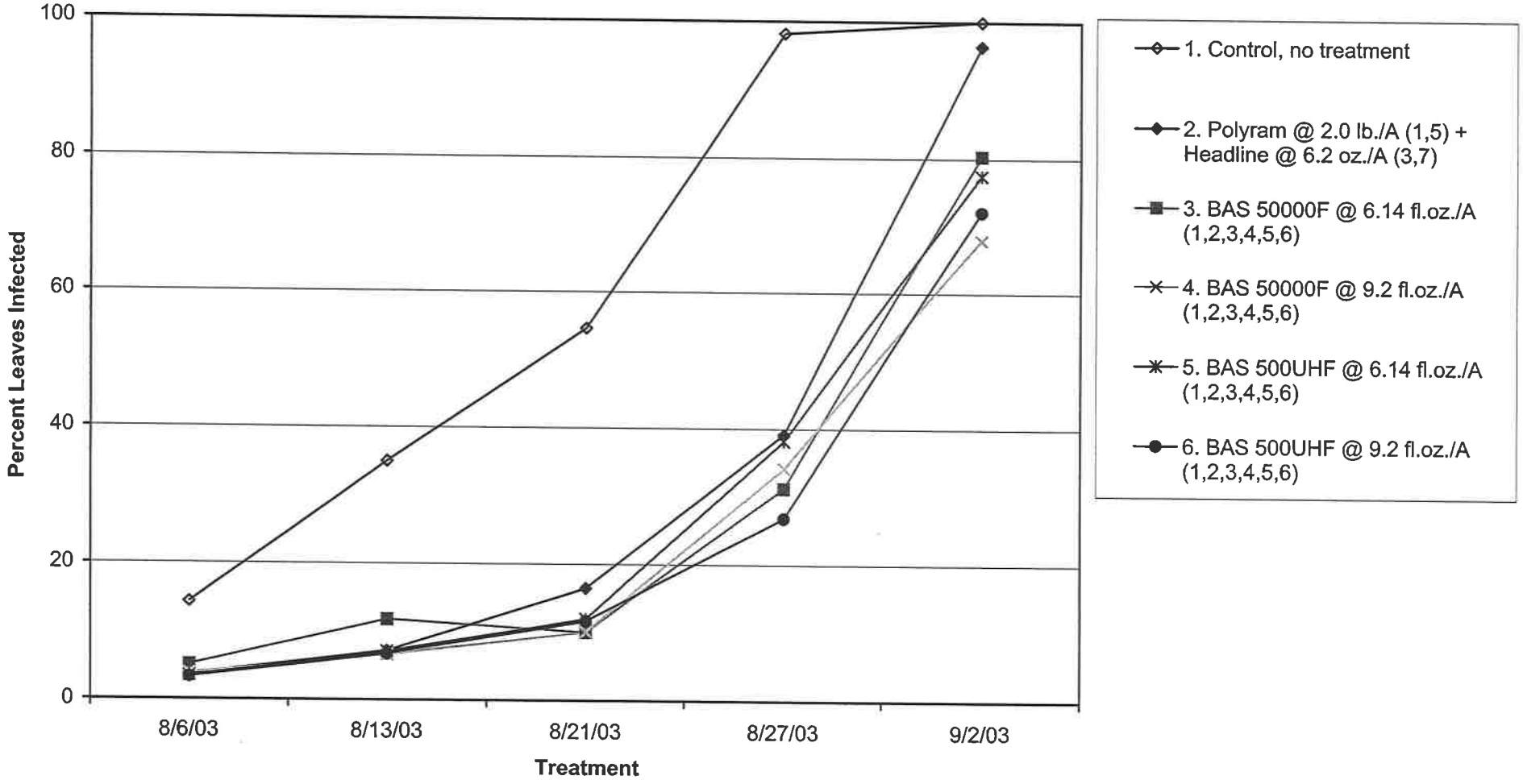
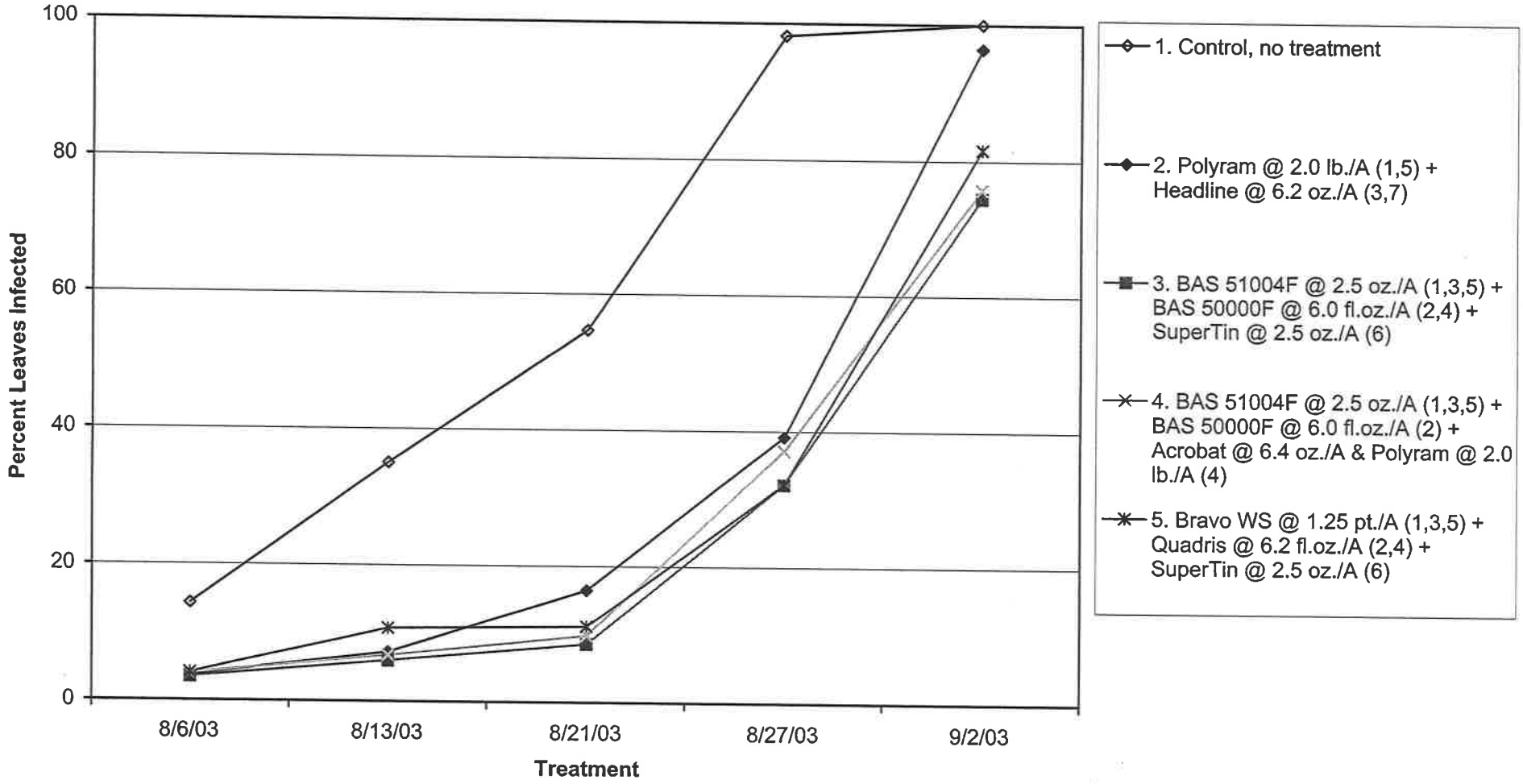
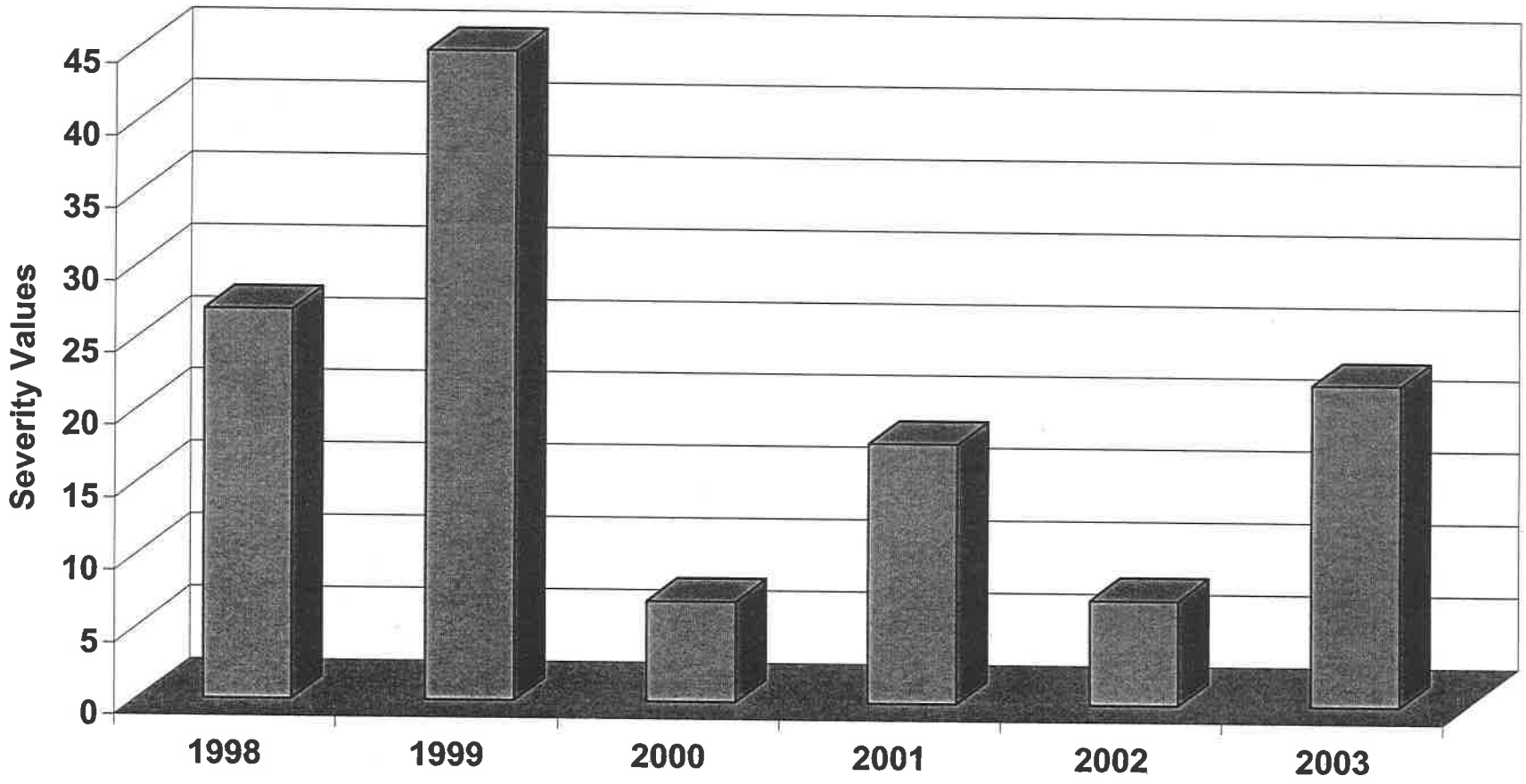


Disease Progress Curve for Early Blight
2003 Fungicide Trial, Colorado State University
San Luis Valley Research Center, Center, CO



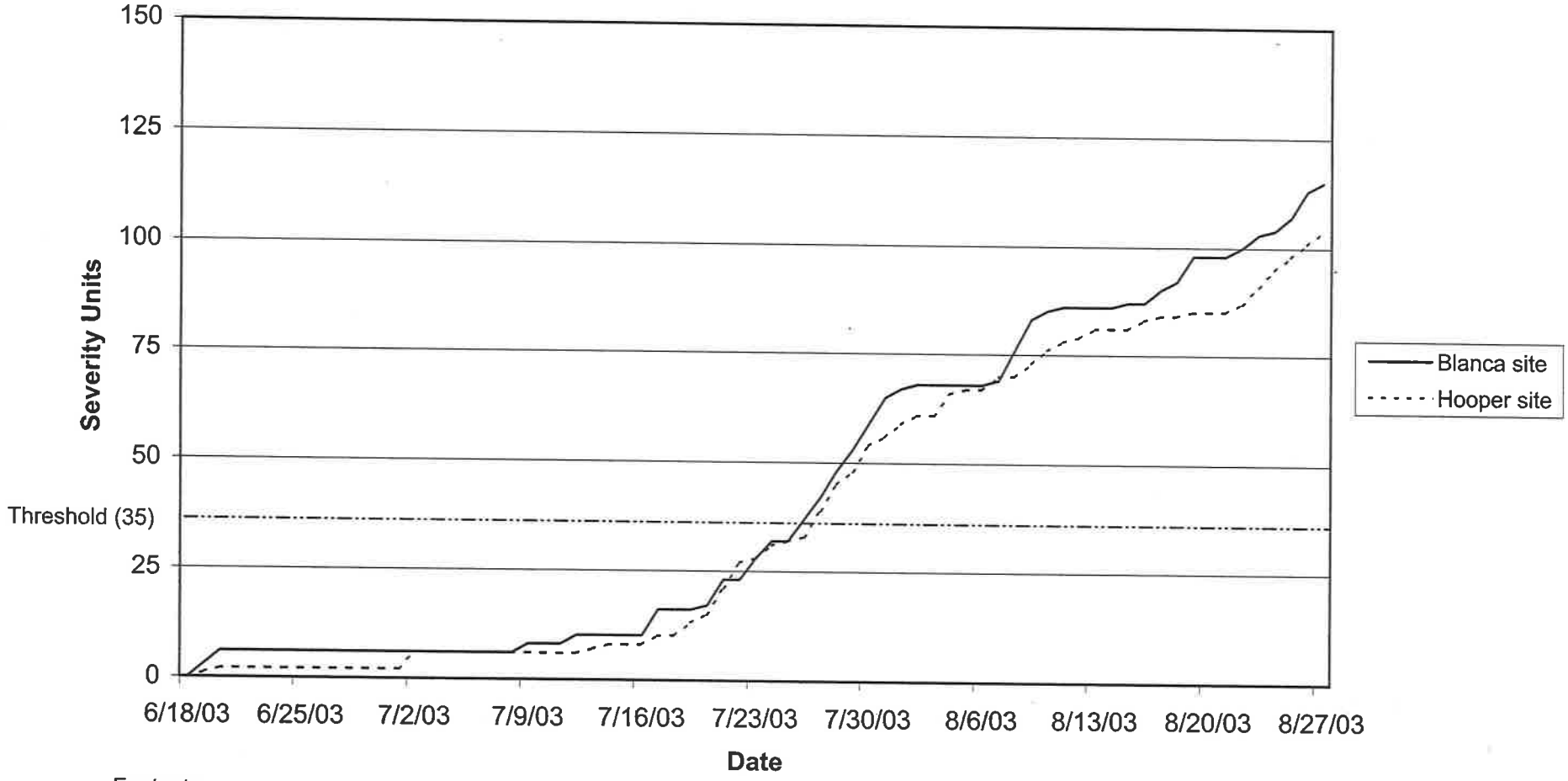
SLV Late Blight Forecasting Data

SLV Late Blight Severity Values



Potato Late Blight Fry Units, San Luis Valley, Colorado, 2003

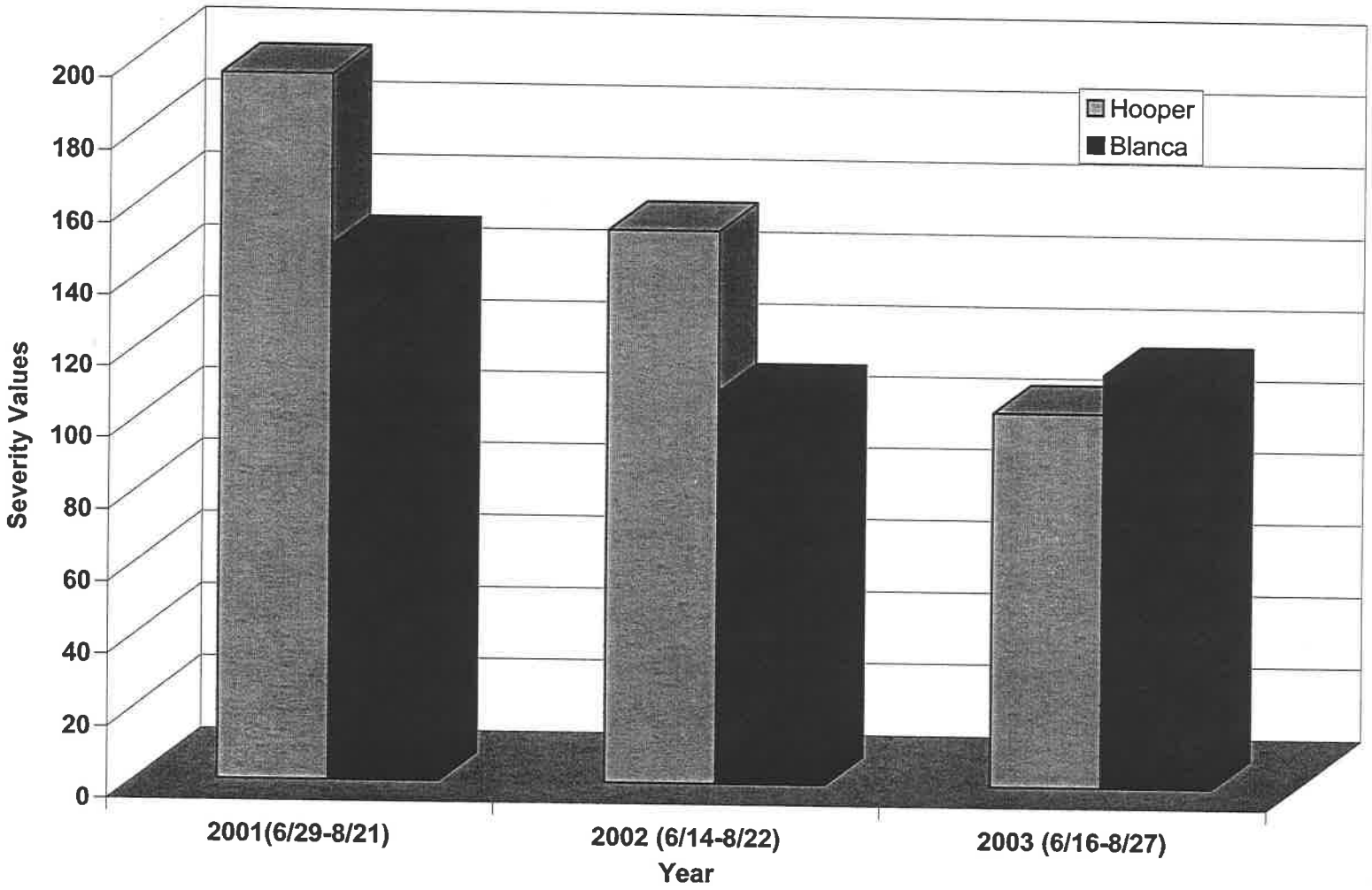
Moderate Susceptible Varieties



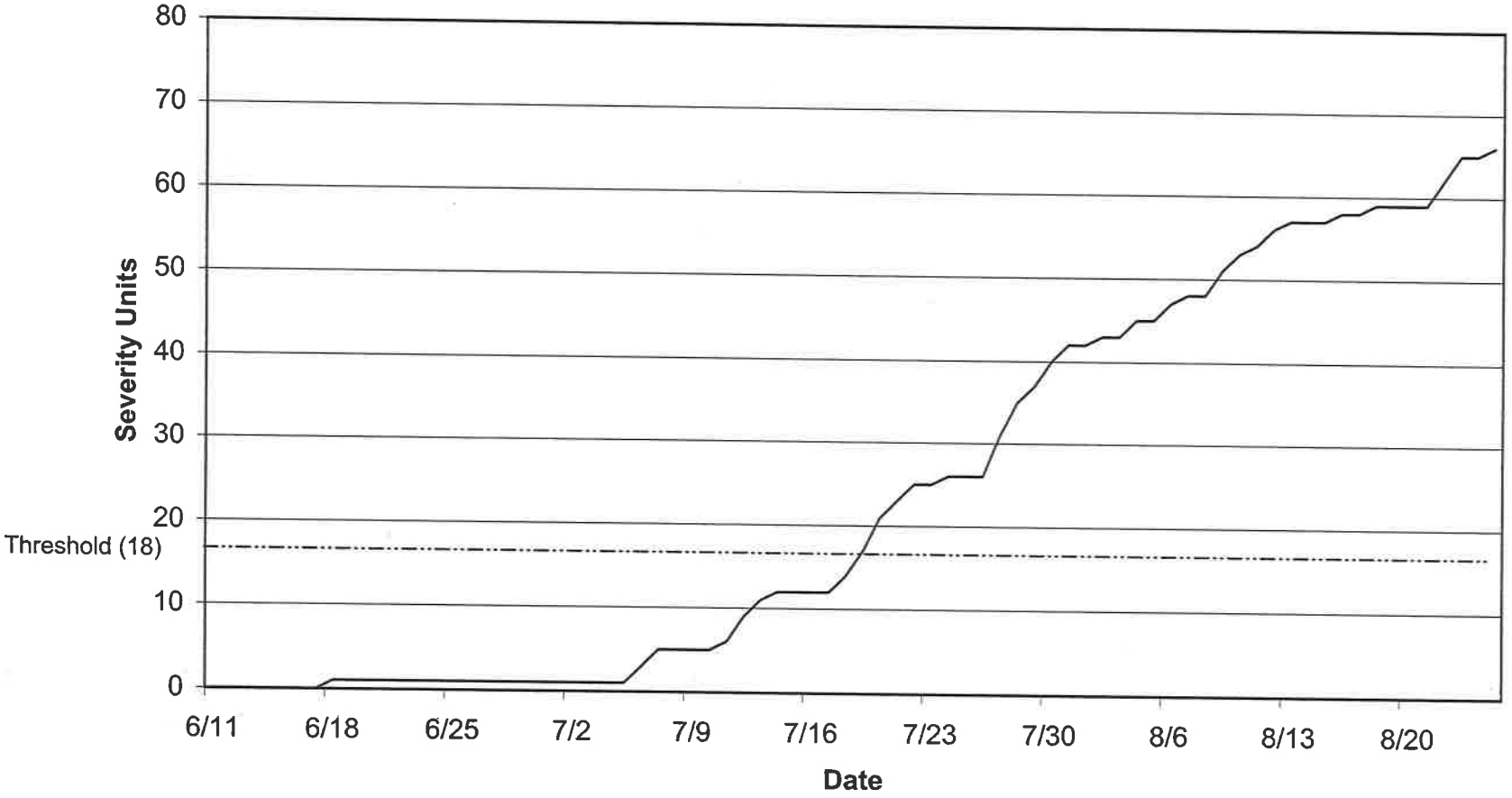
Footnote:

- The Fry Late Blight model was used to calculate the severity units.
- Both weather stations were set up on June 16, 2003.

