

POTATO (*Solanum tuberosum* 'Russet Burbank')
Blackleg and bacterial soft rot; *Erwinia carotovora*.
subsp. *atroseptica*, *E. carotovora* subsp. *carotovora*
Rhizoctonia canker (black scurf); *Rhizoctonia solani*
Silver scurf; *Helminthosporium solani*

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Evaluation of the efficacy of seedpiece or in-furrow fungicide treatment for potato disease control - Spooner, 2004

A field trial was conducted at the Spooner Agricultural Research Station, in northwestern WI to evaluate the effect of selected treatments applied to seed or in-furrow at planting on *Rhizoctonia* stem canker and on plant stand, vigor and yield. US#1 Russet Burbank and Snowden tubers were mechanically cut at the Hancock Agricultural Research Station, Hancock, WI, into approximately 2 oz seedpieces and treated. Potatoes were cut and treated 5 May and were then transported to Spooner for planting. The experiment was designed as a randomized complete block with four replications, each plot consisting of two 25-ft-long rows spaced 36 in. apart with tubers 12 in. apart in the row. Seedpiece treatments were applied to samples of freshly cut potatoes in large plastic bags (40 lb R. Burbank or 45 lb Snowden). The bags were rolled to distribute the chemicals uniformly on the seedpieces. Furrows were opened and seedpieces were hand-planted. In-furrow treatments were applied in an 8-in.-wide band over the seedpieces in the open furrow at a rate equivalent to 4.0 gal/1000 row ft at 40 psi, using a hand-held boom with a single HC-2 70° hollow disc cone nozzle. All plots were inoculated with *Rhizoctonia solani* inoculum grown in a sand cornmeal medium. Approximately 4cc of inoculum was sprinkled over each seedpiece after placement in the furrow. After inoculation and treatment, all seedpieces were mechanically covered using hilling disks. The soil type was Cress sandy loam, pH 6.5. At planting, air temperature was 58 F with relative humidity of 46% and mostly sunny skies, the soil was moderately moist with a temperature of 55 F, and the seedpiece temperature was 62 F. Fertilizer included: 6-24-24, 550 lb/A banded in the row at planting, and sidedress applications on 27 May (46-0-0, 250 lb/A) and 18 Jun (21-0-0-24S, 250 lb/A). Insects were controlled with Admire 2F incorporated with the fertilizer at planting (16 fl oz/500 lb). Dual II Magnum (1.5 pt/A) + Sencor 4 (1.0 pt/A) was applied 28 May for weed control. All treatments received the same foliar fungicide program to control early blight: Bravo WeatherStick Zn (1 pt/A) + Quadris (6.2 fl oz/A) 9 and 22 Jul, 6 Aug; Bravo WeatherStick Zn (1.5 pt/A) 15 and 30 Jul, 13 Aug; Penncozeb (2 lb/A) 20 Aug, 7 Sep; Kocide 101 (2.5 lb/A) 27 Aug. The number of emerged plants was counted for each plot 4, 10, 16 and 22 Jun. On 29 Jun the height of each plant in one row of each plot was recorded, and 5 ft from each row (10 ft/plot) was dug by hand. Plants were rated for symptoms of *Rhizoctonia* on stems, stolons and tubers, black leg, and seedpiece decay. The number of stems and stolons per plant, fresh weight of leaves and stems, and weight and number of daughter tubers were recorded. The remaining portion of each plot (a total of 40 ft of row) was left to mature and provide yield data. Vines were killed with applications of Reglone (1.2 pt/A) 3 Sep, and plots were machine harvested and graded 27-28 Sep. Tubers were graded into US#1, undersize, and cull categories. A 30-40 lb sample of US#1 tubers from each plot was taken to the Hancock Agricultural Research Station and sorted using an optical size grader into six categories: < 4 oz, 4-6 oz, 6-10 oz, 10-13 oz, 13-16 oz and >16 oz. This sample was placed in storage at Hancock and will be evaluated for tuber decay, silver scurf, and black scurf and general quality after several months in storage. Rainfall measured during the growing season (in.) was 7-31 May (6.3); Jun (2.25); Jul (4.34); Aug (3.48); and 1-27 Sep (3.77). An additional 2.9 in. of irrigation was applied to the field in six applications.

