EVALUATION OF STRATEGIES FOR IMPROVED POTATO DISEASE MANAGEMENT

W. R. Stevenson[1/] and R. V. James[2/]

This past growing season was certainly one to remember in terms of weather and the disease problems associated with wet cool weather. We were fortunate to have field trials in several areas of the state where we were able to collect some excellent data on disease control measures. Although we did not have late blight in any of our trials, we still had ample early blight, scab and seedpiece decay to provide significant pressure on the treatments we were evaluating. The pages that follow contain brief summaries of each of our potato trials and the Appendices A through I contain more specific information on each trial. A few years ago at your request, we initiated an economic evaluation of treatments in some of our trials. The economic evaluation gives us an additional criterion for judging the success or failure of treatments in controlling diseases. We hope that you will take the time to review the data contained in this report and that if you have questions, you will call or write for clarification.

Summary of Field Trials that Focus on Improved Potato Disease Management

a) Evaluation of potato seedpiece treatments - Antigo:

Twenty one chemical and cultural treatments were evaluated on the Atlantic cultivar at the Langlade County Research Facility. Seed treatment significantly affected emergence and the vigor of emerged plants. Emergence and plant vigor were highest when seedpieces were cut and healed for three or more days before planting. Chemical treatment of freshly cut seedpieces did not improve emergence or plant vigor when compared to freshly cut seedpieces with no chemical treatment. The least amount of seedpiece decay in the field was observed in plots planted with seedpieces cut and healed for 1,3, 8 and 11 days left untreated with chemicals. Treatment of seedpieces with one of several fungicides and allowing the treated seedpieces to heal for 3 days before planting or planting the day of treatment increased the amount of seedpiece decay observed in the field. Bruising the seedpieces tended to increase seedpiece decay. Total yields were generally lowest in plots where freshly cut seedpieces were bruised and inoculated before planting. Yields tended to be higher when seedpieces were cut and healed before planting. See further details of this research in Appendix A.

1/ Vaughan-Bascom Professor, Department of Plant Pathology, University of Wisconsin, Madison, WI 53706

2/ Research Specialist, Department of Plant Pathology, University of Wisconsin, Madison, WI 53706

b) Evaluation of potato seedpiece treatments - Hancock:

A total of 49 chemical and cultural treatments were evaluated in this large field trial involving the potato cultivars Atlantic (11 treatments), Norland (8 treatments) and Russet Burbank (30 treatments). On the **Atlantic** cultivar, highest emergence and plant vigor was observed with seed that was cut and healed 2-11 days before planting. Inoculation of seedpieces at the time of cutting and holding the inoculated seedpieces in an environment favorable for wound healing reduced the overall impact of the *Erwinia* pathogen on emergence and plant vigor. Planting freshly cut seed significantly reduced crop emergence and plant vigor, but inoculation of freshly cut seed at planting with *Erwinia* or *Fusarium* had an even greater impact on emergence and plant vigor. Inoculation of freshly cut Atlantic seed with *Fusarium* reduced emergence to 28% in contrast to 88% emergence for seed healed for 2 days before planting. Plants in plots grown from healed seed generally produced a more uniform size distribution of tubers than did plants in plots planted with freshly cut seedpieces. Yields were significantly higher in plots planted with healed seedpieces. Precutting and healing for 2 and 4 days before planting without chemical application appeared to be the optimum treatment for this cultivar. Using the fresh cut/no chemical treatment for comparison, many of the cut and healed treatments contributed to a significant improvement in crop economics. **Dark Red Norland** emergence and plant vigor was highest in plots planted with seed that was cut and healed 2-7 days before planting. Application of Captan to seed before healing or to freshly cut seed just before planting did not improve emergence or plant vigor. Total yields and yields of US#1A tubers were also highest in plots planted with healed seedpieces. The optimum treatments for this cultivar included precutting and healing the seedpieces for 2-7 days before planting. In comparison with the fresh cut/no chemical treatment, the only treatment that consistently increased crop value was the treatment consisting of applying fungicide to freshly cut seed and then allowing it to heal for 7 days before planting. Inoculation of cut seed with *Erwinia* significantly reduced the market value regardless of whether the seed was healed or fresh cut at planting. Healing fresh cut **Russet Burbank** seed for 2-11 days before planting significantly improved plant emergence and vigor over plots planted with freshly cut seed. Inoculation of cut seed with *Erwinia* and *Fusarium* significantly reduced emergence and plant vigor. None of the chemical treatments applied to freshly cut seed at the time of planting improved crop emergence or vigor above the untreated check. Chemical treatment of cut seedpieces did not significantly reduce seedpiece decay. The fungicide Maxim continued to provide excellent control of Rhizoctonia and appears to be a promising new product. Inoculation of freshly cut seed with *Erwinia* and *Fusarium* just before planting resulted in very poor emergence and yield. Precutting and healing for 2 and 7 days before planting without chemical application appeared to be the optimum treatment for this cultivar. Most treatments consisting of healing cut seedtubers prior to planting improved crop value when compared with the fresh cut/no chemical treatment. See further details of this research in Appendix B.