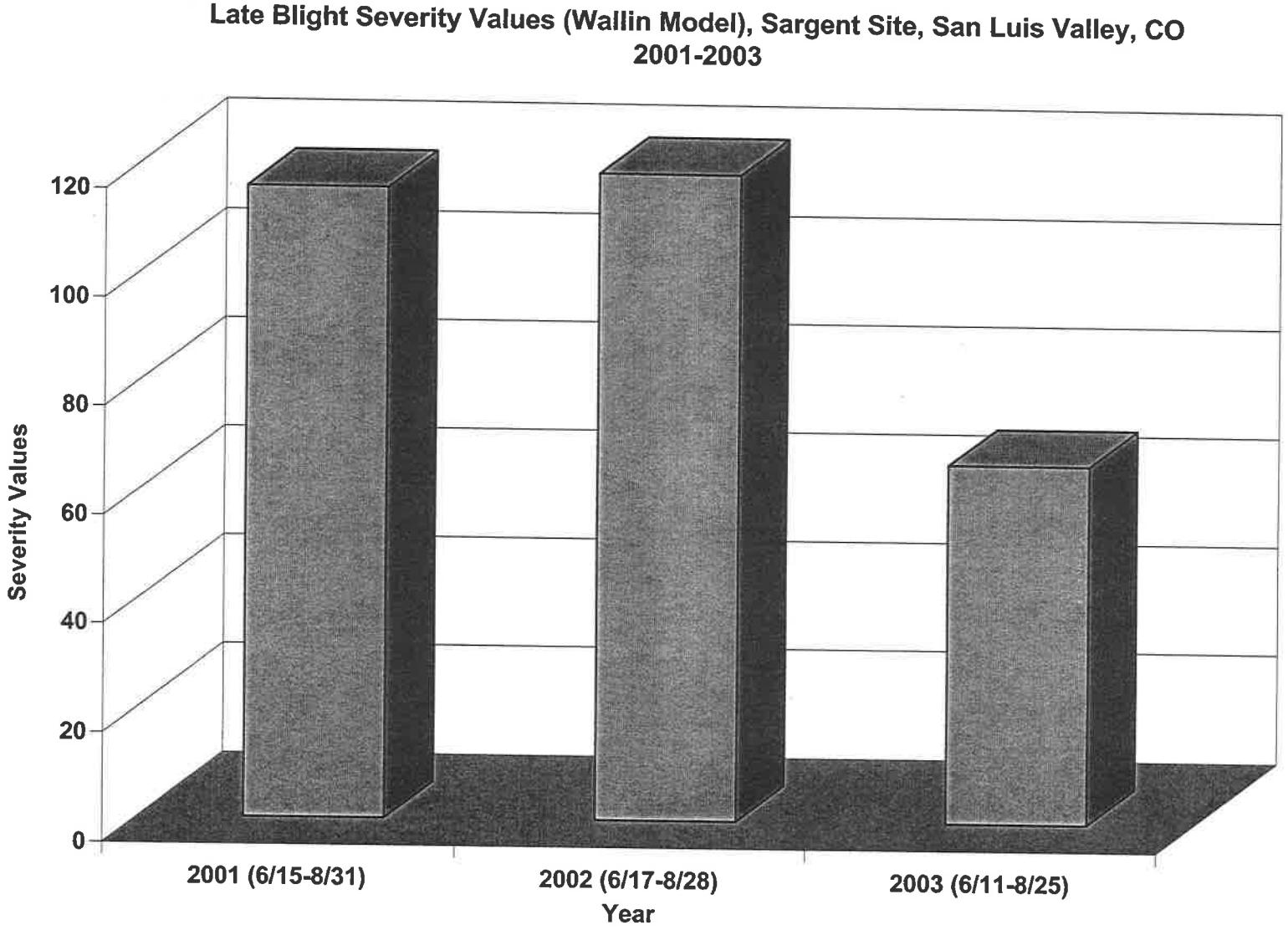
Late Blight Severity Values (Fry Model), Hooper & Blanca Sites, San Luis Valley, CO
2001-2003



Potato Late Blight Severity Values - Wallin Model,
San Luis Valley, Colorado, Sargent Site, 2003



Footnote:
-The Sargent weather station was set up on June 11, 2003.


Late Blight Severity Values (Wallin Model), Sargent Site, San Luis Valley, CO
2001-2003
Severity Values
120
100
80
60
40
20
0
2001 (6/15-8/31)
2002 (6/17-8/28)
2003 (6/11-8/25)
Year

Seed Piece Treatments for Control of Rhizoctonia Trials

EVALUATION OF FUNGICIDES APPLIED AT PLANTING FOR CONTROL OF RHIZOCTONIA ON POTATO, 2003

Researchers: Richard T. Zink and Andrew Houser, Colorado State University, SLVRC

Location: San Luis Valley Research Center, Center, CO

Cultivar: Russet Norkotah selection 8, cut seed, 2-4 oz.

Objective: To evaluate the efficacy of various In-furrow and seed treatments in preventing disease.

Treatments:

1. Control, no treatment
2. Mancozeb @ 0.5 lb./cwt (on seed)
3. Maxim 4 FS @ 0.04 fl.oz./cwt (on seed)
4. Maxim 4 FS @ 0.08 fl.oz./cwt (on seed)
5. Maxim 4 FS @ 0.04 fl.oz./cwt (on seed) + Quadris @ 0.4 fl.oz./1000 row ft. (In-furrow)
6. Maxim 4 FS @ 0.08 fl.oz./cwt (on seed) + Quadris @ 0.4 fl.oz./1000 row ft. (In-furrow)
7. A12534 @ 8 oz./cwt (on seed)
8. Moncoat @ 12 oz./cwt (on seed)
9. Tops MZ 8.5 DS @ 12 oz./cwt (on seed)
10. Quadris 2.08 SC @ 0.4 fl.oz./1000 row ft. (In-furrow)
11. A12534 @ 4 oz./cwt (on seed)
12. A12534 @ 8 oz./cwt (on seed) + Quadris 0.4 fl.oz./1000 row ft. (In-furrow)

Application: In-Furrow treatments were applied using an R & D CO_2 charged backpack sprayer at 35 PSI, with one XR 8002VS nozzle, at 10 gallons/acre as a directed in-furrow application. On seed treatments were applied directly to fresh cut seed and planted within twenty-four hours.

Planted: May 9, 2003
Plot Design: Randomized complete block
Plot Size: 2 - 30 foot rows per treatment per replication
Plant Spacing: 12 inches
Row Spacing: 34 inches
Replications: Four
Irrigation: Solid set sprinkler, rate based on ET
Fertilizer: 80N-60P-40K-25S-2.5Zn, preplant, 10N through sprinkler after tuber set
Herbicide: Matrix, 1.5 oz./A + Eptam, 4.5 pt./A
Insecticide: None
Fungicide: Bravo WS, 1.5 pt./A
Vine Killer: Rotobeat on September 1, 2003
Harvested: September 8, 2003

DATA

Rhizoctonia on seed: Percent tubers infested, 19.7; Mean severity, 24.8; Mean severity equals the mean percent of the affected tuber surface area multiplied by the severity of sclerotia, where 1=small and 3=large sclerotia.
Stand: 2-30 foot rows/treatment/replication, counts taken 42 days after planting.
Seed piece decay: Soft-rot and dry-rot combined rated 0-100, where 0 = no decay and 100 = complete decay; 10 seed pieces/treatment/replication/reading.
Rhizoctonia stem canker: Percent stems infected; 10 plants/treatment/replication/reading.
Blackleg: Percent stems infected; 10 plants/treatment/replication/reading.
Plant vigor: Rated 1-5, where 1 = poor and 5 = good; 10 plants/treatment/replication/reading.
Stems: Average number of stems per plant; 10 plants/treatment/replication/reading.
Tuber set: Average number of tubers per plant at full set; 10 plants/treatment/replication/reading.
Yield: 2-20 foot rows per treatment per replication, total yield expressed in cwt/A.
Grade: By hand, percent tubers by weight in pounds and tuber no. < 4 oz., 4-6 oz., 6-10 oz., > 10 oz., US #2's, and culls.
Black scurf severity index: Mean percent of the affected tuber surface area, 10 8-10 oz. tubers per treatment per replication multiplied by the severity of the sclerotia, where 1= small sclerotia and 3 = large sclerotia.

Table 1. Effects of seed treatments on plant development and incidence of disease in the cultivar Russet Norkotah Selection 8, San Luis Valley, Colorado, 2003

Treatment/Rate[a]	Stand[b]	Vigor[c]		Stems[d]		%Stems with Rhizoctonia[e]		Stolons[f]		%Stolons with Rhizoctonia[g]		Seed piece decay[h]		No. tubers per plant[i]	Black scurf severity index[j]
		6/25	7/23	6/25	7/23	6/25	7/23	6/25	7/23	6/25	7/23	6/25	7/23		
1. Control	91.7	3.9	4.7	4.4	4.3a-d	86.1a	73.1ab	19.9	25.0	8.3a	6.6	32.4a	97.6	33.4	10.4
2. Mancozeb @ 0.5 lb./cwt	95.9	3.8	4.7	3.9	3.7cde	76.5ab	73.7a	21.4	23.1	8.2a	6.1	14.1bcd	92.8	28.3	4.0
3. Maxim 4FS @ 0.04 fl.oz./cwt	96.3	4.0	4.7	4.1	4.5abc	61.4bcd	57.9bc	20.8	23.3	3.9b	4.8	7.5cd	94.6	33.1	2.5
4. Maxim 4 FS @ 0.08 fl.oz./cwt	91.7	4.0	4.8	4.3	4.6a	58.9bcd	49.1cd	21.3	23.6	2.0b	2.1	19.1bc	100.0	31.3	1.1
5. Maxim 4 FS @ 0.04 fl.oz./cwt + Quadris @ 0.4 fl.oz./1000 row ft. (IF)	95.8	4.0	4.7	4.2	4.6ab	53.5cd	49.5cd	22.6	26.9	0.8b	2.2	14.6bcd	92.8	34.4	4.8
6. Maxim 4 FS @ 0.08 fl.oz./cwt + Quadris @ 0.4 fl.oz./1000 row ft. (IF)	95.9	3.9	4.9	4.6	4.9a	56.5bcd	44.5cd	23.7	27.0	0.5b	2.0	24.9ab	98.0	33.5	0.0
7. A12534 @ 8 oz./cwt	93.7	3.6	4.8	3.7	3.7cde	66.8a-d	59.7abc	19.2	21.3	3.2b	5.6	4.9d	91.4	30.3	4.5
8. Moncoat @ 12 oz./cwt	95.4	3.7	4.8	3.6	3.5e	54.0cd	41.0d	20.3	21.5	1.8b	1.2	6.9cd	76.9	28.6	0.4
9. Tops MZ 8.5 DS @ 12 oz./cwt	93.3	3.8	4.8	3.9	3.7de	71.8abc	58.7abc	19.1	22.1	2.8b	7.2	2.0d	86.5	30.0	13.3
10. Quadris 2.08 SC @ 0.4 fl.oz./1000 row ft. (IF)	88.3	3.8	4.7	4.5	3.8b-e	54.9cd	47.6cd	22.3	22.4	1.4b	3.8	11.3cd	85.0	30.5	0.6
11. A12534 @ 4 oz./cwt	93.8	3.8	4.7	3.8	3.5e	70.3abc	70.6ab	20.4	21.7	2.3b	11.9	7.9cd	97.0	27.9	12.6
12. A12534 @ 8 oz./cwt + Quadris 0.4 fl.oz./1000 row ft. (IF)	90.0	3.6	4.4	4.0	3.8b-e	47.2d	48.4cd	19.2	23.3	0.6b	2.0	4.3d	86.9	34.1	2.3
LSD(P=0.05)	NS	NS	NS	NS	0.78	20.91	15.73	NS	NS	4.12	NS	13.02	NS	NS	NS

[a] All treatments were applied according to the manufacturer's recommendations.
[b] Percentage of plants emerged 42 days after planting; four replications.
[c] Mean percent vigor, where 1 = poor, 5 = good; 10 plants/treatment/replication/reading.
[d] Mean number of stems per seed piece 47 and 75 days after planting; 10 plants/treatment/replication/reading.
[e] Mean percent stems with Rhizoctonia canker 47 and 75 days after planting; 10 plants/treatment/replication/reading.
[f] Mean number of stolons per seed piece 47 and 75 days after planting; 10 plants/treatment/replication/reading.
[g] Mean percent stolons with Rhizoctonia canker 47 and 75 days after planting; 10 plants/treatment/replication/reading.
[h] Mean percent incidence of disease combined soft-rot and dry-rot 47 and 75 days after planting; rated 0-100, where 0 = no decay, 100 = complete decay; 10 seed pieces/treatment/replication/reading.
[i] Mean number of tubers per plant 75 days after planting; 10 plants/treatment/replication/reading.
[j] Mean percent of the affected tuber surface area, 10 8-10 oz. tubers per treatment per replication multiplied by the severity of the sclerotia, where 1 = small sclerotia and 3 = large sclerotia.
Means followed by the same letters are not significantly different at P=0.05.

Table 2. Effects of seed treatments on tuber yield and quality in the cultivar Russet Norkotah Selection 8, San Luis Valley, Colorado, 2003

Treatment/Rate	Percent[a]												
	< 4 oz.	No.	4-6 oz.	No.	6-10 oz.	No.	>10 oz.	No.	US #2s	No.	Culls	No.	Cwt/A[b]
1. Control	7.2	22.2	8.6	13.5	27.2d	28.7	52.9abc	31.1a-d	3.1	3.1	1.1	1.4	438.7
2. Mancozeb @ 0.5 lb./cwt	5.6	17.2	8.9	15.7	29.9bcd	32.2	53.0abc	32.4abc	1.8	1.8	0.8	0.7	438.7
3. Maxim 4FS @ 0.04 fl.oz./cwt	6.5	19.2	10.8	17.0	33.9ab	34.4	44.9de	26.1de	1.8	1.6	2.0	1.6	418.3
4. Maxim 4 FS @ 0.08 fl.oz./cwt	6.2	18.8	11.4	18.2	33.1abc	33.9	46.7cde	26.3de	1.9	1.9	0.8	0.9	425.9
5. Maxim 4 FS @ 0.04 fl.oz./cwt + Quadris @ 0.4 fl.oz./1000 row ft. (IF)	6.3	18.0	10.9	17.6	35.5a	35.6	43.3e	25.3e	2.0	2.1	1.9	1.4	455.3
6. Maxim 4 FS @ 0.08 fl.oz./cwt + Quadris @ 0.4 fl.oz./1000 row ft. (IF)	5.7	18.0	9.2	15.5	34.5ab	36.1	46.9cde	27.8cde	1.7	1.4	2.0	1.3	454.5
7. A12534 @ 8 oz./cwt	5.7	17.0	8.6	15.4	29.8bcd	32.6	51.7a-d	30.9a-d	2.4	2.6	1.7	1.5	448.2
8. Moncoat @ 12 oz./cwt	4.4	14.0	7.6	13.2	33.0abc	35.8	51.6a-d	33.7ab	2.1	2.2	1.2	1.0	440.7
9. Tops MZ 8.5 DS @ 12 oz./cwt	4.9	16.1	8.6	15.9	28.4cd	31.6	54.2ab	33.1ab	1.8	1.8	2.0	1.6	463.4
10. Quadris 2.08 SC @ 0.4 fl.oz./1000 row ft. (IF)	6.3	19.6	8.4	16.1	29.6bcd	31.1	50.9a-d	28.9b-e	3.0	3.1	1.8	1.3	407.5
11. A12534 @ 4 oz./cwt	6.2	18.9	9.1	15.6	32.2a-d	34.1	48.3b-e	27.6cde	3.3	3.2	0.9	0.7	435.8
12. A12534 @ 8 oz./cwt + Quadris 0.4 fl.oz./1000 row ft. (IF)	4.6	15.3	8.1	15.1	26.9d	30.7	56.2a	35.2a	2.6	2.7	1.6	1.1	407.1
LSD(P=0.05)	NS	NS	NS	NS	5.32	NS	7.06	5.09	NS	NS	NS	NS	NS

[a] Based on tuber weight in pounds and tuber number, mean of four replications.
[b] Total yield expressed as hundred weight per acre, 2-20 foot rows per treatment per replication, mean of four replications.
Means followed by the same letters are not significantly different at P=0.05.

EVALUATION OF FUNGICIDES APPLIED AT PLANTING FOR CONTROL OF RHIZOCTONIA ON POTATO, 2003

Researchers: Richard T. Zink and Andrew Houser, Colorado State University, SLVRC

Location: San Luis Valley Research Center, Center, CO

Cultivar: Russet Norkotah selection 8, cut seed, 2-4 oz.

Objective: To evaluate the efficacy of various In-furrow seed treatments in preventing disease.

Treatments:
1. Control, no treatment
2. Quadris 2.08 SC @ 6.3 fl.oz./A (In-furrow)
3. Amistar 80WP @ 1.92 oz./A (In-furrow)
4. Moncut 50 WP @ 16.9 oz./A (In-furrow)

Application: In-Furrow treatments were applied using an R & D CO_2 charged backpack sprayer at 35 PSI, with one XR 8002VS nozzle, at 10 gallons/acre as a directed in-furrow application.