Cool temperatures and wet soil conditions normally favor the development of *Rhizoctonia* infection of stems, stolons and tubers. In these trials, we observed up to 24.7% stem infection and up to 31.7% tuber infection. However, treatment with fungicides that are normally effective for control of this disease did not significantly reduce disease severity on stems, stolons or tubers. Likewise, seed or in-furrow treatment did not affect total yield, yield of US#1 tubers or crop value for either cultivar. Treatment did not affect plant emergence. The lowest level of seedpiece decay for Snowden was observed on seedpieces treated with Maxim 4 FS and Amistar 80 WG in-furrow. The number of Snowden stems was lowest where Moncoat MZ was used to treat the seedpieces at planting, but there was no treatment effect on Russet Burbank. Plant growth was uniform for all treatments and there was no evidence of treatment phytotoxicity in this trial.

Table 1. Effect of treatment at planting (seedpiece or in-furrow) on field emergence, stand and height of Russet Burbank and Snowden potatoes.

Trt no.	Treatment chemicals	Rate formulated product	Application	Percentage of plants emerged on: ¹				Avg. days to emergence ²	Height 29 Jun (cm) ³	
				4 Jun	10 Jun	16 Jun	22 Jun		Per plant	Per hill
Russet Burbank										
1	Untreated			77.5	90.5	94.0	92.5	30.8	41.7	40.0
2	Moncut 70 DF	0.79 oz prod/1000 rft	Appl. In-furrow	75.5	91.5	93.5	94.5	31.4	38.4	37.3
3	Moncut 4 SC	1.10 fl oz prod/1000 rft	Appl. In-furrow	58.0	84.5	90.0	90.5	32.1	37.8	36.8
4	Maxim MZ	0.5 lb/cwt	Seedpiece treatment	56.5	80.0	85.0	87.5	31.8	33.6	30.9
5	Potato Seed Treater 6% Dust	0.75 lb /cwt	Seedpiece treatment	69.0	88.0	93.5	94.0	31.5	38.0	34.3
<i>P</i> > <i>F</i> ⁴				0.29	0.53	0.46	0.43	0.37	0.05	0.05
LSD ⁴				NS	NS	NS	NS	NS	4.8	5.9
Snowden										
6	Untreated			71.0	91.0	92.0	93.0	31.1	30.0	27.5
7	Maxim 4 FS	0.04 fl oz/cwt	Seedpiece treatment	71.5	96.0	97.5	98.5	31.1	28.2	27.7
8	Maxim 4 FS Amistar 80 WG	0.04 fl oz/cwt 0.134 oz prod/1000 rft	Seedpiece treatment Appl. In-furrow	54.0	91.0	92.5	95.5	32.3	29.9	27.5
9	Maxim 4 FS Quadris 2.08 SC	0.04 fl oz/cwt 0.41 fl oz prod/1000 rft	Seedpiece treatment Appl. In-furrow	62.0	96.5	98.0	96.5	31.8	33.6	33.0
10	Moncoat MZ	12 oz prod/cwt	Seedpiece treatment	60.0	85.0	87.5	86.0	32.2	25.2	20.3
11	Potato Sd Trt 6% Amistar 80 WG	0.134 oz prod/1000 rft	Seedpiece treatment Appl. In-furrow	69.5	90.0	90.0	88.0	31.6	26.3	22.0
12	Potato Sd Trt 6% Headline 2.09 SC	0.41 fl oz prod/1000 rft	Seedpiece treatment Appl. In-furrow	67.5	92.0	93.5	91.5	31.5	28.7	26.6
<i>P</i> > <i>F</i> ⁴				0.71	0.38	0.30	0.04	0.85	0.20	0.03
LSD ⁴				NS	NS	NS	8.1	NS	NS	7.0

1. Based on 50 seedpieces planted/50 ft of row.

2. The average number of days to emergence was calculated for all plants that grew.

3. Avg. height per plant includes only those plants that grew. To calculate avg. height per hill, a height of 0 is included in the average for hills where no plant grew.

4. Analysis of variance was performed on data, and Fisher's protected least significant difference (LSD) was calculated (alpha=0.05). NS = not significant at *P* = 0.10.

Table 2. Effect of treatment at planting (seedpiece or in-furrow) on decay, black leg and Rhizoctonia symptoms and growth (Treatments as in Table 1).