c) Evaluation of potato seedpiece treatments - Palmyra:

Twelve chemical and cultural treatments were evaluated on Norland seed potatoes grown in muck soil. Plant emergence and plant vigor were highest in plots planted with

seedpieces cut and healed for 8 and 17 days before planting and in plots planted with untreated freshly cut seed. Seedpiece decay was variable between treatments and no clear-cut conclusions were drawn from the data. Seedpiece treatments had no significant affect on yields at this site. See further details of this research in Appendix C.

d) Evaluation of potato seedpiece treatments - Spooner:

Conditions during the two weeks after planting were favorable for the healing of cut seed and rapid plant emergence and were not conducive to the development of seedpiece decay. Final emergence and plant vigor for all treatments was similar. However, bruising freshly cut seed just before planting slowed early emergence of those treatments. Seedpiece decay was greatest on fresh cut seedpieces left untreated with fungicide dust and untreated seedpieces cut for 1 and 3 days before planting. Highest yields were observed in plots planted with freshly cut seed and seed that was healed for 4 days before planting. See further details of this research in Appendix D.

e) Evaluation of biologicals for potato early blight control - Hancock:

Potential biocontrols were compared with standard fungicide treatments for efficacy in controlling early blight. The severity of early blight in untreated control plots exceeded 76% foliage infection by the August 11 rating. Treatment with the Penncozeb and Bravo Zn fungicides provided reasonable control of early blight until mid-August. The application of *P. cepacia* at 0.1 strength each week or at full strength twice per week and the weekly application of a compost extract controlled early blight as well as the standard fungicide treatments on the August 2 rating. While differences in the relative AUDPC's and yields between treatments were not significant at the $P = 0.05$ level, there were interesting trends in the data. Relatively low AUDPC's and high yields in plots treated with *P. cepacia* at 0.1 strength each week or at full strength twice per week or treated weekly with the compost extract provide incentive to repeat this trial during 1994. See further details of this research in Appendix E.

f) Evaluation of disease resistance in potato cultivars and breeding lines - Hancock:

A total of 60 potato cultivars and breeding selections were evaluated for field resistance to early blight at the Hancock Agricultural Research Station. Symptoms of early blight were first observed during the first week of July, and by the first week of August, 76% of the foliage on the most susceptible cultivar, Norland, exhibited typical early blight symptoms. Disease developed more slowly on W84-75R than on Norland resulting in a significantly lower AUDPC value for this breeding line in the early maturity group. Atlantic showed a significantly lower AUDPC than any other entry in the early-medium maturity class. NY95 and Snowden had AUDPC values significantly less than many other cultivars or breeding lines and produced good yields. In the medium-to-late maturity class, C75, a pentaploid resulting from the cross of the somatic hybrid A206 x Katahdin showed outstanding early blight tolerance. Several of the lines derived from crosses of similar material to Katahdin and Atlantic (C75- and C31- series) had AUDPC values significantly lower than Russet Burbank with good yields with C75-5-297 producing 17 lb/5 ft of row. Several cultivars and breeding lines in the late maturity group (CT 88-2, 324-1, 342-2, T450, Ontario, 324-2, 30-6R and FL 1815) also had

AUDPC values significantly lower than Russet Burbank. Of these, CT88-2 and Ontario had the highest yield. Total yields were highest for FL 1533, FL 1291, C75-5-297, AC 80545, AF 1060-2, CKatahdin, C75-5-277, Ontario and Russet Burbank with yield equivalent to 350 cwt/A or greater. FL 1291, St. Johns, AC 80545, CT 60-1, AF 1060-2, CT 133-5, W 971, FL 1815 and FL 1625 all had over 80% of the yield in the US#1A size category. See further details of this research in Appendix F.

g) Evaluation of fungicides and biologicals for control of common scab on potato - Antigo:

Treatment of four potato cultivars with a range of chemical and biological materials had little effect on seedpiece decay, plant emergence and plant vigor. Cultivars differed in their susceptibility to scab as evidenced by differences in the lesion area index and the lesion type index between cultivars. LaChipper appeared to be more susceptible than Snowden, FL1533 and FL1625. The most effective treatments on LaChipper for reducing the scab lesion area index included Potato Seed Treater MZ as a seed treatment and EXP60135A 10G in the furrow at planting. Application of *Streptomyces scabies* strains SS-2 and 93 appeared to increase scab severity on the LaChipper cultivar. Potato Seed Treater MZ, EXP60135A 10G in the furrow at planting, Maxim 0.5% DP-A and Fluazinam 2 pt/acre as a furrow drench at planting and Fluazinam applied as a foliar spray significantly reduced scab level on the Snowden cultivar. *S. scabies* strains also provided a modest level of scab control on this cultivar. The *S. scabies* strains reduced the scab lesion area index when applied to FL1533 and FL1625, but application of the strains to these cultivars had no effect on the scab lesion type index. Highest yields of LaChipper and Snowden were generally associated with the most effective chemical treatments. Treatment of the FL1533 and FL1625 did not affect total yield or yield of US#1A tubers. Treatment of these cultivars with the *S. scabies* strains tended to increase the yield of undersize tubers. Application of *S. scabies* strains to three of the four cultivars provided some control of common scab. Chemical treatments generally provided better control than the biological materials. The potential for improved control by combining treatments, e.g. seedpiece treatment with Potato Seed Treater MZ and furrow application of EXP60135A, or *S. scabies* combined with a fungicide seed treatment, should be explored in future experiments. See further details of this research in Appendix G.

h) Evaluation of potato early blight control with fungicides - Hancock:

Twenty eight treatments were evaluated for efficacy in controlling early blight on the Russet Burbank potato cultivar. Treatments that included EXP10386B, EXP10385B, Bravo 720 (1.5 pt/acre), Bravo Zn (1.5 and 2.13 pt/acre), Bravo 825 and ASC 66897 provided the best overall control. Yields were significantly affected by plot treatment. Lowest yields were observed in plots with the poorest early blight control. Differences in total yield between the highest yielding plots (370 cwt/acre) and the untreated control (298.7) represent a 23.9% increase in yield. Treatment with some fungicides significantly increased yield of US#1A tubers, but did not affect the yields of undersize and culls. Higher numbers of tubers in the 6-10 oz size category for some treatments are reflected in large positive net treatment values. Using a fresh market pricing scheme to compare treatment values, several treatments exceeded $500 per acre in value. The

application of Zn in combination with fungicide sprays significantly increased the level of Zn in foliage samples collected in late July and again in late August. Overall control of early blight and final yields appeared to be related more to fungicide efficacy rather than the levels of Zn in the foliage. Highest levels of foliage Zn were not associated with the best overall disease control and yield while lowest levels of foliage Zn were not associated with the worst overall disease control and lowest yields. See further details of this research in Appendix H.

i) Effect of Ridomil application in the field on severity of potato storage decay - Two sites:

Field trials were established to evaluate the effect of Ridomil fungicide, applied to the potato foliage during the growing season, on decay caused by *Pythium* and *Phytophthora* species during tuber storage. Sampling sites in commercial fields were positioned to include the compacted drive rows used for all spray applications (compacted, +/- Ridomil) and rows located away from the drive rows (non-compacted, +/- Ridomil). Tubers were hand harvested at maturity and samples were placed in the storage facility at the Ore-Ida processing facility at Plover. Additional samples were placed directly in the departmental mist chamber facility for evaluation of decay potential at harvest. Tubers incubated in the mist chamber for four days were evaluated for decay and no differences between treatments were observed. The tuber samples being stored at Ore-Ida were evaluated on January 4, 1994. Severity of decay on these stored tubers was very low and significant differences between Ridomil treated/not treated and compacted/non-compacted soils were not observed. See further details of this research in Appendix I.