Planted: May 13, 2003
Plot Design: Randomized complete block
Plot Size: 2 - 30 foot rows per treatment per replication
Plant Spacing: 12 inches
Row Spacing: 34 inches
Replications: Four
Irrigation: Solid set sprinkler, rate based on ET
Fertilizer: 80N-60P-40K-25S-2.5Zn, preplant, 10N through sprinkler after tuber set
Herbicide: Matrix, 1.5 oz./A + Eptam, 4.5 pt./A
Insecticide: None
Fungicide: Bravo WS, 1.5 pt./A
Vine Killer: Rotobeat on September 1, 2003
Harvested: September 8, 2003

DATA

Rhizoctonia on seed: Percent tubers infested, 19.7; Mean severity, 24.8; Mean severity equals the mean percent of the affected tuber surface area multiplied by the severity of sclerotia, where 1=small and 3=large sclerotia.
Stand: 2-30 foot rows/treatment/replication, counts taken 38 days after planting.
Seed piece decay: Soft-rot and dry-rot combined rated 0-100, where 0 = no decay and 100 = complete decay; 10 seed pieces/treatment/replication/reading.
Rhizoctonia stem canker: Percent stems infected; 10 plants/treatment/replication/reading.
Blackleg: Percent stems infected; 10 plants/treatment/replication/reading.
Plant vigor: Rated 1-5, where 1 = poor and 5 = good; 10 plants/treatment/replication/reading.
Stems: Average number of stems per plant; 10 plants/treatment/replication/reading.
Tuber set: Average number of tubers per plant at full set; 10 plants/treatment/replication/reading.
Yield: 2-20 foot rows per treatment per replication, total yield expressed in cwt/A.
Grade: By hand, percent tubers by weight in pounds and tuber no. < 4 oz., 4-6 oz., 6-10 oz., > 10 oz., US #2's, and culls.
Black scurf severity index: Mean percent of the affected tuber surface area, 10 8-10 oz. tubers per treatment per replication multiplied by the severity of the sclerotia, where 1= small sclerotia and 3 = large sclerotia.

Table 1. Effects of seed treatments on plant development and incidence of disease in the cultivar Russet Norkotah Selection 8, San Luis Valley, Colorado, 2003

Treatment/Rate[a]	Stand[b]	Vigor[c]		Stems[d]		%Stems with Rhizoctonia[e]		Stolons[f]		%Stolons with Rhizoctonia[g]		Seed piece decay[h]		No. tubers per plant[i]	Black scurf severity index[j]
		7/3	7/22	7/3	7/22	7/3	7/22	7/3	7/22	7/3	7/22	7/3	7/22		
1. Control, no treatment	95.4	4.0	4.3	4.4	3.8	94.4	75.3	22.2	18.1	8.6	14.5	55.6	98.8	31.0	6.8
2. Quadris 2.08SC @ 6.3 fl.oz./A (IF)	98.8	4.1	4.5	4.2	4.3	88.1	68.4	24.0	22.5	4.0	4.6	44.3	98.4	32.4	3.3
3. Amistar 80WP @ 1.92 oz./A (IF)	92.9	4.1	4.6	4.1	4.4	92.4	72.0	22.8	22.3	4.7	4.7	43.9	97.5	33.4	3.0
4. Moncut 50 WP @ 16.9 oz./A (IF)	95.4	4.0	4.6	3.9	4.3	94.9	78.3	23.3	22.7	10.3	8.3	39.1	100.0	29.6	2.5
LSD(P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

[a] All treatments were applied according to the manufacturer's recommendations.
[b] Percentage of plants emerged 38 days after planting; four replications.
[c] Mean percent vigor, where 1 = poor, 5 = good; 10 plants/treatment/replication/reading.
[d] Mean number of stems per seed piece 51 and 70 days after planting; 10 plants/treatment/replication/reading.
[e] Mean percent stems with Rhizoctonia canker 51 and 70 days after planting; 10 plants/treatment/replication/reading.
[f] Mean number of stolons per seed piece 51 and 70 days after planting; 10 plants/treatment/replication/reading.
[g] Mean percent stolons with Rhizoctonia canker 51 and 70 days after planting; 10 plants/treatment/replication/reading.
[h] Mean percent incidence of disease combined soft-rot and dry-rot 51 and 70 days after planting; rated 0-100, where 0 = no decay, 100 = complete decay; 10 seed pieces/treatment/replication/reading.
[i] Mean number of tubers per plant 70 days after planting; 10 plants/treatment/replication/reading.
[j] Mean percent of the affected tuber surface area, 10 8-10 oz. tubers per treatment per replication multiplied by the severity of the sclerotia, where 1 = small sclerotia and 3 = large sclerotia.

Table 2. Effects of seed treatments on tuber yield and quality in the cultivar Russet Norkotah Selection 8, San Luis Valley, Colorado, 2003

Treatment/Rate	Percent[a]												
	< 4 oz.	No.	4-6 oz.	No.	6-10 oz.	No.	>10 oz.	No.	US #2s	No.	Culls	No.	Cwt/A[b]
1. Control, no treatment	7.7	23.3	11.9	18.1	31.9	30.7b	45.6	25.4	1.1	1.0	1.9	1.5	389.5
2. Quadris 2.08SC @ 6.3 fl.oz./A (IF)	8.0	23.5	12.5	17.8	41.0	37.3a	35.7	18.7	1.2	1.2	1.6	1.6	380.0
3. Amistar 80WP @ 1.92 oz./A (IF)	9.2	25.2	13.0	17.9	35.8	32.4ab	38.1	21.1	1.9	1.4	2.0	2.0	373.1
4. Moncut 50 WP @ 16.9 oz./A (IF)	7.3	21.4	9.3	14.2	38.7	37.4a	41.4	23.9	2.1	1.9	1.2	1.2	385.3
LSD(P=0.05)	NS	NS	NS	NS	NS	5.46	NS	NS	NS	NS	NS	NS	NS

[a] Based on tuber weight in pounds and tuber number, mean of four replications.
[b] Total yield expressed as hundred weight per acre, 2-20 foot rows per treatment per replication, mean of four replications.
Means followed by the same letters are not significantly different at P=0.05.

EVALUATION OF FUNGICIDES APPLIED AT PLANTING FOR CONTROL OF RHIZOCTONIA ON POTATO, 2003

Researchers: Richard T. Zink and Andrew Houser, Colorado State University, SLVRC

Location: San Luis Valley Research Center, Center, CO

Cultivar: Russet Norkotah selection 8, cut seed, 2-4 oz.

Objective: To evaluate the efficacy of various In-furrow and seed treatments in preventing disease and seed piece decay.

Treatments:
1. Control, no treatment
2. Moncut SC @ 16.0 fl.oz./A (In-furrow)
3. Moncut 70 DF @ 0.9 lb./A (In-furrow)
4. PCC-3 @ 0.5 lb./cwt (on seed)
5. PCC-4A @ 0.022 lb./cwt (In-furrow) + PCC-4B @ 0.75 lb./cwt (on seed)

Application: In-Furrow treatments were applied using an R & D CO_2 charged backpack sprayer at 35 PSI, with one XR 8002VS nozzle, at 10 gallons/acre as a directed in-furrow application. On seed treatments were applied directly to fresh cut seed and planted within twenty-four hours.

Planted: May 15, 2003
Plot Design: Randomized complete block
Plot Size: 1 - 30 foot rows per treatment per replication
Plant Spacing: 12 inches
Row Spacing: 34 inches
Replications: Four
Irrigation: Solid set sprinkler, rate based on ET
Fertilizer: 80N-60P-40K-25S-2.5Zn, preplant, 10N through sprinkler after tuber set
Herbicide: Matrix, 1.5 oz./A + Eptam, 4.5 pt./A
Insecticide: None
Fungicide: Bravo WS, 1.5 pt./A
Vine Killer: Rotobeat on September 1, 2003
Harvested: September 18, 2003

DATA

Rhizoctonia on seed: Percent tubers infested, 19.7; Mean severity, 24.8; Mean severity equals the mean percent of the affected tuber surface area multiplied by the severity of sclerotia, where 1=small and 3=large sclerotia.
Stand: 1-30 foot rows/treatment/replication, counts taken 36 days after planting.
Seed piece decay: Soft-rot and dry-rot combined rated 0-100, where 0 = no decay and 100 = complete decay; 5 seed pieces/treatment/replication/reading.
Rhizoctonia stem canker: Percent stems infected; 5 plants/treatment/replication/reading.
Blackleg: Percent stems infected; 5 plants/treatment/replication/reading.
Plant vigor: Rated 1-5, where 1 = poor and 5 = good; 5 plants/treatment/replication/reading.
Stems: Average number of stems per plant; 5 plants/treatment/replication/reading.
Tuber set: Average number of tubers per plant at full set; 5 plants/treatment/replication/reading.
Yield: 1-20 foot rows per treatment per replication, total yield expressed in cwt/A.
Grade: By hand, percent tubers by weight in pounds and tuber no. < 4 oz., 4-6 oz., 6-10 oz., > 10 oz., US #2's, and culls.
Black scurf severity index: Mean percent of the affected tuber surface area, 10 8-10 oz. tubers per treatment per replication multiplied by the severity of the sclerotia, where 1= small sclerotia and 3 = large sclerotia.

Table 1. Effects of seed treatments on plant development and incidence of disease in the cultivar Russet Norkotah Selection 8, San Luis Valley, Colorado, 2003

Treatment/Rate[a]	Stand[b]	Vigor[c]		Stems[d]		%Stems with Rhizoctonia[e]		Stolons[f]		%Stolons with Rhizoctonia[g]		Seed piece decay[h]		No. tubers per plant[i]	Black scurf severity index[j]
		6/24	7/16	6/24	7/16	6/24	7/16	6/24	7/16	6/24	7/16	6/24	7/16		
1. Control, no treatment	98.4	3.5	4.2b	4.0	3.8	83.5	99.0	20.1ab	19.1	6.0	7.9	8.5	93.0a	24.3	13.1
2. Moncut SC @ 16.0 fl.oz./A (IF)	99.2	3.9	4.8a	4.2	4.1	84.1	95.5	22.7a	23.0	4.4	4.1	3.0	89.8a	26.0	7.6
3. Moncut 70 DF @ 0.9 lb./A (IF)	100.0	3.5	4.5ab	4.0	3.5	79.6	99.2	17.3b	19.6	4.9	10.1	0.5	84.0a	31.3	8.5
4. PCC-3 @ 0.5 lb./cwt (on seed)	98.4	3.6	4.7a	3.4	3.8	90.1	90.9	20.3ab	22.0	7.6	2.3	4.3	61.0b	27.8	3.0
5. PCC-4A @ 0.022 lb./cwt (IF) + PCC-4B @ 0.75 lb./cwt (on seed)	98.3	3.8	4.8a	3.9	3.6	85.2	95.4	24.4a	21.3	3.2	4.0	11.3	86.0a	30.8	4.8
LSD(P=0.05)	NS	NS	0.39	NS	NS	NS	NS	4.36	NS	NS	NS	NS	20.50	NS	NS

[a] All treatments were applied according to the manufacturer's recommendations.
[b] Percentage of plants emerged 36 days after planting; four replications.
[c] Mean percent vigor, where 1 = poor, 5 = good; 5 plants/treatment/replication/reading.
[d] Mean number of stems per seed piece 40 and 62 days after planting; 5 plants/treatment/replication/reading.
[e] Mean percent stems with Rhizoctonia canker 40 and 62 days after planting; 5 plants/treatment/replication/reading.
[f] Mean number of stolons per seed piece 40 and 62 days after planting; 5 plants/treatment/replication/reading.
[g] Mean percent stolons with Rhizoctonia canker 40 and 62 days after planting; 5 plants/treatment/replication/reading.
[h] Mean percent incidence of disease combined soft-rot and dry-rot 40 and 62 days after planting; rated 0-100, where 0 = no decay, 100 = complete decay; 5 seed pieces/treatment/replication/reading.
[i] Mean number of tubers per plant 62 days after planting; 5 plants/treatment/replication/reading.
[j] Mean percent of the affected tuber surface area, 10 8-10 oz. tubers per treatment per replication multiplied by the severity of the sclerotia, where 1 = small sclerotia and 3 = large sclerotia.
Means followed by the same letters are not significantly different at P=0.05.

Table 2. Effects of seed treatments on tuber yield and quality in the cultivar Russet Norkotah Selection 8, San Luis Valley, Colorado, 2003

Treatment/Rate	Percent[a]												
	< 4 oz.	No.	4-6 oz.	No.	6-10 oz.	No.	>10 oz.	No.	US #2s	No.	Culls	No.	Cwt/A[b]
1. Control, no treatment	6.6	21.4	10.8	17.7	28.1	29.4	50.1	28.4	1.8	1.4	2.6	1.8	432.3
2. Moncut SC @ 16.0 fl.oz./A (IF)	6.8	20.6	7.1	12.1	29.2	31.7	51.3	30.5	1.8	1.6	3.9	3.6	430.4
3. Moncut 70 DF @ 0.9 lb./A (IF)	8.4	25.7	7.9	12.5	34.0	32.4	44.5	25.4	1.1	1.1	4.2	2.9	444.6
4. PCC-3 @ 0.5 lb./cwt (on seed)	6.0	18.0	8.2	13.8	30.2	32.9	48.8	29.9	0.9	1.0	6.0	4.3	437.5
5. PCC-4A @ 0.022 lb./cwt (IF) + PCC-4B @ 0.75 lb./cwt (on seed)	7.3	19.3	9.9	14.9	36.8	36.7	43.5	27.4	1.1	0.9	1.5	0.8	451.4
LSD(P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

[a] Based on tuber weight in pounds and tuber number, mean of four replications.
[b] Total yield expressed as hundred weight per acre, 1-20 foot row per treatment per replication, mean of four replications.

Powdery Scab Trials

EVALUATION OF FUNGICIDES APPLIED AT PLANTING FOR CONTROL OF POWDERY SCAB ON POTATO, 2003

Researchers: Richard Zink, Robert Davidson, and Andrew Houser, Colorado State University, SLVRC

Location: Lynn McCullough's Farm, Center, CO

Cultivar: Cherry Red, whole seed

Objective: To evaluate the efficacy of various fungicide treatments in preventing powdery scab on potato.

Treatments:

1. Omega @ 1.5 pt./A (IF)
2. Omega @ 3.0 pt./A (IF)
3. Quadris @ 2.5 pt./A (IF)
4. Quadris @ 5.0 pt./A (IF)
5. Manex @ 5.0 qt./A (IF)
6. Manex @ 10.0 qt./A (IF)
7. ZnSu @ 5.0 lb. Zn/A (IF)
8. Evolve @ 1.0 lb./cwt (On seed)
9. Omega @ 1.5 pt./A (IF) + Manex @ 5.0 qt./A (IF)
10. Omega @ 1.5 pt./A (IF) + Manex @ 10.0 qt./A (IF)
11. Omega @ 3.0 pt./A (IF) + Manex @ 5.0 qt./A (IF)
12. Omega @ 3.0 pt./A (IF) + Manex @ 10.0 qt./A (IF)
13. Quadris @ 2.5 pt./A (IF) + Manex @ 5.0 qt./A (IF)
14. Quadris @ 2.5 pt./A (IF) + Manex @ 10.0 qt./A (IF)
15. Omega @ 1.5 pt./A (IF) + Quadris @ 2.5 pt./A (IF) + Manex @ 5.0 qt./A (IF)
16. Omega @ 3.0 pt./A (IF) + Quadris @ 5.0 pt./A (IF) + Manex @ 10.0 qt./A (IF)
17. Evolve @ 1.0 lb./cwt (On seed) + Omega @ 3.0 pt./A (IF) + Quadris @ 5.0 pt./A (IF) + Manex @ 10.0 qt./A (IF)
18. Control, no treatment

Application: In-furrow (IF) treatments were applied using an R & D CO_2 charged backpack sprayer at 35 PSI, with one XR 8002VS nozzle, at 10 gallons/acre. On seed treatments were applied directly to whole seed and planted within twenty-four hours.

Planted: May 16, 2003
Plot Design: Randomized
Plot Size: 1 - 15 foot row per treatment per replication
Plant Spacing: 12 inches
Row Spacing: 34 inches
Replications: Four
Irrigation: Center pivot sprinkler, rate based on ET
Fertilizer: 40N-125P-120K-19S-3Zn preplant, 110N topdress
Herbicide: Dual II Magnum, 1.3 pt./A + Sencor DF, 4.0 oz./A
Insecticide: Provado, 3.75 oz./A + Perm Up, 6.4 oz./A
Fungicide: Kocide 4.5LF, 2.0 pt./A + Ridomil Gold EC, 4.3 oz./A + Quadris, 6.4 oz./A + Bravo WS, 14.9 oz./A
Vine Killer: Beat Vines on September 4, 2003
Harvested: September 16, 2003

DATA

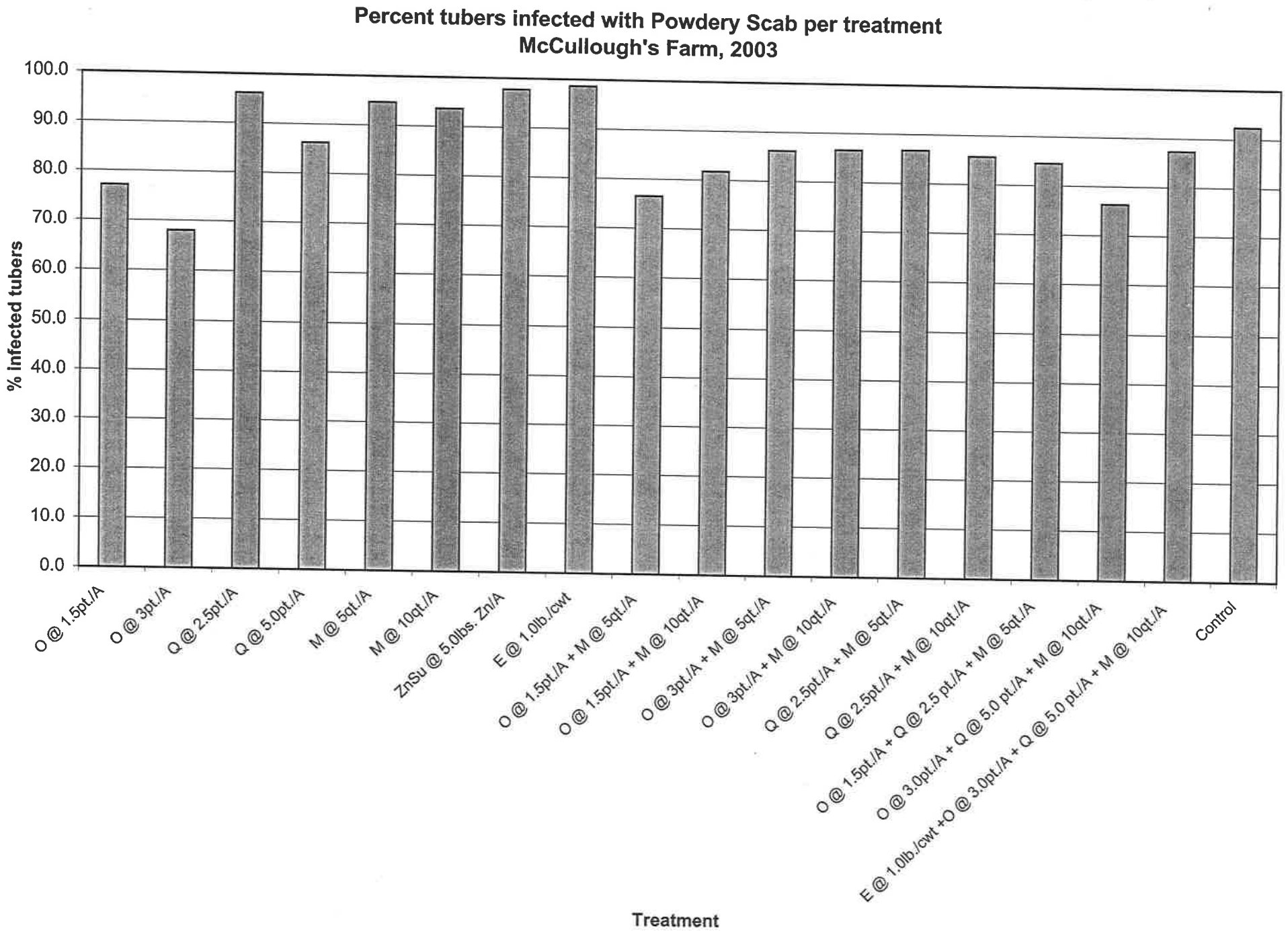
Disease: Mean percent of the number of tubers showing one or more powdery scab lesions at harvest multiplied by the severity of the lesions, where 1 = not severe and 5 = very severe.