Trt no.	29 Jun evaluation of 10 hills per replication											
	% decay ¹	% of plants with black leg	% of total stems with black leg	Rhizoctonia severity (%) ²			Avg. no. / plant		Avg. fresh weight per hill (g) ³		Avg. no. daughter tubers/ hill	
				Stems	Stolons	Tubers	Stems	Stolons	Leaves + stems	Daughter tubers		
Russet Burbank												
1	33.3	2.5	1.4	10.6	6.2	30.2	4.3	14.3	377.1	112.0	11.0	
2	33.7	12.5	4.4	22.9	4.8	26.0	4.5	11.0	309.0	83.6	8.7	
3	39.6	7.5	3.6	24.1	8.1	26.9	3.6	12.5	326.0	99.9	10.1	
4	47.6	5.0	2.7	24.7	8.3	31.7	3.9	13.2	271.6	57.7	7.3	
5	52.0	5.0	1.9	17.3	6.5	23.3	4.0	15.8	352.7	109.8	11.7	
<i>P>F</i> ⁴	0.25	0.52	0.78	0.30	0.72	0.76	0.23	0.36	0.11	0.13	0.21	
LSD ⁴	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
Snowden												
6	49.3	5.0	1.1	19.1	8.7	20.6	5.4	14.7	284.6	128.1	8.5	
7	25.9	10.0	2.8	13.4	7.2	17.6	6.6	15.7	343.6	152.3	11.0	
8	34.8	15.0	3.6	17.2	4.9	18.7	6.1	15.6	282.4	111.2	9.4	
9	28.0	5.0	1.9	14.7	6.3	15.8	5.0	14.3	332.3	132.0	9.2	
10	77.7	7.5	2.8	18.7	13.1	11.3	3.8	10.3	224.0	102.1	6.6	
11	64.8	5.0	1.1	15.2	6.2	16.4	5.4	18.5	323.8	134.8	9.6	
12	64.2	17.5	6.8	13.8	7.2	19.5	5.6	15.9	314.7	138.5	10.7	
<i>P>F</i> ⁴	0.02	0.66	0.67	0.95	0.73	0.40	0.06	0.09	0.20	0.43	0.20	
LSD ⁴	32.6	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	

1. Severity of seedpiece decay rated on a Horsfall-Barratt scale of 0 (no decay) to 11 (100% decay). Ratings were converted to percentages.
2. Severity rated on a Horsfall-Barratt scale of 0 (no symptoms) to 11 (death of all stems/stolons due to Rhizoctonia infection or complete coverage of tuber surface with Rhizoctonia symptoms). Ratings were converted to percentages.
3. All daughter tubers > 0.75-in.-diam were removed and weighed. Remains of seedpieces were also removed. Fresh weight was taken of all remaining plant tissue. Calculations are based on 10 hills per plot. If no plant emerged for a hill, a value of 0 for that plant was included in the calculation.
4. Analysis of variance was performed on data, and Fisher's protected least significant difference (LSD) was calculated (alpha=0.05). NS = not significant at $P = 0.05$.

Table 3. Effect of treatment at planting (seedpiece or in-furrow) on yield and value (Treatments as in Table 1).

Trt no.	Yield								No. of rotted tubers ²	Size grades of US#1 potatoes - %							Gross value of yield (\$/A)	
	Total cwt/A	US#1		Undersize ¹		Culls		< 4 oz		4-6 oz	6-10 oz	10-13 oz	6-13 oz	13-16 oz	>16 oz	Fresh ³	Proc-essing ⁴	
		cwt/A	%	cwt/A	%	cwt/A	%											
Russet Burbank																		
1	513.4	308.6	60.1	168.9	33.0	35.8	6.9	6.3	14.0	47.0	31.4	3.4	34.7	2.3	2.0	2301	1771	
2	507.6	291.9	57.4	158.6	31.4	57.1	11.1	13.3	13.9	43.9	31.2	8.2	39.4	0.9	1.9	2229	1731	
3	495.2	314.6	63.6	145.2	29.1	35.4	7.3	8.5	10.1	36.4	36.2	12.3	48.5	2.3	2.7	2510	1841	
4	482.6	294.9	61.0	142.3	29.3	45.4	9.7	9.5	8.0	36.2	36.6	11.7	48.3	4.5	3.0	2429	1754	
5	509.7	331.3	65.1	138.4	27.1	40.0	7.8	3.8	10.8	39.4	39.4	5.5	44.9	4.1	0.7	2556	1922	
<i>P</i> > <i>F</i> ⁵	0.70	0.32	0.17	0.61	0.67	0.34	0.30	0.29	0.36	0.56	0.63	0.47	0.57	0.68	0.87	0.49	0.58	
LSD ⁵	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	