Listing of Appendices:

Appendix A - Evaluation of Potato Seedpiece Treatments - Antigo, 1993

Appendix B - Evaluation of Potato Seedpiece Treatments - Hancock, 1993

Appendix C - Evaluation of Potato Seedpiece Treatments - Palmyra, 1993

Appendix D - Evaluation of Potato Seedpiece Treatments - Spooner, 1993

Appendix E - Evaluation of Biological Control of Early Blight - Hancock, 1993

Appendix F - Evaluation of Disease Resistance in Potato Cultivars and Breeding Selections - Hancock, 1993

Appendix G - Evaluation of Chemical and Biological Treatments to Control Common Scab - Antigo, 1993

Appendix H - Evaluation of Early Blight Control with Fungicides - Hancock, 1993

Appendix I - Effect of Ridomil Application in Grower Fields on Severity of Field and Storage Decay - 1993

APPENDIX A

Evaluation of Potato Seedpiece Treatments - Antigo, 1993

Field trials were established May 18 at the Langlade County Research Area, Antigo, WI to evaluate the effect of chemical and cultural treatment of potato seedpieces on seedpiece decay, emergence, stand, and yield. Tubers of cultivar Atlantic were mechanically cut by a commercial grower into approximately 2 oz seedpieces. For some treatments, tubers were cut 1, 3, 6, 8 or 11 days prior to planting and cut seedpieces were maintained in the grower's storage at 55° F and 90% relative humidity to allow healing to occur. Seedpieces for remaining treatments were fresh cut the morning of planting. Chemical treatments were applied to 36 lb seedpiece samples by shaking cut seedpieces in plastic bags with the chemical treatment until all seedpieces were uniformly coated. For treatments combining healing with chemical application, treatments were applied immediately after cutting so the chemical was present during the healing period. To test the effect of high populations of *Erwinia carotovora* pvar. *atroseptica* on the surface of tubers and the effects of severe bruising incurred through rough handling of seedpieces or tubers, seedpieces in some treatments were bruised and/or inoculated. To inoculate seedpieces, 250 ml of inoculum containing 10^7 colony forming units per ml was sprayed on 36 lb of cut seedpieces in a plastic garbage bag. To achieve severe bruising, the bag containing seedpieces was dropped 10 times from a height of 3 feet onto a concrete floor. Seedpieces were planted with an Underhaug assist-feed planter at a depth of approximately 3 inches. Conditions at planting were: Air temperature, 49°F; soil temperature, 52°F at the depth of seedpiece placement; relative humidity 62% and seedpiece temperature, 56° F.

The experiment consisted of four replications arranged in a randomized complete block design. Each plot contained two 25 foot rows spaced three feet apart with seedpieces planted 12 inches apart in the row. Soil type was an Antigo silt loam with pH 5.8. Plots were fertilized with 250 lb/A of 0-0-62 broadcast before planting, 1200 lb/A of 6-24-24 in the row at planting, and 60 lb/A of 33-0-0 as a prehill topdress application on June 28. Insects were controlled with a foliar spray of Asana XL at 0.4 pt/A on July 20. Weeds were controlled by pre-emergence application of Linex 50DF, 2 lb/A June 4. A standard foliar fungicide program for early and late blight control included: Bravo 90DG (1.0 lb/A - July 28, August 13, Sept. 1), and Manzate 200 DF (1.0 lb/A - July 20, Aug. 6; 2.0 lb/A - August 19, 25) . Vines were killed with application of Diquat H/A, 1.0 pt/A + Valent X-77 spreader 1.0 pt/100 gal. on August 25 and September 1. Total accumulation of rainfall and overhead sprinkler irrigation during the growing season (May 18 - September 15) was 14.6 inches.

A sample of seedpieces from each treatment was evaluated for seedpiece decay in our laboratory in Madison, WI. A total of forty seedpieces from each treatment (four replicates of 10 seedpieces) were placed in a mist chamber at 70°F and 100% RH. The mist kept seedpiece surfaces wet throughout the incubation period. Plastic canopies protected the seedpieces from dripping water and contamination from other samples. Decay severity was rated after 96 hours.

Emergence in the field was recorded for each plot 9 times between June 14 and July 14 and treatments were also rated on July 14 for overall plant vigor -- a combined evaluation of number and size of plants, and above-ground symptoms of black leg. Ten plants from each plot were hand harvested on July 14 and evaluated for number of stems per plant, average height, extent of seedpiece decay, symptoms of black leg and Rhizoctonia stem canker, daughter tuber development, and the formation of secondary tubers. The remaining portion of each plot was mechanically harvested September 8 and graded into US#1A, undersize, and cull categories.