Table 1. Effect of fungicides applied at planting on the incidence of powdery scab on tubers in the cultivar Cherry Red, San Luis Valley, Colorado, 2003

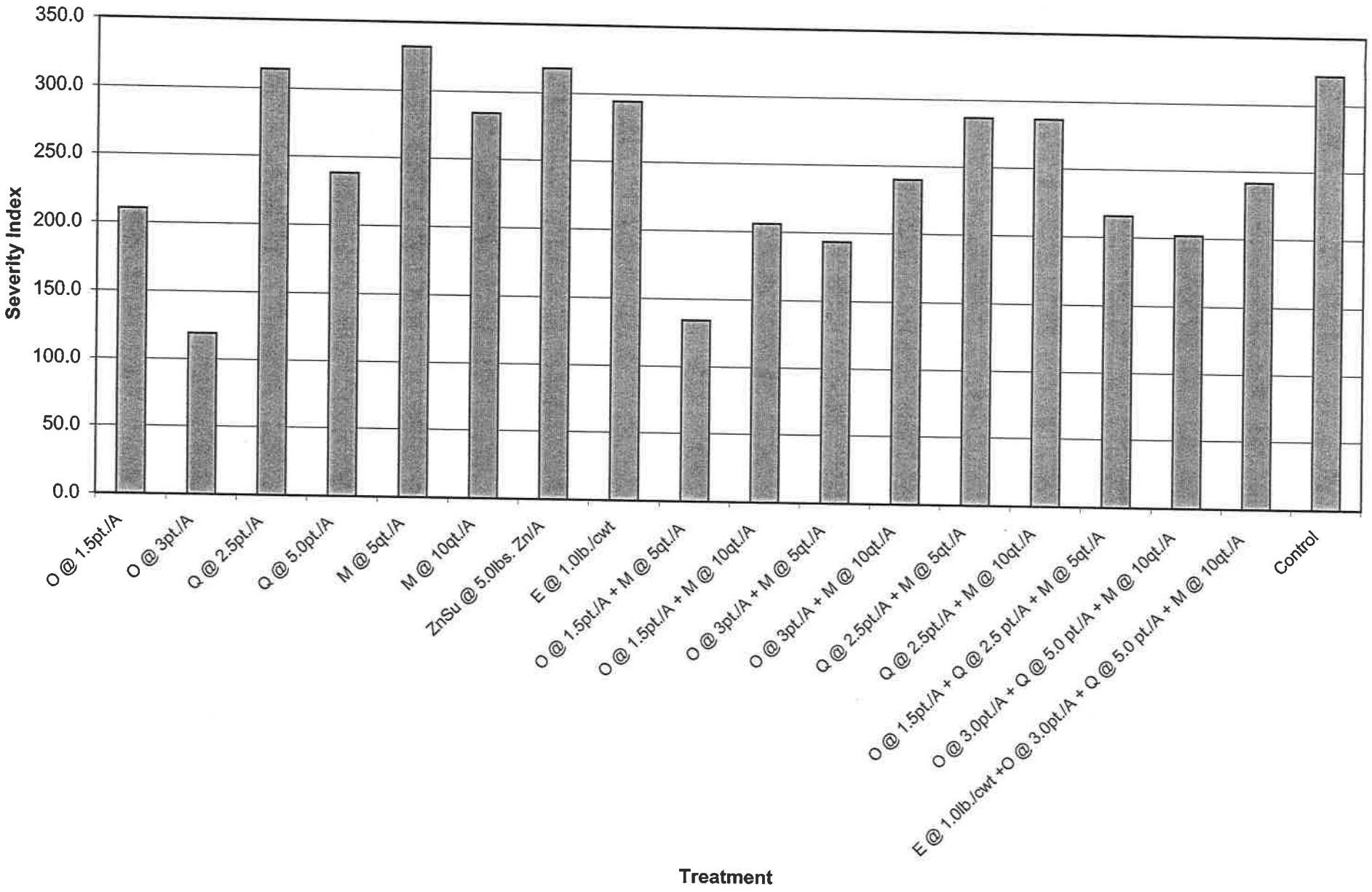
Cultivar	Percent Incidence	Percent Healthy	% Culls	Severity Index[a]
1. Omega @ 1.5 pt./A (IF)	77.1 ef	22.9	14.2 de	210.4
2. Omega @ 3.0 pt./A (IF)	68.0 f	32.0	13.0 de	119.2
3. Quadris @ 2.5 pt./A (IF)	96.1 abc	3.9	29.4 abc	314.1
4. Quadris @ 5.0 pt./A (IF)	86.3 b-e	13.7	24.1 a-d	238.2
5. Manex @ 5.0 qt./A (IF)	94.7 abc	5.3	30.1 ab	332.1
6. Manex @ 10.0 qt./A (IF)	93.6 a-d	6.4	21.6 a-d	284.0
7. ZnSu @ 5.0 lb. Zn/A (IF)	97.7 ab	2.3	28.6 abc	318.1
8. Evolve @ 1.0 lb./cwt (On seed)	98.6 a	1.4	17.8 b-e	294.5
9. Omega @ 1.5 pt./A (IF) + Manex @ 5.0 qt./A (IF)	76.5 ef	23.5	7.2 e	134.3
10. Omega @ 1.5 pt./A (IF) + Manex @ 10.0 qt./A (IF)	81.8 de	18.2	13.9 de	206.0
11. Omega @ 3.0 pt./A (IF) + Manex @ 5.0 qt./A (IF)	86.2 b-e	13.8	15.4 cde	193.4
12. Omega @ 3.0 pt./A (IF) + Manex @ 10.0 qt./A (IF)	86.6 a-e	13.4	19.4 a-e	240.0
13. Quadris @ 2.5 pt./A (IF) + Manex @ 5.0 qt./A (IF)	86.7 a-e	13.3	25.0 a-d	286.8
14. Quadris @ 2.5 pt./A (IF) + Manex @ 10.0 qt./A (IF)	85.6 b-e	14.4	16.9 b-e	286.5
15. Omega @ 1.5 pt./A (IF) + Quadris @ 2.5 pt./A (IF) + Manex @ 5.0 qt./A (IF)	84.5 cde	15.5	13.3 de	215.8
16. Omega @ 3.0 pt./A (IF) + Quadris @ 5.0 pt./A (IF) + Manex @ 10.0 qt./A (IF)	76.4 ef	23.6	16.1 b-e	201.9
17. Evolve @ 1.0 lb./cwt (On seed) + Omega @ 3.0 pt./A (IF) + Quadris @ 5.0 pt./A (IF) + Manex @ 10.0 qt./A (IF)	87.4 a-e	12.6	17.6 b-e	241.5
18. Control, no treatment	92.4 a-d	7.6	32.5 a	322.0
LSD(P=0.05)	12.13	NS	14.28	NS

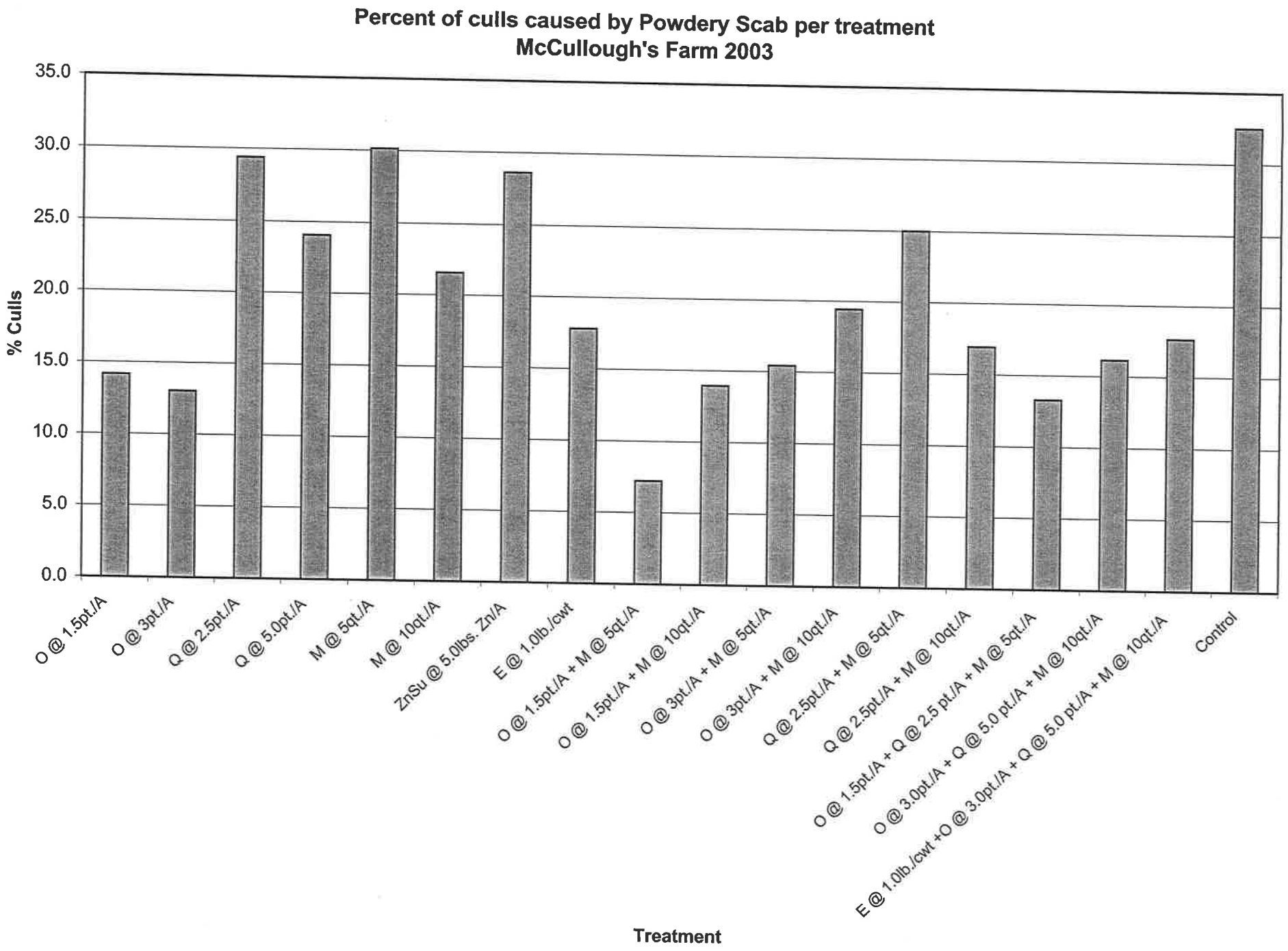
[a] Severity Index = mean percent of the number of affected tubers, Tubers from five plants/treatment/replication multiplied by the severity of the lesions, where 1 = not severe and 5 = very severe.

Richard T. Zink, Associate Professor, Colorado State University


Percent tubers infected with Powdery Scab per treatment
McCullough's Farm, 2003
% infected tubers
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
O @ 1.5pt./A
O @ 3pt./A
Q @ 2.5pt./A
Q @ 5.0pt./A
M @ 5qt./A
M @ 10qt./A
ZnSu @ 5.0lbs. Zn/A
E @ 1.0lb./cwt
O @ 1.5pt./A + M @ 5qt./A
O @ 1.5pt./A + M @ 10qt./A
O @ 3pt./A + M @ 5qt./A
O @ 3pt./A + M @ 10qt./A
Q @ 2.5pt./A + M @ 5qt./A
Q @ 2.5pt./A + M @ 10qt./A
O @ 1.5pt./A + Q @ 2.5 pt./A + M @ 5qt./A
O @ 3.0pt./A + Q @ 5.0 pt./A + M @ 10qt./A
E @ 1.0lb./cwt +O @ 3.0pt./A + Q @ 5.0 pt./A + M @ 10qt./A
Control
Treatment

Effect of fungicides applied at planting on the incidence of powdery scab on tubers of the cultivar Cherry Red, McCullough's Farm, 2003




Percent of culls caused by Powdery Scab per treatment
McCullough's Farm 2003
% Culls
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
O @ 1.5pt./A
O @ 3pt./A
Q @ 2.5pt./A
Q @ 5.0pt./A
M @ 5qt./A
M @ 10qt./A
ZnSu @ 5.0lbs. Zn/A
E @ 1.0lb./cwt
O @ 1.5pt./A + M @ 5qt./A
O @ 1.5pt./A + M @ 10qt./A
O @ 3pt./A + M @ 5qt./A
O @ 3pt./A + M @ 10qt./A
Q @ 2.5pt./A + M @ 5qt./A
Q @ 2.5pt./A + M @ 10qt./A
O @ 1.5pt./A + Q @ 2.5 pt./A + M @ 5qt./A
O @ 3.0pt./A + Q @ 5.0 pt./A + M @ 10qt./A
E @ 1.0lb./cwt +O @ 3.0pt./A + Q @ 5.0 pt./A + M @ 10qt./A
Control
Treatment

EVALUATION OF ADVANCED CLONES FOR SUSCEPTIBILITY TO POWDERY SCAB, 2003

Researchers: Richard Zink, Robert Davidson, and Andrew Houser, Colorado State University, SLVRC

Location: Lynn McCullough's Farm, Center, CO

Objective: To evaluate the susceptibility of advanced potato clones to powdery scab.

Clones:

1. Atlantic
2. Superioir
3. B0564-8 (Harley Blackwell)
4. B0766-3
5. Liberator
6. MSG227-2
7. NDTX4271-1R
8. NDTX4304-6R
9. AF1758-7
10. AF1921-4
11. W1201
12. W1836-1rus
13. ND2470-27
14. ND3196-1R
15. Russet Burbank
16. Ranger Russet
17. A93157-6LS
18. Bannock Russet
19. Alturas
20. Gem Russet
21. AC89536-5RU
22. AC92009-4RU
23. AC93026-9RU
24. CO93001-11RU
25. CO93016-3RU
26. CO93037-6R
27. NDC5281-2R
28. TC1675-1RU
29. Dakotah Rose
30. Calred
31. Keulca Gold
32. Baltica

Planted: May 16, 2003
Plot Design: Randomized
Plot Size: 1 - 10 foot row per treatment per replication
Plant Spacing: 12 inches
Row Spacing: 34 inches
Replications: Four
Irrigation: Center pivot sprinkler, rate based on ET
Fertilizer: 40N-125P-120K-19S-3Zn preplant, 110N topdress
Herbicide: Dual II Magnum, 1.3 pt./A + Sencor DF, 4.0 oz./A
Insecticide: Provado, 3.75 oz./A + Perm Up, 6.4 oz./A
Fungicide: Kocide 4.5LF, 2.0 pt./A + Ridomil Gold EC, 4.3 oz./A + Quadris, 6.4 oz./A + Bravo WS, 14.9 oz./A
Vine Killer: Beat Vines on September 4, 2003
Harvested: September 16, 2002

DATA

Disease: Galls on roots rated 0 to 4, 0 = none, 4 = heavily infected, readings taken August 7.
Mean percent of the number of tubers showing one or more powdery scab lesions at harvest multiplied by the severity of the lesions, where 1 = very little or no disease and 5 = heavily infested.

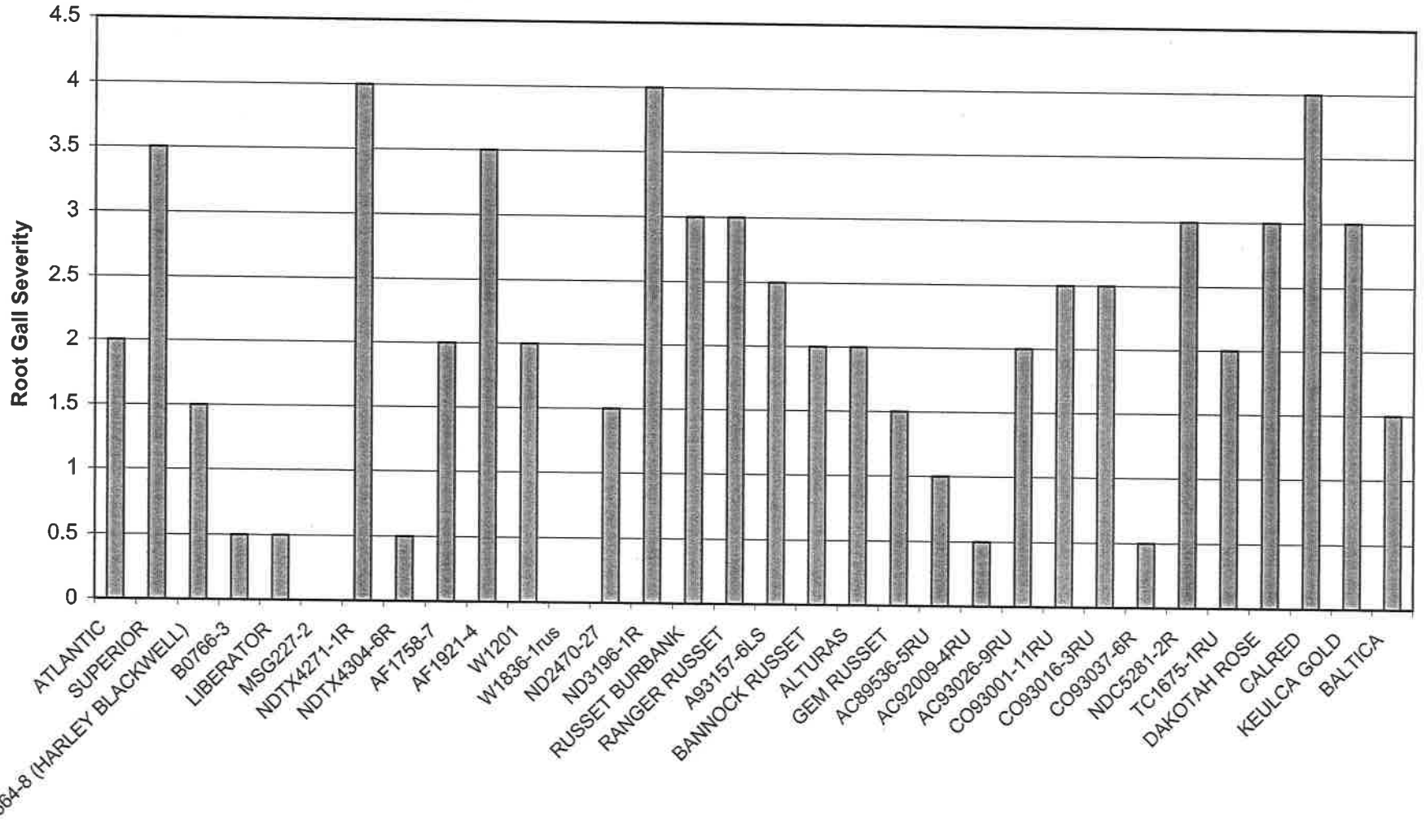
Table 1. Evaluation of advanced clones for tuber susceptibility to powdery scab, San Luis Valley, Colorado, 2003