Trt no.	Yield								No. of rotted tubers ²	Size grades of US#1 potatoes - %							Gross chipping value (\$/A) ⁶
	Total cwt/A	US#1		Undersize ¹		Culls		< 4 oz		4-6 oz	6-10 oz	10-13 oz	6-13 oz	13-16 oz	>16 oz		
		cwt/A	%	cwt/A	%	cwt/A	%										
Snowden																	
6	408.2	308.0	74.3	85.7	22.5	14.6	3.2	0.0	30.6	39.9	24.6	4.3	28.8	0.7	0.0		2072
7	460.4	359.2	78.0	79.0	17.2	22.2	4.8	0.5	31.1	38.7	24.7	4.8	29.5	0.6	0.0		2369
8	420.7	319.1	75.6	85.4	20.7	16.2	3.8	0.5	36.5	36.0	21.5	4.7	26.2	0.0	1.3		2140
9	459.1	346.4	75.4	95.1	20.8	17.6	3.8	0.8	27.1	39.4	29.1	3.1	32.2	1.3	0.0		2330
10	426.7	339.0	79.4	60.3	14.1	27.4	6.5	0.8	24.3	34.3	30.5	5.5	36.0	4.6	0.8		2212
11	439.7	355.0	80.7	53.6	12.2	31.0	7.1	1.0	22.7	24.3	32.5	9.9	42.4	6.1	4.5		2295
12	430.3	354.0	82.3	60.8	14.1	15.5	3.6	0.5	20.8	35.2	31.1	7.9	38.9	1.2	3.9		2265
<i>P</i> > <i>F</i> ⁵	0.63	0.57	0.07	< 0.01	0.03	0.12	0.08	0.77	0.12	0.02	0.34	0.61	0.28	0.04	0.07		0.65
LSD ⁵	NS	NS	NS	22.0	6.7	NS	NS	NS	NS	8.8	NS	NS	NS	4.1	NS		NS

1 Undersize indicates potatoes < 2" in diameter.

2 The average number of tubers per treatment with any kind of rot observed during grading.

3 Typical 2004 fresh market pricing: 4-6 oz \$6.50/cwt, 6-10 oz \$8.00/cwt, 10-13 oz \$10.00/cwt, >13 oz \$12.50/cwt, < 4 oz and culls \$1.25/cwt.

4 Typical 2004 processing contract pricing:

- Base price is \$5.45/cwt for 69% US#1 (4 oz minimum) with specific gravity of 1.078.
- There is an increase or decrease of \$.01 per hundred weight for each 1% above or below 69% US No1 2 inch or 4 oz minimum to a maximum of 85% or a minimum of 53%. (There is no additional incentive for % US No. 1 > 85% and there is no additional penalty for % US No. 1 < 53%).
- A premium is paid for > 17% 10 oz or greater. For each 1% above 17% (to a maximum of 36%) > 10 oz the price increases \$0.01/cwt. The price decreases \$0.01/cwt for each 1% below 17%.
- There is also an increase/decrease of (\$.001) per hundred weight for each 1% above/below 35% >7 oz (to a maximum of 52% >7 oz). There is no further penalty if % > 7 oz is less than 18%.
- There is a payment of \$2.00/cwt for processing culls (up to a maximum of 15% of the total by weight).
- Additional contract adjustments are made for percent bruise free and percent soft rot. We do not have data to calculate these adjustments.

5 Analysis of variance was performed on data, and Fisher's protected least significant difference (LSD) was calculated (alpha=0.05). NS = not significant at *P* = 0.05.

6 Typical chipping price of \$5.75/cwt for a size range of 1 7/8 to 4" (estimated to be all US#1 potatoes from our trial); process grade for chip stock (undersize + culls) = \$3.00/cwt.