Cultivar	Tuber symptoms			
	Percent Incidence	Percent Healthy	Severity Index[a]	Root Gall Rating[b]
1. ATLANTIC	22.5 efg	77.5	30.0 ij	2.0
2. SUPERIOR	75.6 abc	24.4	151.3 efg	3.5
3. B0564-8 (HARLEY BLACKWELL)	16.9 fg	83.1	16.9 ij	1.5
4. B0766-3	76.9 abc	23.1	217.5 cde	0.5
5. LIBERATOR	60.6 cd	39.4	160.6 d-g	0.5
6. MSG227-2	1.9 g	98.1	1.9 j	0.0
7. NDTX4271-1R	58.1 cd	41.9	161.3 d-g	4.0
8. NDTX4304-6R	64.4 bcd	35.6	151.3 efg	0.5
9. AF1758-7	11.3 fg	88.7	18.8 ij	2.0
10. AF1921-4	95.0 a	5.0	383.1 a	3.5
11. W1201	78.8 abc	21.2	240.0 cd	2.0
12. W1836-1rus	0.0 g	100.0	0.0 j	0.0
13. ND2470-27	78.1 abc	21.9	178.1 def	1.5
14. ND3196-1R	89.4 ab	10.6	287.5 bc	4.0
15. RUSSET BURBANK	0.0 g	100.0	0.0 j	3.0
16. RANGER RUSSET	0.0 g	100.0	0.0 j	3.0
17. A93157-6LS	0.0 g	100.0	0.0 j	2.5
18. BANNOCK RUSSET	0.0 g	100.0	0.0 j	2.0
19. ALTURAS	0.0 g	100.0	0.0 j	2.0
20. GEM RUSSET	0.0 g	100.0	0.0 j	1.5
21. AC89536-5RU	0.0 g	100.0	0.0 j	1.0
22. AC92009-4RU	0.0 g	100.0	0.0 j	0.5
23. AC93026-9RU	0.0 g	100.0	0.0 j	2.0
24. CO93001-11RU	0.0 g	100.0	0.0 j	2.5
25. CO93016-3RU	0.0 g	100.0	0.0 j	2.5
26. CO93037-6R	91.3 a	8.7	365.0 ab	0.5
27. NDC5281-2R	76.9 abc	23.1	262.5 c	3.0
28. TC1675-1RU	16.9 fg	83.1	33.8 ij	2.0
29. DAKOTAH ROSE	44.4 de	55.6	88.8 ghi	3.0
30. CALRED	65.0 bcd	35.0	116.9 fgh	4.0
31. KEULCA GOLD	28.8 ef	71.2	39.4 hij	3.0
32. BALTICA	64.4 bcd	35.6	116.9 fgh	1.5
LSD(P=0.05)	25.67		81.89	NS

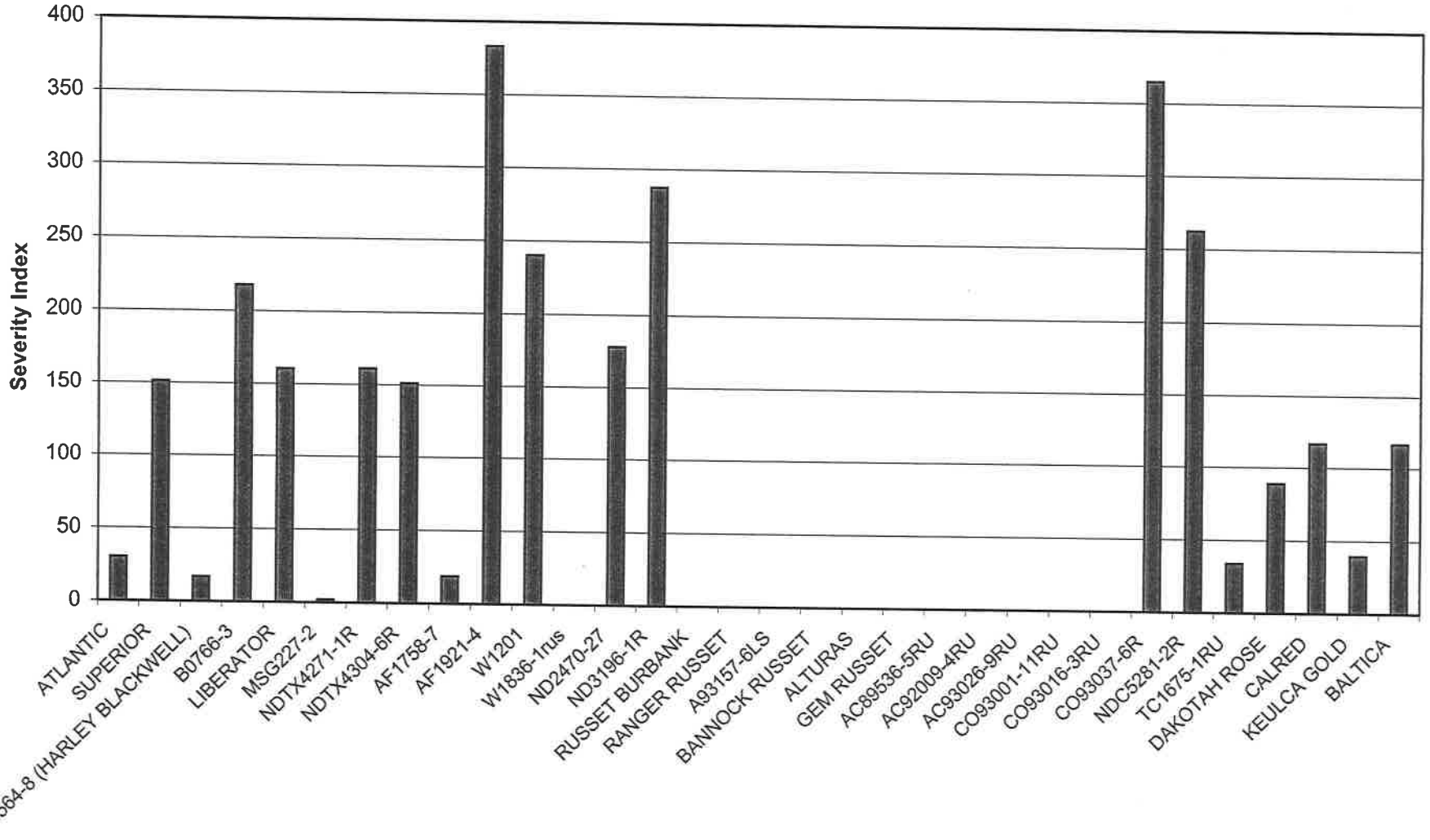
[a] Severity Index = mean percent of the number of affected tubers, 40 tubers/treatment/replication multiplied by the severity of the lesions, where 1 = very little or no disease and 5 = heavily infested.
[b] Root Gall Rating = mean percent of plants infected with powdery scab root galls, where 0 = no root galls and 4 = extensive root galls.
Means followed by the same letter are not significantly different at P=0.05.

Richard T. Zink, Associate Professor, Colorado State University

Evaluation of advanced clones for suseptibility to powdery scab root galls
San Luis Valley, Colorado, 2003



Evaluation of advanced clones for tuber susceptibility to powdery scab
San Luis Valley, Colorado, 2003



EVALUATION OF OMEGA APPLIED BY CHEMIGATION FOR CONTROL OF POWDERY SCAB ON POTATO, 2003

Researchers: Richard T. Zink and Andrew Houser, Colorado State University, SLVRC

Location: Off-station

Cultivar: Chipeta, cut seed, 2-4 oz.

Objective: To evaluate the efficacy of applying Omega fungicide throughout the growing season in preventing powdery scab on potato.

Treatments:
1. Control, no treatment
2. Omega @ 3.0 pt./A, applied on July 10, 2003
3. Omega @ 3.0 pt./A, applied on August 5, 2003
4. Omega @ 3.0 pt./A, applied on August 22, 2003

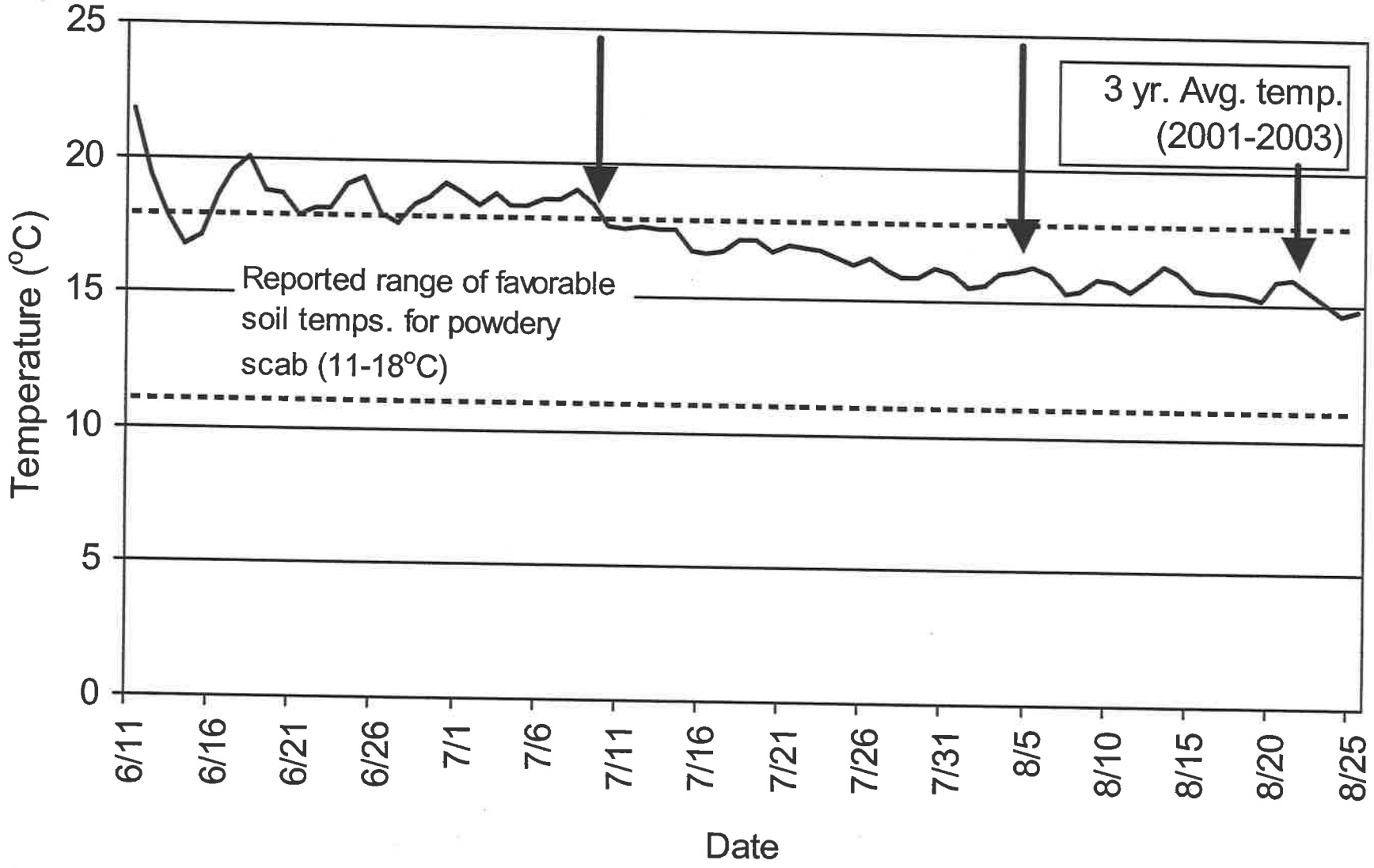
Application: Omega was applied through center pivot chemigation for all treatments.
For Omega Applications: Chemical was mixed with 20 gal. of water and was irrigated with 0.5 inches of water.

Planted: May 12, 2003
Plot Design: Randomized sampling within treatment blocks.
Plot Size: 1- 4 acre plot of ground per treatment per replication
Plant Spacing: 12 inches
Row Spacing: 34 inches
Replications: Three
Irrigation: Center pivot sprinkler, rate based on ET
Fertilizer:
Herbicide:
Insecticide:
Fungicide:
Vine Killer: Sulfuric Acid
Harvested: September 10, 2003

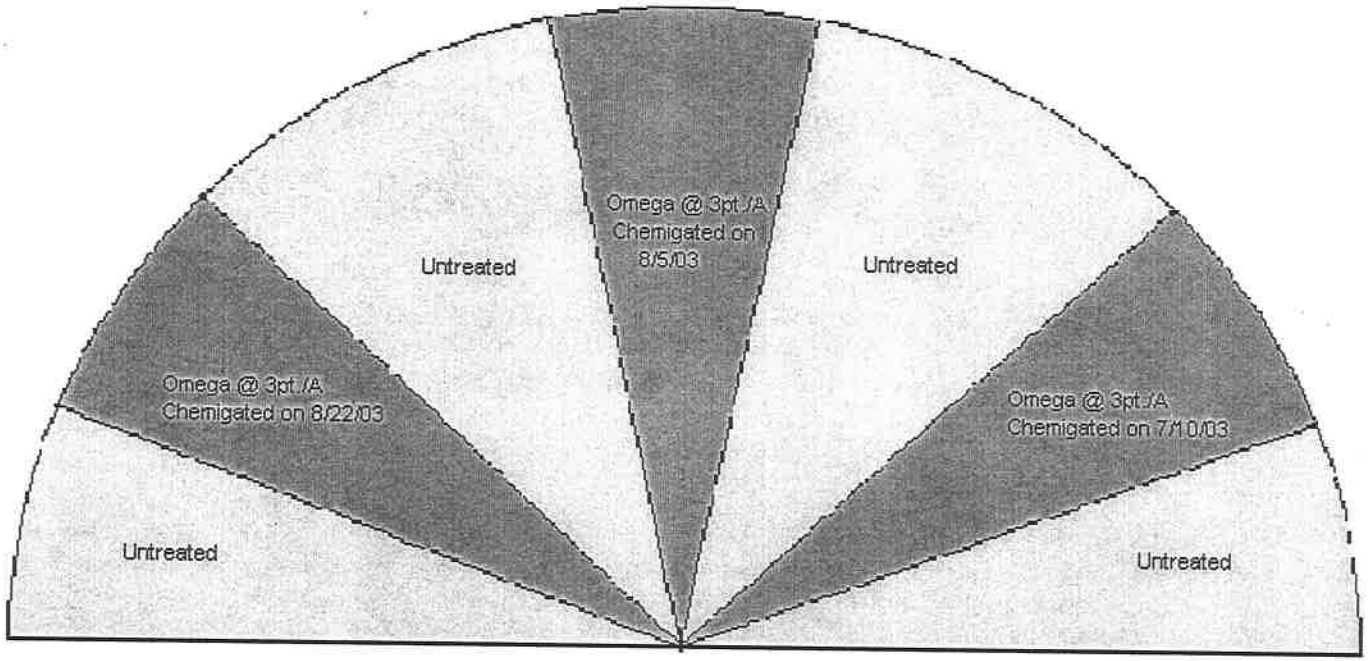
DATA

Disease: Mean percent of 100 tubers, taken from three samples from the treated area, showing powdery scab lesions at harvest and the number of lesions found per tuber at harvest.

Soil temperature readings at 8" under potato plant canopy, San Luis Valley, Colorado



← = **Dates when Omega fungicide was applied.**



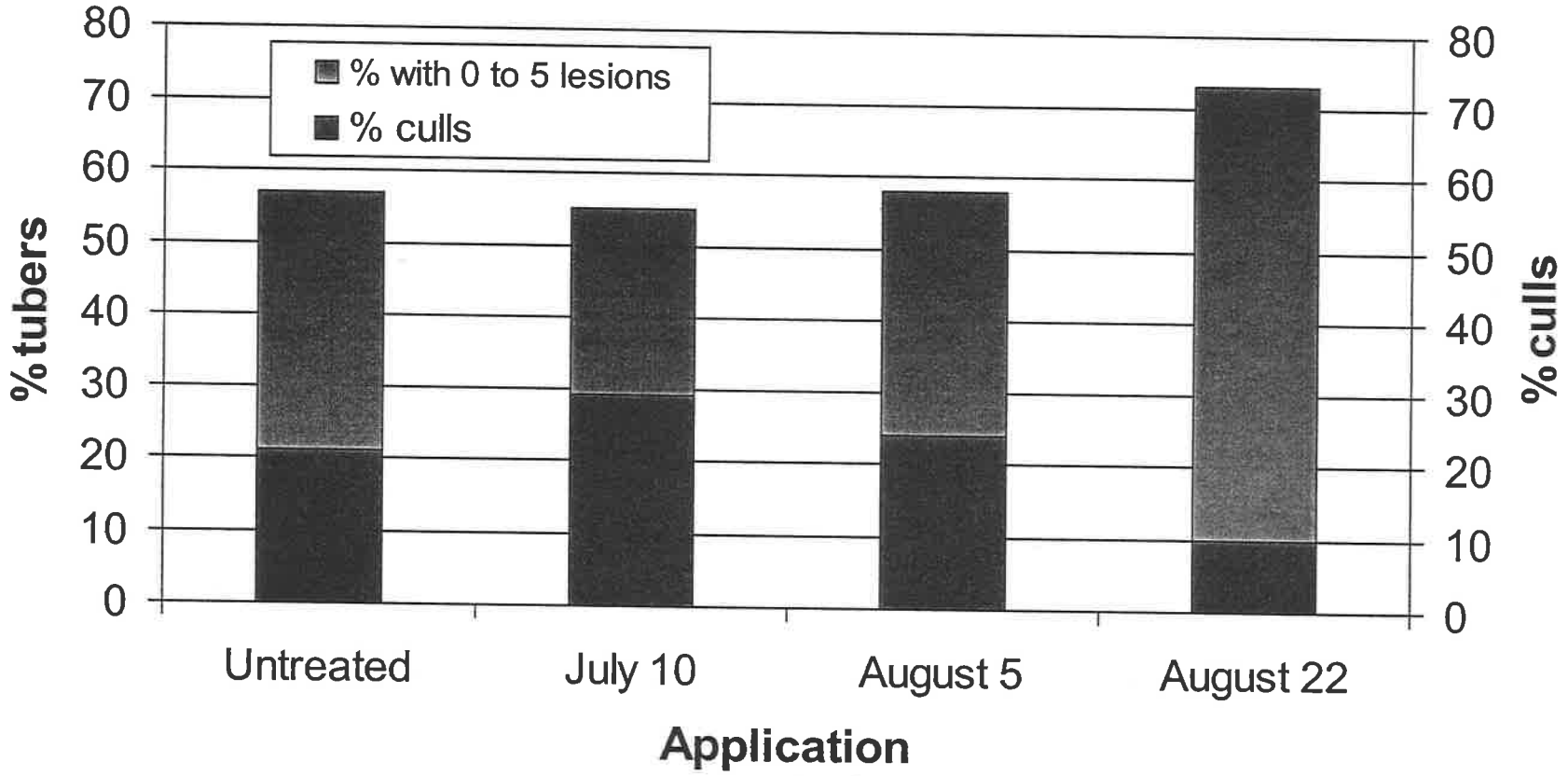
Omega Chemigation Trial Layout, San Luis Valley, 2003

Table 1. Effect of Omega fungicide applied by chemigation on the incidence of powdery scab on tubers in the cultivar Chipeta, San Luis Valley, Colorado, 2003

Cultivar	% Healthy[a]	% with 1-5 lesions[b]	% with 6-10 lesions[c]	% with 11-20 lesions[d]	% with 21-30 lesions[e]	% with >21 lesions[f]	% with >30 lesions[g]
1. Control, no treatment	38.0	19.0	9.0	13.0	12.0	21.0	9.0
2. Omega @ 3.0 pt./A, applied on July 10, 2003	41.0	14.0	12.0	4.0	8.0	29.0	21.0
3. Omega @ 3.0 pt./A, applied on August 5, 2003	29.0	29.0	8.0	10.0	12.0	24.0	12.0
4. Omega @ 3.0 pt./A, applied on August 22, 2003	51.0	22.0	9.0	8.0	3.0	10.0	7.0
LSD(P=0.05)	NS	NS	NS	NS	NS	NS	NS

[a] Percent tubers with no lesions, 100 8 to 10 oz. tubers/treatment/replication.
[b] Percent tubers with 1-5 lesions/treatment/replication.
[c] Percent tubers with 6-10 lesions/treatment/replication.
[d] Percent tubers with 11-20 lesions/treatment/replication.
[e] Percent tubers with 21-30 lesions/treatment/replication.
[f] Percent tubers with >21 lesions/treatment/replication.
[g] Percent tubers with >30 lesions/treatment/replication.

Effect of chemigated applications of Omega on powdery scab in the cultivar Chipeta, San Luis Valley CO 2003



Pink Rot Trials

EVALUATION OF FUNGICIDES APPLIED FOR CONTROL OF PINK ROT ON POTATO, 2003

Researchers: Richard T. Zink and Andrew Houser, Colorado State University, SLVRC

Location: San Luis Valley Research Center, Center, CO

Cultivar: Russet Norkotah selection 8, cut seed, 2-4 oz.

Objective: To evaluate the efficacy of various fungicides in preventing of pink rot in potato.

Application: In-Furrow treatments were applied using an R & D CO_2 charged backpack sprayer at 35 PSI, with two XR 8002VS nozzle, at 10 gallons/acre as a directed in-furrow application. Foliar treatments were applied using an R & D CO_2 charged backpack sprayer at 35 PSI, with two XR 8002VS nozzles, at 20 gallons/acre.

Program	Infurrow		Foliar (Foliar applications began on July 8, 2003)		
	Products	Rate	Products	Rate	Itinerary/Week
1.	Control, no treatment	-	Control, no treatment	-	-
2.	Reason SC	300 g.ai./Ha	Reason SC + Bond Bravo WS	300 g.ai./Ha + 2.57 fl.oz./A 1260 g.ai./Ha	2,4 3,5
3.	Previcur SC	1020 g.ai./Ha	Previcur SC + Bravo WS Bravo WS	1020 g.ai./Ha + 840 g.ai./Ha 1260 g.ai./Ha	2,4 3,5
4.	Ridomil Gold 480 EC	1710 g.ai./Ha	Ridomil Gold 480 EC Bravo WS	1710 g.ai./Ha 1260 g.ai./Ha	2,4 3,5
5.	None	None	Reason SC + Bond Bravo WS	300 g.ai./Ha + 2.57 fl.oz./A 1260 g.ai./Ha	2,4 3,5
6.	None	None	Reason SC + Bond Bravo WS	300 g.ai./Ha + 2.57 fl.oz./A 1260 g.ai./Ha	1,3 2,4
7.	Reason w/Tops MZ Seed treatment		Reason SC + Bond Bravo WS	300 g.ai./Ha + 2.57 fl.oz./A 1260 g.ai./Ha	2,4 3,5
8.	Reason SC	300 g.ai./Ha	Reason SC + Bond Bravo WS	300 g.ai./Ha + 2.57 fl.oz./A 1260 g.ai./Ha	2,4 3,5

Planted: May 13, 2003
Plot Design: Randomized complete block
Plot Size: 2 - 20 foot rows per treatment per replication
Plant Spacing: 12 inches
Row Spacing: 34 inches
Replications: Four
Irrigation: Solid set sprinkler, rate based on ET
Fertilizer: 80N-60P-40K-25S-2.5Zn, preplant, 10N through sprinkler after tuber set
Herbicide: Matrix, 1.5 oz./A + Eptam, 4.5 pt./A
Insecticide: None
Fungicide: None
Vine Killer: Beat vines on September 2, 2003
Harvested: September 18 & 19, 2003

DATA

Disease: Percent tubers with pink rot at harvest, at grading and during storage. The plot was flooded to induce pink rot on August 20th & 29th.
Yield: 2-20 foot row per treatment per replication, total yield expressed as cwt/A.
Grade: By hand, percent tubers by weight in pounds < 4 oz., 4-10 oz., > 10 oz., US #2's, and culls.

Table 1. Effects of products applied at planting and in season for control of pink rot on tuber yield and quality in the cultivar Russet Norkotah Selection 8, San Luis Valley, Colorado, 2003

Program	Infurrow	Foliar (Applications began on July 8, 2003)		Percent[a]					
	Products/Rate	Products/Rate	Itinerary/Week	< 4 oz.	4-10 oz.	> 10 oz.	US #2s	Culls	Cwt/A[b]
1.	Control, no treatment	Control, no treatment	-	10.7	48.7	35.6	3.9	1.2	376.3
2.	Reason @ 300 g.ai./Ha	Reason @ 300 g.ai./Ha	2,4	11.3	51.8	30.8	3.3	2.8	389.2
		Bond @ 2.57 fl.oz./A	2,4						
		Bravo WS @ 1260 g.ai./Ha	3,5						
3.	Previcur @ 1020 g.ai./Ha	Previcur @ 1020 g.ai./Ha	2,4	12.4	49.2	32.9	3.7	1.9	399.7
		Bravo WS @ 840 g.ai./Ha	2,4						
		Bravo WS @ 1260 g.ai./Ha	3,5						
4.	Ridomil Gold @ 1710 g.ai./Ha	Ridomil Gold @1710 g.ai./Ha	2,4	11.2	48.6	35.2	3.9	1.1	412.2
		Bravo WS @ 1260 g.ai./Ha	3,5						
5.	None	Reason @ 300 g.ai./Ha	2,4	9.9	49.6	34.3	4.1	2.2	411.4
		Bond @ 2.57 fl.oz./A	2,4						
		Bravo WS @ 1260 g.ai./Ha	3,5						
6.	None	Reason @ 300 g.ai./Ha	1,3	11.1	49.9	31.4	5.4	2.2	379.8
		Bond @ 2.57 fl.oz./A	1,3						
		Bravo WS @ 1260 g.ai./Ha	2,4						
7.	Reason w/Tops MZ Seed treatment	Bravo WS @ 1260 g.ai./Ha	2,4	9.6	50.2	34.1	3.0	3.1	398.8
		Bond @ 2.57 fl.oz./A	2,4						
		Bravo WS @ 1260 g.ai./Ha	3,5						
8.	Reason @ 300 g.ai./Ha	Reason @ 300 g.ai./Ha	2,4	10.7	50.3	32.7	3.6	2.6	421.3
		Bond @ 2.57 fl.oz./A	2,4						
		Bravo WS @ 1260 g.ai./Ha	3,5						
LSD(P=0.05)				NS	NS	NS	NS	NS	NS

[a] Based on tuber weight in pounds, mean of four replications.
[b] Total yield expressed as hundred weight per acre, 2-20 foot rows per treatment per replication, mean of four replications.

Table 2. Effects of products applied at planting and in season for control of pink rot in the cultivar Russet Norkotah Selection 8, San Luis Valley, Colorado, 2003

Program	Infurrow	Foliar (Applications began on July 8, 2003)		Incidence of tuber rot[a]	Incidence of tuber rot during stroage[b]
	Products/Rate	Products/Rate	Itinerary/Week		
1.	Control, no treatment	Control, no treatment	-	4.9	0.0
2.	Reason @ 300 g.ai./Ha	Reason @ 300 g.ai./Ha	2,4	0.3	1.2
		Bond @ 2.57 fl.oz./A	2,4		
		Bravo WS @ 1260 g.ai./Ha	3,5		
3.	Previcur @ 1020 g.ai./Ha	Previcur @ 1020 g.ai./Ha	2,4	0.4	2.6
		Bravo WS @ 840 g.ai./Ha	2,4		
		Bravo WS @ 1260 g.ai./Ha	3,5		
4.	Ridomil Gold @ 1710 g.ai./Ha	Ridomil Gold @1710 g.ai./Ha	2,4	0.0	0.0
		Bravo WS @ 1260 g.ai./Ha	3,5		
5.	None	Reason @ 300 g.ai./Ha	2,4	0.3	1.8
		Bond @ 2.57 fl.oz./A	2,4		
		Bravo WS @ 1260 g.ai./Ha	3,5		
6.	None	Reason @ 300 g.ai./Ha	1,3	1.4	0.0
		Bond @ 2.57 fl.oz./A	1,3		
		Bravo WS @ 1260 g.ai./Ha	2,4		
7.	Reason w/Tops MZ Seed treatment	Bravo WS @ 1260 g.ai./Ha	2,4	1.2	0.0
		Bond @ 2.57 fl.oz./A	2,4		
		Bravo WS @ 1260 g.ai./Ha	3,5		
8.	Reason @ 300 g.ai./Ha	Reason @ 300 g.ai./Ha	2,4	0.6	0.0
		Bond @ 2.57 fl.oz./A	2,4		
		Bravo WS @ 1260 g.ai./Ha	3,5		
LSD(P=0.05)				NS	NS

[a] Mean percent by weight of tubers showing water rot at harvest and at grading, four replications.
[b] Mean percent by weight of tubers showing water rot during tuber storage, four months post harvest, four replications.

EVALUATION OF FUNGICIDES APPLIED THROUGH CHEMIGATION FOR CONTROL OF PINK ROT ON POTATO, 2003

Researchers: Richard T. Zink and Andrew Houser, Colorado State University, SLVRC

Location: San Luis Valley Research Center, Center, CO

Cultivar: Russet Norkotah selection 8, cut seed, 2-4 oz.

Objective: To evaluate the efficacy of various fungicides in preventing of pink rot in potato.

Application: Treatments were chemigated on through the solid set irrigation system. Treatments that did not require a chemigation application were covered by a plastic tarp.

Chemigation: For Ridomil Gold Applications: Chemical was mixed with 10 gal. of water and was irrigated with 0.5 inches of water.
For Omega Applications: Chemical was mixed with 17 gal. of water and was irrigated with 0.7 inches of water.

Treatments:
1. Control, no treatment
2. Ridomil Gold @ 3.2 oz./A (2 applications – July 9 & July 18)
3. Omega @ 8 oz./A (2 applications – July 9 & July 18)
4. Omega @ 8 oz./A (4 applications – July 9, July 18, August 1, and August 14)

Planted: May 7, 2003
Plot Design: Randomized complete block
Plot Size: 4 - 16 foot rows per treatment per replication, data taken on two center rows only.
Plant Spacing: 12 inches
Row Spacing: 34 inches
Replications: Four
Irrigation: Solid set sprinkler, rate based on ET
Fertilizer: 80N-60P-40K-25S-2.5Zn, preplant, 10N through sprinkler after tuber set
Herbicide: Matrix, 1.5 oz./A + Eptam, 4.5 pt./A
Insecticide: None
Fungicide: Bravo WS, 1.5 pt./A
Vine Killer: Beat vines on September 2, 2003
Harvested: September 19, 2003

DATA

Disease: Percent tubers with pink rot at harvest and at grading.
The plot was flooded to induce pink rot on August 20th & 29th.
Yield: 2-10 foot rows per treatment per replication, total yield expressed as cwt/A.
Grade: By hand, percent tubers by weight in pounds < 4 oz., 4-10 oz., > 10 oz., US #2's, and culls.

Table 1. Effects of products applied through chemigation for control of pink rot on tuber yield and quality in the cultivar Russet Norkotah Selection 8, San Luis Valley, Colorado, 2003

Treatment/Rate	Percent[a]					Cwt/A[b]	Incidence of tuber rot[c]
	< 4 oz.	4-10 oz.	> 10 oz.	US #2s	Culls		
1. Control, no treatment	10.2	40.3	45.7	0.3	3.5	370.6	0.0
2. Ridomil Gold @ 3.2 oz./A (2 applications)	15.8	51.9	29.9	1.2	1.3	353.8	0.0
3. Omega @ 8 oz./A (2 applications)	12.5	50.4	36.0	0.4	0.8	357.3	0.7
4. Omega @ 8 oz./A (4 applications)	9.9	50.1	37.9	1.0	1.0	432.7	0.0
LSD(P=0.05)	NS	NS	NS	NS	NS	NS	NS

[a] Based on tuber weight in pounds, mean of four replications.
[b] Total yield expressed as hundred weight per acre, 2-10 foot rows per treatment per replication, mean of four replications.
[c] Mean percent by weight of tubers showing water rot at harvest and at grading, 4 replications.
Means followed by the same letters are not significantly different at P=0.05.

Three-Year Compost Study

Utilization of Compost made from Agricultural and Forestry Wastes for Improving the Economic and Ecological Sustainability of Agronomic Crop Production on Low Organic Matter Soils in the San Luis Valley of Colorado.

Project Leaders: Richard Zink, Merlin Dillon, and Andrew Houser, CSU

Project Description: The main objective of this study is to improve water conservation and sustainability of crop production on the low organic matter soils of the San Luis Valley, Colorado. This will be accomplished through on-farm demonstrations that will examine the impact of field incorporated compost made from agricultural and forestry wastes has on: 1.) reducing the use of synthetic fertilizers and fungicides, by improving nutrient retention in the root zone and the health and diversity of the soil's biomass, 2.) improving water utilization, thereby reducing water and power use in center-pivot irrigation systems, 3.) crop yields and costs of production for potatoes, barley and alfalfa.

Two agricultural waste streams, sawdust and cull potatoes, being generated in the San Luis Valley have become problematic for their local industries. Logs harvested from the National Forests surrounding the San Luis Valley are milled locally, generating sawdust for which there are very few feasible uses. In a 1997 Colorado State University (CSU) survey of western Colorado mill operators, the second most mentioned problem was that of mill residues (sawdust). Most of this sawdust has been stockpiled at locations near the mills. Potatoes are the area's most economically important crop, and the foundation of the local economy. On average, about 9.6% of each year's potato crop is not marketable, due to size, appearance or presence of disease. This study looks at using cull potatoes in combination with sawdust to create a dry compost that can be used on agronomic crops in the San Luis Valley, Colorado.

This was a three-year study that looked at applying compost to potato, alfalfa, and barley crops. Rates of 0, 4, 8, and 12 tons of compost/acre have been applied to six different sites around the San Luis Valley in the falls of 2000, 2001, and 2002. Four of the sites were planted to potato rotated with barley and the two remaining sites were planted to alfalfa. Crop disease, crop yield, and soil readings were taken at each of the six sites during the 2001, 2002, and 2003 growing season to determine the effect compost had on the soil and crops.

Table 1. Effects of different rates of compost on potato plant development and incidence of disease, San Luis Valley, Colorado, 2003

Field	Treatment[a]	Vigor[b]	Stems[c]	% Rhizoctonia[d]	Stolons[e]	% Rhizoctonia[f]	Black scurf severity index[g]
3A	0	4.9	4.5	33.2	27.5	0.9	0.9
	4	4.9	3.7	35.3	24.6	2.4	1.5
	8	4.8	3.7	28.9	25.7	1.8	0.0
	12	4.4	3.8	35.8	25.9	7.5	0.1
3B	0	4.8	3.4	24.3	19.4	0.7	0.0
	4	4.9	4.2	37.5	22.2	2.4	0.0
	8	4.8	3.6	33.8	25.0	6.6	0.1
	12	4.6	4.1	27.6	28.4	4.6	0.2
Overall Mean	0	4.8 a	4.0	28.7	23.4	0.8 b	0.5
	4	4.9 a	4.0	36.4	23.4	2.4 ab	0.8
	8	4.8 a	3.6	31.3	25.3	4.2 ab	0.1
	12	4.5 b	3.9	31.7	27.1	6.1 a	0.1
LSD(P=0.05)		0.26	NS	NS	NS	3.70	NS

[a]Rate of compost applied in tons/acre.
[b]Mean plant growth rated 1 – 5, where 1 = poor and 5 = good; five plants/treatment/replication.
[c]Mean number of stems per plant; five plants/treatment/replication.
[d]Mean percent stems with Rhizoctonia canker; five plants/treatment/replication.
[e]Mean number of stolons per plant; five plants/treatment/replication.
[f]Mean percent stolons with Rhizoctonia canker; five plants/treatment/replication.
[g]Black scurf severity index = mean percent of the affected tuber surface area, 10 8-10oz. tubers per treatment per replication multiplied by the severity of the sclerotia, where 1 = small sclerotia and 3 = large sclerotia.

Table 2. Effects of different rates of compost on the incidence of potato early blight, San Luis Valley, Colorado, 2003

		Percent Leaves Infected	
Field	Treatment	August 12	August 28
3A	0	2.8	62.5
	4	3.3	57.5
	8	3.2	48.3
	12	5.3	46.3
3B	0	3.1	62.9
	4	2.2	58.8
	8	2.6	59.2
	12	1.6	62.5
Overall Mean	0	3.0	62.7
	4	2.7	58.1
	8	2.9	53.7
	12	3.5	54.4
LSD(P=0.05)		NS	NS

Table 3. Effects of different rates of compost on potato tuber number, size, and quality, San Luis Valley, Colorado, 2003

		Percent[b]										
Field	Treatment[a]	< 4 oz.	No.	4-10 oz.	No.	> 10 oz.	No.	MS[c]	No.	Total lbs.	Total no.	Cwt/A[d]
3A	0	10.4	27.1	56.7	54.1	29.3	14.2	3.6	4.6	44.2	107.8	452.7
	4	8.6	25.8	55.7	54.5	30.7	14.3	5.0	5.4	42.0	99.5	430.3
	8	13.8	33.5	49.8	45.7	32.5	15.6	4.6	5.2	42.0	112.3	430.3
	12	13.6	35.0	45.0	42.0	36.8	18.4	4.7	4.6	44.8	110.5	459.8
3B	0	10.5	31.2	52.7	48.8	33.1	16.5	3.6	3.5	39.3	105.8	403.4
	4	10.4	31.1	56.7	52.7	27.9	13.4	5.0	2.9	43.3	112.0	444.4
	8	11.5	32.5	52.8	48.8	32.9	16.3	2.8	2.5	42.0	110.0	430.9
	12	10.8	32.0	47.1	46.9	39.5	18.7	2.7	2.5	42.9	111.0	440.0
Overall mean	0	10.5	29.2	54.7	51.4	31.2	15.3	3.6	4.1	41.8	106.8	428.1
	4	9.5	28.4	56.2	53.6	29.3	13.8	5.0	4.1	42.7	105.8	437.4
	8	12.3	33.0	51.3	47.2	32.7	16.0	3.7	3.8	42.0	111.1	430.6
	12	12.2	33.5	46.0	44.5	38.1	18.5	3.7	3.5	43.9	110.8	449.9
LSD(P=0.05)		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

[a] Rate of compost applied in tons/acre.
[b] Based on tuber weight in pounds and tuber number, mean of four replications.
[c] Misshaped tubers.
[d] Total yield expressed as hundred weight per acre, 1-15 foot row per treatment per replication, mean of four replications.
Means followed by the same letter are not significantly different at P=0.05.

Research Update on Root-Knot Nematodes of Potato in the SLV

RESEARCH UPDATE ON ROOT-KNOT NEMATODES OF POTATO IN THE SAN LUIS VALLEY

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Introduction

Columbia root-knot nematode (CRKN) represents a significant threat to the profitability of potato production. These nematodes infect and develop in tubers, causing quality defects such as galling (bumps) on the surface and brown spots in the vascular tissue. These defects are unacceptable for fresh market or processing and tubers with even a low level of infection must be culled. If even a small percentage of tubers are damaged, the entire crop may be substantially devalued or rejected. Seed growers must be especially diligent so that the infestation does not spread to new areas in infected seed. While primarily considered a pest in the Pacific Northwest (Idaho, Oregon, Washington), CRKN has also been reported from California, Colorado, Nevada, New Mexico, Texas and Utah.

CRKN can be controlled by soil fumigation, particularly with Telone, which is expensive ($185+/acre), but is probably the most effective strategy for seed growers, fields with high nematode populations and/or areas with long, warm growing seasons. Vydate (oxamyl) is a nonfumigant nematicide that can be effective in suppressing CRKN damage at low densities, particularly in cooler growing areas. Vydate is cheaper than soil fumigants (less than $25/a per application), but because it breaks down rapidly in soil, repeated applications during the season are necessary. The optimum timing of applications is being refined with ongoing research, but is believed to be related to the development of the nematode population as determined from heat units, which can be predicted by tracking accumulated soil degree-days (average daily temperature – minimum temperature for nematode development, 5C or 41F) after the crop is planted. In 2001, the Colorado Potato Administrative Committee (CPAC) funded a research project to determine the population dynamics cycle of CRKN in the SLV and develop a management program for CRKN using Vydate applications based on degree-day accumulations. Dupont provided additional assistance. Results from 2001 were reported in Pomme de terre Vol. 8 No 4 June 2002. This report briefly describes results from research completed during 2002. A complete report will be printed in the proceedings for the 2004 Potato Grain Conference.

Site Selection and Experimental Design

This study was conducted in a Russet Nugget field near Blanca, CO. Initial density across the study area averaged 281 CRKN/250 g soil. Different schedules of Vydate application times (See table 1) were evaluated. Untreated plots and three treatments representing various application schedules were sampled weekly for most of the season to determine effects of Vydate C-LV on population dynamics. Samples of 25 tubers/plot were evaluated for any external or internal symptoms of nematode damage following incubation at ambient temperature for 900 DD_{5C} after harvest (January 9, 2003) and after storage in the grower's cellar (May 6, 2003). Additional sets of tuber samples were collected from treatments where population dynamics were monitored (PD Row) and evaluated at harvest and after incubation.

Nematode Population Dynamics

Densities of CRKN in soil increased slowly until June 14, presumably due to spring hatching of eggs, and then declined rapidly as nematodes in the soil invaded roots or died (figure 1). CRKN densities began to increase slowly again between July 12 (888 DD_{5C}) and July 19 (984 DD_{5C}) and then increased rapidly. This represents the hatching of the 2nd generation and the time period of initial tuber invasion by CRKN. Numbers continued to rise until September 6 (1,558 DD_{5C}), after which, populations increased at

a much faster rate, suggesting the hatching of the 3rd generation. Peak densities on September 13 (1,632 DD_{5C}) were nearly 23-fold higher than populations at planting. After vine-kill, populations declined rapidly, reaching 30% of peak densities by harvest. **This suggests that the optimum time to sample for CRKN that may be present in a current season potato crop would be immediately after vine-kill.**

Effect of Vydate C-LV Treatments on Population Dynamics

In furrow applications of Vydate C-LV delayed hatch of the 2nd generation and populations increased less than in the same treatment without an in furrow application. Banded application at hilling had no lasting impact on populations. Chemigation applications at 888 DD_{5C}, two weeks later and four weeks later did not delay initiation of the hatch of the second generation, but substantially suppressed the number hatching after mid-August. In addition, there was little increase in these treatments at the time of the 3rd generation hatch in untreated plots. At the time of peak density in untreated plots, populations in all treated plots averaged 84% less. **However, while Vydate suppressed nematode population growth, it did not reduce nematode populations, as densities at harvest were much higher than at planting.**

Effect of Vydate C-LV Treatments on Suppression of Nematode Tuber Damage

For **fresh market production**, external damage from stored samples is probably the most appropriate evaluation to assess treatment performance. However, while 38% of tubers from untreated plots had external damage, all but one Vydate treatment had little to no external damage. Therefore, internal infection after incubation was used to determine the relative performance of the different application times. None of the treatments that had applications at hilling were better than comparable treatments without this application. Similarly, comparable treatments with and without applications at hooking demonstrated no or marginal improvement with the application at hooking. This suggests that the applications at hilling or hooking may be ineffective for suppression of damage from CRKN. These treatments may have been ineffective because the CRKN is less susceptible to Vydate at this stage in its life cycle, or because these applications were sprayed on the surface and then incorporated by irrigation later. Delivery of Vydate through chemigation on these dates may have been more effective. In contrast, all treatments with in furrow applications had markedly less infection than comparable treatments without an in furrow treatment. **Therefore, these data suggest that, for control of CRKN, it would be better to spend the money on an in furrow application than on applications at hilling or hooking.** Applications at these times may be necessary to control corky ringspot, however. Treatments with an in furrow application plus one, two, or three additional chemigation applications starting at 900 DD_{5C} had 56%, 21% and 7% infection, respectively, after incubation, demonstrating the value of chemigation applications at these times. Overall, the best strategy may be to apply Vydate C-LV in furrow and at 900 DD_{5C} with additional later applications depending on initial densities and/or the warmth of the growing season.

For **seed production**, presence of any internal infection sites after incubation is the most critical evaluation to determine if treatments are keeping nematodes out of tubers. In this case, only one of the treatments with five applications of Vydate C-LV had less than 1% of infected tubers. However, even 0.6% infected seed tubers would result in a large number of potential infestation sites when planted.

Effect of Cold Storage and Warm Incubation on Tuber Symptoms

It took 35 days for the cellar to reach a temperature (5C, 41F) below which CRKN can no longer develop. During this period, nematodes in tubers collected an additional 135 degree-days. However, during transport and evaluation, "harvest" sample tubers collected an additional 115 degree-days, so there was little difference in total degree-day accumulation between harvest (1,905 DD_{5C}) and storage (1,925 DD_{5C}) samples. Nevertheless, untreated plots appeared to have a slightly higher percentage of tubers with external and internal symptoms of nematode damage in stored samples than in samples evaluated after harvest. **In any case, there was no increase in symptom severity during storage for any of the three**

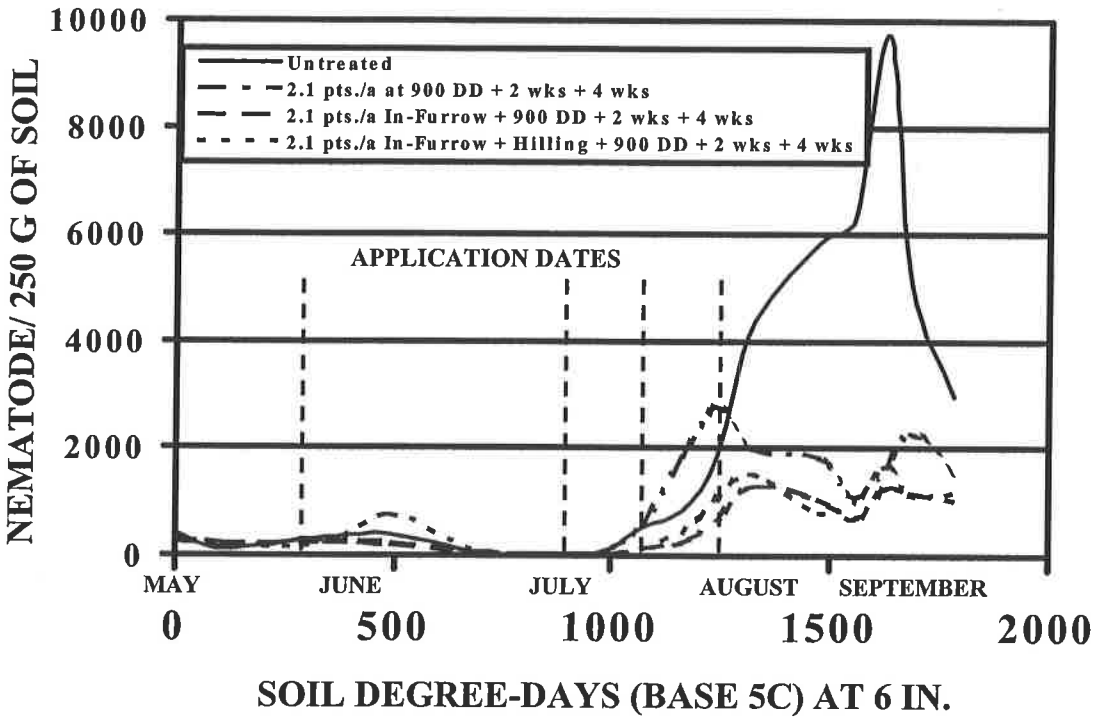

Figure 1. Population dynamics of Columbia root-knot nematode on Russet Nugget in the San Luis Valley, 2003

Vydate treatments evaluated, suggesting that the suppression of damage observed at harvest persisted through storage.

Percentage of tubers with external symptoms was similar between stored samples and those incubated for an additional 900 DD_{5C} (2,680 DD_{5C} total) after harvest, but internal infection was higher in most treatments after incubation. **Thus, incubation at room temperature appears to be an adequate procedure to estimate the amount of external damage to expect in fresh market tubers coming out of storage, as well as a useful assay for seed tubers which may harbor nematodes that are undetectable at harvest. In addition, since many tubers without external symptoms had nematodes inside, external evaluation of seed is not an effective method to determine if tubers are infected.**

At Planting Nematode Thresholds With and Without Vydate Treatment

During 2001, comparisons of CRKN densities at planting with tuber damage at harvest in a Russet Norkotah field indicated only minimal external symptoms in untreated plots with up to 230 CRKN/250 g soil at planting. Analysis of internal infection estimated that 5%, 10% and 15% of tubers would be culled if densities of 23, 55 and 110 CRKN/250 g soil were not treated. In plots treated with Vydate C-LV on July 16 and August 9, external and internal damage were minimal in all plots, so no relationship between initial density and nematode damage could be determined. This suggests that all population levels up to 231 CRKN/250 g soil were controlled by these two applications. No untreated plots could be examined in the Russet Nugget field in 2002. In plots treated with Vydate C-LV sprayed on the surface and watered in at hooking and chemigated in ½ in water on July 12th, July 29th, and August 12th, CRKN at planting ranged from 0-1,380 and averaged 187/250 g of soil. Averaged over all plots, external and internal symptoms were observed in 2.5% and 24% of incubated tubers, respectively. Even in the five plots with the highest initial CRKN populations (ave. = 745/250 g soil), only 3.1 % of tubers expressed external symptoms. Again, there was no mathematical relationship between initial density and subsequent tuber damage. Therefore, **these four applications of Vydate C-LV suppressed damage by CRKN to commercially acceptable levels at relatively high populations of CRKN.** Furthermore, since the hooking application may have been ineffective, **the three later applications may have been sufficient.**

Table 1. Performance of different application schedules of Vydate C-LV for suppression of tuber damage caused by Columbia root-knot nematode (*Meloidogyne chitwoodi*). Russet Nugget, Planted May 1, Harvested October 1, 2003 (1,790 DD_{5C}) San Luis Valley, CO.

		Number of Applications of C-LV at 2.1 pts/a								
Applications	Date	0	3	3	4	4	4	5	5	5
In furrow at planting	May 1	--	X		X	X		X		X
Banded spray at hilling	June 6	--	X		X			X	X	
Broadcast spray at hooking	June 20	--					X		X	X
Chemigation at 900 DD_{5C}	July 12	--	X	X	X	X	X	X	X	X
Chem. 2 wks. After 900 DD_{5C}	July 29	--		X	X	X	X	X	X	X
Chem. 4 wks. After 900 DD_{5C}	Aug 12	--		X		X	X	X	X	X
PD Row – Harvest (1,905 DD_{5C}) Evaluations		% Tubers Affected								
Any external symptoms		23		0		0		0		
1 or more internal infection sites		73		9		9		7		
PD Row – Incubation (2,680 DD_{5C}) Evaluations		% Tubers Affected								
Any external symptoms		40		0		1		0		
1 or more internal infection sites		91		17		9		2		
Storage (1,925 DD_{5C}) Evaluations		% Tubers Affected								
Any external symptoms		**38**	**13**	**0**	**1**	**0**	**<1**	**<1**	**<1**	**0**
1 or more internal infection sites		81	35	7	5	<1	23	2	12	<1
Incubation (2,680 DD_{5C}) Evaluations		% Tubers Affected								
Any external symptoms		29	7	<1	<1	<1	<1	2	<1	0
1 or more internal infection sites		**92**	**56**	**22**	**21**	**7**	**15**	**9**	**19**	**<1**

Effect of Telone fumigation on control of Columbia root-knot nematode

A barley field with high nematode densities was grid sampled before (October 3, 2002) fumigation with Telone at 20 gpa (October 7, 2002) and before planting potatoes (May 8, 2003) the following spring. Before fumigation, root-lesion nematode densities ranged from 108-4,102 and averaged 1,021/250 g soil. Root-knot nematode densities ranged from 2-6,922 and averaged 1,905/250 g soil. After fumigation, spring densities of root-lesion nematodes ranged from 0-30 and averaged 13/250 g soil while total CRKN ranged from 0-192 and averaged 23/250 g soil. **However, out of 15 grid samples examined, only 6 (avg. = 0.4/250 g soil) of all the CRKN examined were found to be alive at planting.**

Summary

CRKN increased 23-fold in untreated plots of Russet Nugget in the SLV. Vydate C-LV, particularly treatments including in furrow applications, suppressed population growth substantially. Three or more applications of Vydate C-LV adequately controlled damage to fresh market tubers at CRKN densities commonly found in the SLV. In furrow and chemigation applications at and after 900 DD_{5C} were more effective than applications sprayed on the surface and watered in at hilling or hooking. However, while Vydate may be sufficient for fresh market production, many tubers were infected with a low number of nematodes that probably would not be detected at harvest and high populations were present in the soil at harvest. Therefore, Telone, which nearly eliminated all CRKN from soil, would be preferable to Vydate C-LV for seed production.

Advanced Clone Disease Assessment Program

Significant Accomplishments for the 2003
Advanced Clone Disease Assessment Program

Numerous advanced clones were evaluated for their reaction to potato leafroll virus, PVY, bacterial ring rot, powdery scab and storage rots caused by *Fusarium* spp. and *Erwinia carotovora*. Two clones, CO94019-1R and VC1015-1R/Y have been tested three and two years respectively for symptom expression to potato leafroll virus. This is of significant concern since inoculation with green peach aphids carrying leafroll have been shown to be adequate in transmitting the virus to all other clones and controls, but these two clones have shown no symptoms. This could be the result of good resistance to leafroll spread or the result of latent expression of symptoms. If it is the latter, this would make the clones unacceptable for release. Further discussion with the Cultivar development team will take place prior to any decisions for release. All of the clones screened for natural in-field spread of leafroll demonstrated relatively high levels of leafroll spread similar to the higher level cultivars like Russet Burbank. Two clones, however, demonstrated low levels of spread, CO96076-7W and CO94157-2W/Y. Under high aphid numbers like last year, this could be significant for growers producing stocks in regions of high leafroll pressure. Several clones showed no symptoms when inoculated with PVY. This is most likely the result of poor inoculation technique and they will be screened again in 2004 either in the field or in the plot for reaction to PVY.

Bacterial ring rot testing was conducted for both Colorado selections and the selections moving forward in the Western Regional trials. Within the Colorado selections, two clones did not show any symptoms in 2003. These clones, CO94019-1R and CO93037-6R, have shown symptoms in past trials. Relatively few plants, however, have shown symptoms and the symptoms have been either late in the season or somewhat mild. In these cases, the overall rating for the clones (Table 5) ranges between 2-3 with a rating of 2 being marginally acceptable with provisions. CO94019-1R also has problems with leafroll, placing this clone on the list of questionable for release. None of the clones demonstrated excess tuber decay with the whites being the highest in this regards, not unexpected.

Clones tested against the storage rots showed relatively good results. Two clones in particular, CO93001-11RU and VC0967-2R/Y, demonstrated good consistent resistance against both *Fusarium* spp. and *Erwinia carotovora*. They bear further scrutiny. Overall, the program still appears to be on track to find good resistance in horticulturally acceptable material.

Finally, a series of grower "on farm" plots were examined comparing the use of certified seed with year out or "common" seed. The results were favorable toward the use of certified seed and are discussed in the report "Certified Seed versus Common Seed - The San Luis Valley Dilemma". This project will be repeated in 2004 with new cooperators.

2003 Potato Leafroll CE, NIFS, and PVY CE

Location: NW Corner, Selter's Farm, 9 North, ½ mile east of SLVRC

Treatments: PLRV and PVY Infected and Healthy + Natural In-Field Spread of PLRV

Plot Design: RCB - 7 seedpcs/cultivar x two trts (½ HE & ½ Infected) (PLRV, PVY)
RCB - 12 seedpcs x 3 reps - leafroll spacer between each treatment (NIFS)
Aphid inoculation for PVY and PLRV was 7/11/03 with kill on 7/15/03.

Plant Date: 5/3/03

Plot Size: 12" plant spacing x 34" row spacing

Cultivar:

1. AC96010-3RU
2. AC96052-1RU
3. CO96043-5RU
4. CO96045-1RU
5. CO96047-7RU
6. CO96076-7W
7. CO96083-7RU
8. CO96109-7RU
9. CO96133-11RU
10. CO96141-4W
11. CO96142-4W
12. CO96293-4RU
13. CO94157-2W/Y
14. VC1106-1RU/Y
15. VC1123-2W/Y
16. VC1009-1W/Y (No PVY)
17. VC1015-1R/Y (No PVY, NIFS)
18. CO94019-1R (No PVY, NIFS)
19. WNC230-14RU
20. Ute Russet (No PVY)
21. Green Mountain (No PVY, PLRV)
22. Houma (No PVY, PLRV)
23. Keswick (No PVY, PLRV)
24. Penobscot (No PVY, PLRV)
25. Katahdin (No PVY, PLRV)
26. Centennial Russet
27. Russet Burbank
28. Sangre
29. Russet Norkotah
30. Russet Nugget

PVY only add from 20. (21. CO95070-7W; 22. CO95172-3RU;
23. VC1075-1R; 24. VC1002-3W/Y; no 25.)

LR CE = 1-20, 26-30; PVY CE = 1-15, 19, 21-24(below), 26-30; NIFS = 1-16, 19-30.

Irrigation: Solid set sprinkler: rate based on ET & ppt. Total water for season: 21".

Fertilizer: Ground applied 80:60:40:25(S):2.5(Zn) with 12 N from irrigation water.
Total for season = 92:60:40:25(S):2.5(Zn).

Herbicide: Ground rig application: 5/28/03 - Eptam(4.5pt/a) & Matrix (1.5 oz/a).

Fungicide/Insecticide: No fungicides or insecticides applied during season.

Harvest: 9/24/03

Table 1. 2003 Clonal Evaluation for PLRV and PVY Symptom Expression					
Cultivar/Clone	PLRV (0-3+)	Symptoms	Cultivar/Clone	PVY (0-3+)	Symptoms
1 AC96010-3RU	3+	ALL	1 AC96010-3RU	3+	Typical
2 AC96052-1RU	2+	ALL	2 AC96052-1RU	3+	Typical, severe
3 CO96043-5RU	3+	ALL	3 CO96043-5RU	3+	Typical
4 CO96045-1RU	3+	ALL	4 CO96045-1RU		
5 CO96047-7RU	3+	ALL	5 CO96047-7RU		
6 CO96076-7W	3+	ALL	6 CO96076-7W	3+	Typical
7 CO96083-7RU	3+	ALL	7 CO96083-7RU	3+	Severe, leaf drop
8 CO96109-7RU	3+	ALL	8 CO96109-7RU		
9 CO96133-11RU	2+	ALL + P	9 CO96133-11RU		
10 CO96141-4W	3+	ALL	10 CO96141-4W		
11 CO96142-4W	3+	ALL	11 CO96142-4W		
12 CO96293-4RU	3+	ALL	12 CO96293-4RU		
13 CO94157-2W/Y	3+	ALL	13 CO94157-2W/Y	3+	Hypersensitive
14 VC1106-1RU/Y	3+	ALL	14 VC1106-1RU/Y		
15 VC1123-2W/Y	3+	ALL	15 VC1123-2W/Y		
16 VC1009-1W/Y	3+	ALL	19 WNC230-14RU		
17 VC1015-1R/Y	None		21 CO95070-7W		
18 CO94019-1R	None		22 CO96172-3RU		
19 WNC230-14RU	0		23 VC1075-1R	3+	Typical, purpling
20 Ute Russet	3+	ALL	24 VC1002-3W/Y		
26 Centennial Russet	3+	ALL	26 Centennial Russet		
27 Russet Burbank	3+	ALL	27 Russet Burbank		
28 Sangre	3+	ALL	28 Sangre		
29 Russet Norkotah	3+	ALL	29 Russet Norkotah		
30 Russet Nugget	3+	ALL	30 Russet Nugget		
All = WP - whole plant, LL - Lower leaf rolling,			Typical = mosaic type symptom with yellowing, vein		
CC - color change; P = purpling along leaf margins.			burning, and stunting. Hypersensitive - severe stunting		
			with leaf drop.		
Rating; 0 = no symptoms up to 3+ = typical symptoms which are easy to recognize visually.					

Table 2. 2003 Leaf Roll Natural In-Field Spread				
Cultivar/Clone	# Pos / # Emerged	% Spread 2003	14 Yr. Avg.	Risk
1 AC96010-3RU	3/38	7.9		Medium
2 AC96052-1RU	23/39	59.0		High
3 CO96043-5RU	6/31	19.3		High
4 CO96045-1RU	8/34	23.5		High
5 CO96047-7RU	3/17	17.6		High
6 CO96076-7W	0/21	0.0		Low
7 CO96083-7RU	14/27	51.8		High
8 CO96109-7RU	2/15	13.3		High
9 CO96133-11RU	23/39	59.0		High
10 CO96141-4W	9/50	18.0		High
11 CO96142-4W	4/12	33.3		High
12 CO96293-4RU	16/43	37.2		High
13 CO94157-2W/Y	1/26	3.8		Low
14 VC1106-1RU/Y	35/51	68.6		High
15 VC1123-2W/Y	16/37	43.2		High
16 VC1009-1W/Y	2/21	9.5		Medium
19 WNC230-14RU	0/19	0.0	0.2	Low
20 Ute Russet	15/49	30.6	14.4	High
21 Green Mountain	5/26	19.2	17.1	High
22 Houma	0/35	0.0	4.8	Medium
23 Keswick	0/36	0.0	5.3	Medium
24 Penobscot	1/35	2.9	1.0	Low
25 Katahdin	2/33	6.1	3.2	Low
26 Centennial Russet	4/41	9.8	4.3	Low
27 Russet Burbank	23/37	62.1	13.1	High
28 Sangre	0/22	0.0	7.5	Medium
29 Russet Norkotah	13/39	33.3	32.3 (4 yr. avg.)	High
30 Russet Nugget	17/32	53.1	14.0	High
Data is generated using 2 tubers/plant, 12 plants/rep, and 3 reps/cultivar for a total				
of 72 tubers planted per clone per year.				
Advanced clones only have one year of testing (1-19).				
Risk assessment; Low = 0-4.9%, Medium = 5.0-9.9%, High = 10.0% and higher.				

2003 Bacterial Ring Rot Evaluation

Location: NW Corner, Selter's Farm, 9 North, ½ East of SLVRC

Treatments: 74 clones/cultivars - Non-inoculated controls consisted of 21 tubers cut lengthwise with no dipping. Inoculated treatments were obtained by placing 21 seed pieces (fresh cut lengthwise) into one liter of Ringers solution (100 ml of 10x with 900 ml of cold water) for 5 minutes. Three Cms plates exhibiting good bacterial growth, with some agar, were scraped into the Ringers. After four treatments were dipped, a fourth plate was added to the solution to finish out the last three treatments. Seven cultivars were dipped per batch and the cold solution was not used for more than 45 minutes total time. Cms plates were 7-9 days old and inoculation took place on 5/6/03. Inoculated tubers were allowed to stay moist in paper sack overnight. After planting, tubers were immediately covered with soil.

Plot Design: Randomized complete block - 7 inoculated, 7 non-inoculated seed pieces/cultivar x 3 reps with non-inoculated controls planted south of inoculated treatments.

Plant Date: 5/7/03

Cultivars:

1. AC96010-3RU
2. AC96052-1RU
3. CO96043-5RU
4. CO96045-1RU
5. CO96047-7RU
6. CO96076-7W
7. CO96083-7RU
8. CO96109-7RU
9. CO96133-11RU
10. CO96141-4W
11. CO96142-4W
12. CO96293-4RU
13. CO94157-2W/Y
14. VC1106-1RU/Y
15. VC1123-2W/Y
16. AC94296-5W
17. AC95405-2RU
18. CO93037-6R
19. CO94019-1R
20. CO95007-1RU
21. CO95051-7W
22. CO95070-7W
23. CO95086-8RU
24. CO95172-3RU
25. VC1009-1W/Y
26. VC1015-1R/Y
27. VC1015-7R/Y
28. VC1075-1R
29. VC0967-2R/Y
30. VC0967-5R/Y
31. VC1002-3W/Y
32. WNC230-14RU
33. Ute Russet
34. Centennial Russet
35. Russet Burbank
36. Sangre
37. Russet Norkotah
38. A8893-1
39. A9014-2
40. A9045-7
41. A91790-13
42. NDO4323-2R
43. Alturas
44. A84118-3
45. A90586-11
46. A91186-2
47. A91814-5
48. A92030-5
49. A92294-6
50. A92584-3BB
51. A9304-3
52. A9305-10
53. A93157-6LS
54. AO93487-2R
55. AO96747-1R
56. AO96747-2R/Y
57. ATX9202-1RU
58. ATX92230-1RU
59. BTX1544-2W/Y
60. NDA5507-3YF
61. NDTX4271-5R
62. NDTX4304-1R
63. NDTX4930-5W
64. PA95A11-14
65. Sierra Gold
66. TX1674-1W/Y
67. Stampede Russet
68. FL2053
69. FL2048
70. FL2027
71. FL1922
72. FL2006
73. FL2049
74. FL2000 (MT)

Irrigation: Solid set sprinkler: rate based on ET and ppt. Total water for season was 21"

Fertilizer: Planting fertilizer ground applied 80:60:40:25(S):2.5(Zn) with 12N from irrigation water. Total for season = 92:60:40:25(S):2.5(Zn).

Herbicide: Ground rig application: 5/28/03 - Eptam (4.5pt/a) + Matrix 1.5 oz/a).

Fungicide/ Insecticide: No fungicides or insecticides applied during season.

Harvest: 9/24/03

Table 3. 2003 Clonal Evaluation for Bacterial Ring Rot Foliar Symptom Expression									
^	Clone	Date of First Symptoms	# Reps Positive	# Plants Positive	% Plants Positive	Date 50% or More +	Total # Reps Positive	% Plants + 100 DAP	Summary of Symptoms
1	AC96010-3RU	7/16	1	1	4.8		3	42.8	IVC,IVN,MN,W
1	AC96052-1RU	6/26	1	1	5.2	7/24	3	63.1	All
1	CO96043-5RU	6/26	1	1	4.8		1	4.8	ED,R
1	CO96045-1RU	7/24	1	1	4.8		2	14.3	ED,R,IVC,IVN,MN
1	CO96047-7RU	7/16	1	1	4.8		3	33.3	All
1	CO96076-7W	7/16	1	1	4.8	8/27	3	85.7	All
1	CO96083-7RU	8/7	2	2	10.0		2	20.0	IVC,IVN,MN,W
1	CO96109-7RU	7/8	1	2	9.5	8/7	3	76.2	All
1	CO96133-11RU	7/8	1	1	4.8	8/7	3	57.1	All
1	CO96141-4W	6/26	1	2	9.5		2	28.6	All
1	CO96142-4W	7/8	1	2	9.5		2	28.6	All
1	CO96293-4RU	7/8	1	3	14.3	8/27	3	71.4	All
1	CO94157-2W/Y	6/26	1	1	4.8		3	38.1	All
1	VC1106-1RU/Y	8/27	2	6	30.0		2	30.0	IVC,IVN,MN,W
1	VC1123-2W/Y	8/27	1	1	5.0		1	5.0	IVC,IVN,MN,W
2	AC94296-5W	8/1	1	1	5.6	8/27	3	55.6	IVC,IVN,MN,W
2	AC95405-2RU	7/8	1	1	5.0	8/27	3	60.0	All
4	CO93037-6R		0	0	0.0		0	0.0	
3	CO94019-1R		0	0	0.0		0	0.0	
2	CO95007-1RU	7/24	1	2	10.0	8/27	3	70.0	All
2	CO95051-7W	8/1	1	4	19.0	8/27	2	52.3	IVC,IVN,MN,W
2	CO95070-7W	8/7	1	1	5.0		2	25.0	IVC,IVN,MN,W
2	CO95086-8RU	6/26	1	2	9.5	8/27	3	66.7	All
2	CO95172-3RU	7/8	3	4	19.0	8/1	3	66.7	All
2	VC1009-1W/Y	8/27	2	3	14.3		2	14.3	IVC,IVN,MN,W
2	VC1015-1R/Y	8/27	3	4	19.0		3	19.0	IVC,IVN,MN,W
2	VC1015-7R/Y	7/16	1	1	4.8		3	47.6	All
2	VC1075-1R	6/26	1	1	4.8	8/27	3	57.1	All
3	VC0967-2R/Y	8/27	1	4	20.0		1	20.0	IVC,IVN,MN,W
3	VC0967-5R/Y	7/16	1	1	4.8		3	14.3	ED,R, IVC
3	VC1002-3W/Y	8/7	2	2	11.8		3	41.2	IVC,IVN,MN,W
	WNC230-14RU	6/26	1	1	5.0		3	40.0	All
	Ute Russet	8/7	1	1	4.8		1	4.8	IVC,IVN,MN,W
	Centennial Russet		0	0	0.0		0	0.0	
	Russet Burbank	6/26	3	7	33.3	7/24	3	61.9	All
	Sangre	7/8	1	2	9.5	8/27	3	61.9	All
	Russet Norkotah	6/26	3	5	25.0	7/24	3	90.0	All

Table 4. 2003 Clonal Evaluation for Bacterial Ring Rot				
Tuber Symptom Expression				
Clone	# Reps +	# Tubers +	%Tubers +	PS Rating
1 AC96010-3RU				
2 AC96052-1RU	1	1	5	
3 CO96043-5RU				
4 CO96045-1RU				
5 CO96047-7RU	1	1	5	
6 CO96076-7W	1	4	20	
7 CO96083-7RU	1	1	5	
8 CO96109-7RU	1	2	10	
9 CO96133-11RU				
10 CO96141-4W				
11 CO96142-4W				
12 CO96293-4RU				PS+
13 CO94157-2W/Y	1	2	10	
14 VC1106-1RU/Y				
15 VC1123-2W/Y				
16 AC94296-5W	1	1	5	PS+
17 AC95405-2RU				
18 CO93037-6R	1	1	5	
19 CO94019-1R				
20 CO95007-1RU				
21 CO95051-7W	2	5	25	
22 CO95070-7W	2	5	25	
23 CO95086-8RU	2	2	10	
24 CO95172-3RU				
25 VC1009-1W/Y				PS+
26 VC1015-1R/Y	1	1	5	
27 VC1015-7R/Y	2	4	20	
28 VC1075-1R				
29 VC0967-2R/Y				
30 VC0967-5R/Y				
31 VC1002-3W/Y				
32 WNC230-14RU				
33 Ute Russet	1	1	5	
34 Centennial Russet				
35 Russet Burbank	1	1	5	
36 Sangre	2	3	15	PS+
37 Russet Norkotah	1	1	5	
2 of 3 reps screened with 10 tubers cut/treatment representing at least 5 plants.				
FL lines had 3 reps screened for a total of 30 tubers cut and examined.				
% tubers (+) is based upon #pos/#cut. Harvest = 9/24/03				
PS+ = powdery scab present on tubers				

Table 5. Clonal Evaluation for Disease Expression - 2003 Finalyzed by Clone										
Clone	BRR Rating Foliar	BRR Rating Tuber	PLRV	NIFS PLRV	PVY	Powdery Scab	*Fusarium*	*Alternaria*	*Erwinia*	
AC94296-5W	5	2	3	5	3					
AC95405-2RU	5	1	3	4	3					
					Gem R. type					
CO93037-6R	2	2	3	5	3		2.80	0.07	2.00	
CO94019-1R	2-3	1	0	1	3		3.00	0.00	1.00	
					HyperSen					
CO95007-1RU	5	5	3	5	3					
					Silverton type					
CO95051-7W	4	4	3	4	3					
CO95070-7W	3	4	3	4	1					
					Vein burn					
CO95086-8RU	5	3	3	4	3					
CO95172-3RU	5	1	3	5	1					
					Shepody type					
VC1009-1W/Y	3	1	2	2	3					
VC1015-1R/Y	2-3	2	0	1	3					
					Leaf drop					
VC1015-7R/Y	5	3	3	4	3					
VC1075-1R	3	2	3	1	3					
VC0967-2R/Y	3	2	3	3	3		2.00	0.00	1.40	
VC0967-5R/Y	2-3	1	2	1			2.90	0.60	2.70	
VC1002-3W/Y	2-3	2	3	4			3.00		1.00	
CO94035-15RU	4	2	3	3	3		2.00	1.00	1.10	

Clone	BRR Rating Foliar	Tuber	PLRV	NIFS PLRV	PVY	Powdery Scab	*Fusarium*	*Alternaria*	*Erwinia*	
WNC230-14RU	3	1	0	1	3		NA	NA	NA	
Ute Russet	3	2	2	4	3		NA	NA	NA	
Centennial Russet	2	2	3	2	3		NA	NA	NA	
Russet Burbank	5	3	3	5	3		NA	NA	NA	
Sangre	4	3	3	2	3		2.24	0.08	2.70	
Russet Norkotah	5	4	3	5	3		2.40	0.12	1.94	
Russet Nugget	3	2	3	4	3		3.88	0.15	2.09	

BRR foliar rating 1-5 with 1 = no symptoms; 2 = mild symptoms which appear late, acceptable ?; 3 to 5 = acceptable symptoms with 5 best.

BRR tuber rating 1-5 with 1 = no symptoms and 5 = high % of tubers with good rot symptoms.

PLRV rating 0-3 with 0 = no symptoms observed and 3 = good typical symptoms.

NIFS rating 1-5 with 1 = very low risk assessment, 2 = low, 3 = medium, 4 = high and 5 = very high.

PVY rating 0-3 with 0 = no symptoms observed and 3 = good typical symptoms.

Powdery scab rating is a severity index (% tubers affected out of 40 x severity index of 1-3 = 80.0 highest susceptibility)

by root galling rating 1-4 with 1 = no galls and 4 = extensive galling. An example of a reading = 18.2/2.3 for severity index/root galling.

Fusarium rating 1-5 with 1 = no symptoms and 5 = 100% tuber loss; Grade loss at 3.00.

Alternaria rating 0-5 with 0 = no symptoms and 5 = 100% tuber loss; Grade loss at 4.00.

Erwinia rating 1-5 with 1 = no symptoms and 5 = 100% tuber loss; Grade loss at 3.00.

Table 6. Clonal Evaluation for Storage Rot			
Fusarium			
Inoculation	11/26/2002	10/30/2003	
Reading	12/24/2002	12/17/2003	
Clone	Avg Score	Avg Score	2 Yr. Avg
AC93026-9RU	3.00	3.10	3.05
CO93001-11RU	2.50	2.20	2.35
CO93016-3RU	1.90	3.10	2.50
CO93037-6RU	2.80	3.40	3.10
CO94019-1R	3.00	3.10	3.05
CO94035-15RU	2.00	2.90	2.45
CO94084-12RU	2.90	2.50	2.70
CO94165-3P/P	2.80	3.30	3.05
CO94183-1R/R	2.70	3.10	2.90
VC0967-2R/Y	2.00	2.60	2.30
VC0967-5R/Y	2.90	2.60	2.75
VC1002-3W/Y	3.00	3.30	3.15
AC94296-5W		3.10	
AC95405-2RU		3.20	
CO95007-1RU		3.40	
CO95051-7W		3.30	
CO95070-7W		2.80	
CO95086-8RU		3.10	
CO95172-3RU		3.50	
VC1009-1W/Y		3.40	
VC1015-1R/Y		2.00	
VC1015-7R/Y		3.70	
VC1075-1R		2.20	
Sangre 10	2.00	2.30	2.15
Rus. Norkotah	2.00	2.30	2.15
Rus. Nugget	3.50	4.80	4.15

1 = No symptoms, 2 = Localized damage
3 = <50% tuber damage, 4 = >50% tuber damage,
5 = 100% tuber damage. Grade loss occurs at 3.00.

Table 7. Clonal Evaluation for Storage Rot			
Erwinia			
Inoculation	11/25/2002	10/30/2003	
Reading	12/24/2002	12/17/2003	
Clone	Avg Score	Avg Score	2 Yr. Avg
AC93026-9RU	1.40	1.80	1.60
CO93001-11RU	1.10	1.60	1.35
CO93016-3RU	2.30	2.00	2.15
CO93037-6RU	2.00	1.90	1.95
CO94019-1R	1.00	2.10	1.55
CO94035-15RU	1.10	1.80	1.45
CO94084-12RU	1.40	1.90	1.65
CO94165-3P/P	1.10	1.90	1.50
CO94183-1R/R	2.90	2.10	2.50
VC0967-2R/Y	1.40	2.30	1.85
VC0967-5R/Y	2.70	2.60	2.65
VC1002-3W/Y	1.00	1.80	1.40
AC94296-5W		2.00	
AC95405-2RU		1.70	
CO95007-1RU		2.20	
CO95051-7W		1.70	
CO95070-7W		1.60	
CO95086-8RU		2.10	
CO95172-3RU		1.90	
VC1009-1W/Y		1.90	
VC1015-1R/Y		2.40	
VC1015-7R/Y		2.00	
VC1075-1R		2.50	
Sangre 10	2.80	1.60	2.20
Rus. Norkotah	1.60	1.90	1.75
Rus. Nugget	1.70	1.50	1.60
1 = No symptoms, 2 = Localized damage			
3 = <50% tuber damage, 4 = >50% tuber damage,			
5 = 100% tuber damage. Grade loss occurs at 3.00.			

Certified Seed Evaluation

Certified Seed versus Common Seed - The San Luis Valley Dilemma
by Robert Davidson

San Luis Valley potato producers routinely deal with the issue of whether to buy certified seed potatoes or replant their own common seed. Since Colorado currently does not have an "all certified seed law", growers are forced to make a choice. The choice you make can make a big difference in your pocket book (profit margins)! Two concerns have been repeatedly voiced by commercial growers: a) My own common seed does not have enough disease to justify the added expense of purchasing certified seed, and b) The first year of planting certified seed, the yield and quality are not comparable to my own common seed replant These two concerns are at the crux of a project begun in 2003.

The Colorado Certified Potato Growers' Association, Inc. (CCPGA) asked local seed growers to donate up to 100 cwt of their saleable seed (Generation 4 or 5) to interested commercial growers for comparison purposes. The commercial grower participants were asked to plant the certified seed next to their own "year out" common seed of the same cultivar in order to handle the two lots in a similar fashion during the growing season. The grower volunteers also allowed CCPGA representatives to inspect both the certified and common seed sources for diseases during the growing season and to spot harvest both treatments to obtain yield and quality information. Three commercial growers agreed to these conditions and participated in this project. Three different certified seed producers donated Russet Norkotah and two Russet Norkotah Selections. Dr. Robert Davidson, CSU Extension Seed Potato Specialist and Mr. Preston Stanley, CCPGA Manager agreed to inspect and conduct the spot harvests for the CCPGA. Three plots (replications) of one thousand plants each was established in each of the seed sources representative of the lots. Inspections were conducted twice during the season. Results were listed as an average of the three replications.

The results were quite interesting and definitely refuted the two concerns listed above. Disease levels in the two seed sources are listed in Table 1. The difference in disease was quite apparent with the year out common seed typically showing higher levels of mosaic (PVY) and leafroll and, in two cases, bacterial ring rot. While stands were comparable between the two sources, the year out seed demonstrated a higher percentage of weak plants or plants displaying toxic seed piece decay.

At harvest, only producers A and B were compared. The yield and grade of the harvest plots are shown in Table 2. The certified seed source was equal to (in the case of grower A) or significantly better than (in the case of grower B) regarding yield and grade. As expected, higher levels of mosaic reduced overall tuber numbers, pushed more of the production into the under 4 oz category, and reduced overall marketable yield. Imagine the loss which might be experienced due to levels of disease in the 25-50% range, common in commercial Russet Norkotah fields in the San Luis Valley.

Growers have a choice to make when looking at which seed to replant . . . Make the right choice for your farm!

This project will be repeated in 2004. Growers interested in participating should contact Mr. Preston Stanley during the 2003/04 SLV Potato/Grain Conference in February.

Table 1. Inspection comparisons between Certified (CERT) and Common (COM) seed sources.

Producer	A	B	C
Stand - CERT	88	95	92
- COM	88	88	93
% LR - CERT	0.00	0.00	0.20
- COM	0.17	0.47	3.07
% MO - CERT	0.17	1.27	1.80
- COM	5.87	3.13	3.50
BRR- CERT	(-)	(-)	(-)
- COM	(-)	(+)	(+)
Other - CERT	0.03 CA	---	0.07 BL
- COM	0.03 HW	---	0.03 HW

CA = Calico, HW = Haywire, BL = Blackleg

Table 2. Yield and grade comparisons between Certified (CERT) and Common (COM) seed sources from three replications of 25' of row.

Grade	< 4 oz	4-10 oz	> 10 oz	Total
Producer A				
Tuber # -CERT	35.7	108.7	17.0	161.4
- COM	42.7	114.0	14.0	170.7
Tuber weight - CERT	5.4	51.7	17.0	74.1
- COM	6.1	52.1	15.1	73.3
Producer B				
Tuber # -CERT	73.0	123.0	15.3	211.3
- COM	38.0	94.0	14.7	146.7
Tuber weight - CERT	12.3	51.7	12.1	76.1
- COM	10.7	43.6	13.0	67.3

Tuber weight recorded in pounds.
Projected yield for A = 456 cwt/a vs. 451 cwt/a; B = 468 cwt/a vs. 414 cwt/a