Soil was at field moisture capacity at planting and soil temperature was 52° F. During the two weeks after planting an additional 1.2" of rain was received (distributed in several showers during the period) and soil temperature (4" below the surface) averaged 54-65° F, conditions generally considered favorable for seedpiece healing, emergence and early season plant development. Final emergence for many treatments exceeded 90%. Seed treatment significantly affected emergence and the vigor of emerged plants. Emergence and plant vigor were highest when seedpieces were cut and healed for three or more days before planting. Chemical treatment of freshly cut seedpieces did not improve emergence or plant vigor when compared to freshly cut seedpieces with no chemical treatment. Seed treatment also had a significant effect on seedpiece decay in the mist chamber and in the field. Cutting and healing the seed for one or more days prior to planting, generally reduced seedpiece decay in the mist chamber and in the field. The least amount of seedpiece decay in the field was observed in plots planted with seedpieces cut and healed for 1,3, 8 and 11 days. These seedpieces were left untreated with chemicals. Treatment of seedpieces with one of several fungicides and allowing the treated seedpieces to heal for 3 days before planting or planting the day of treatment increased the amount of seedpiece decay observed in the field. Bruising the seedpieces tended to increase seedpiece decay although this was not reflected in emergence or plant vigor. Significant differences in Rhizoctonia infection were observed between treatments, but clear-cut conclusions could not be drawn from the data. The lowest amount of Rhizoctonia was observed in plots planted with freshly cut seed treated with Captan fungicide. Total yields were generally above 300 cwt/acre with lowest yields observed in plots where freshly cut seedpieces were bruised and inoculated before planting. Yields tended to be higher when seedpieces were cut and healed before planting, but differences were not significant.

Footnotes

Table 1

1 Percentages are calculated based on 50 seedpieces planted in 50 feet of row.

2 The average number of days to emergence was calculated for all plants which did come up.

3 An assessment of number, size and health of plants. Number of plants in each class was counted: 1= <3" tall, weak plants; 2 = healthy, < 3" tall; 3 = healthy, 3-6" tall; 4 = healthy, 6-9" tall; 5 = healthy > 9". Based on 50 seedpieces/plot, those which failed to emerge were given a rating of 0. Average vigor/plant was calculated. Rating is expressed as a percentage of the maximum possible (50 plants in class 5).

4 Inoculated with 250 ml/36 lb sample of 10^7 colony forming units per ml of *Erwinia carotovora* pvar. *atroseptica*.

5 Analysis of variance was performed on data, and Fisher's protected least significant difference (LSD) was calculated. NS = not significant at the $P = 0.05$ (or $P = 0.10$) level.

Table 2

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 infection) to 11 (death of all stems due to Rhizoctonia infection). Ratings were converted to percentages.

3 Inoculated with 250 ml/36 lb sample of 10^7 colony forming units per ml of *Erwinia carotovora* pvar. *atroseptica*.

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

Table 3

1 Inoculated with 250 ml/36 lb sample of 10^7 colony forming units per ml of *Erwinia carotovora* pvar. *atroseptica*.

2 Analysis of variance was performed on data, and Fisher's protected least significant difference (LSD) was calculated. NS = not significant at the $P = 0.05$ (or $P = 0.10$) level.

Table 1. Effect of potato seedpiece treatment on field emergence and stand.

Treatment and rate per cwt		Percentage of plants emerged on [1]									Ave. Days to Emergence[2]	Vigor Rating[3]
		6/14	6/18	6/21	6/24	6/28	7/1	7/5	7/8	7/14		
Cut and healed before planting to permit suberization												
Cut 11 days	No chemical treatment	22.0	64.0	75.5	85.0	85.5	82.0	85.0	80.0	91.5	38.8	91.3
Cut 8 days	No chemical treatment	21.0	53.0	69.0	86.0	89.0	89.0	88.5	82.0	95.5	39.2	95.0
	Bruised, not inoculated	32.0	60.5	71.0	85.0	85.0	82.5	86.0	80.5	93.0	38.2	92.4
	TOPS 2.5 D, 1 lb, at cutting	22.0	64.5	81.0	87.0	90.5	89.0	85.0	86.0	96.5	38.2	96.4
Cut 6 days	No chemical treatment	28.0	63.5	78.0	89.5	91.5	91.0	86.0	78.5	94.5	40.3	94.2
Cut 3 days	No chemical treatment	20.0	51.0	71.0	84.5	89.5	82.5	88.0	84.5	93.5	39.2	93.4
	Potato Seed Treater PS (fir bark), 1 lb, at cutting	30.5	62.5	75.5	89.5	88.0	88.0	87.0	79.0	93.5	40.5	93.4
	TOPS 2.5 D, 1 lb, at cutting	27.0	57.5	72.0	86.0	88.0	82.0	86.5	79.0	91.5	40.7	91.3
	Captan, 1 lb, at cutting	20.0	57.5	68.5	83.5	89.0	81.0	84.5	80.5	92.0	40.8	91.6
	Potato Seed Treater MZ, 1 lb, at cutting	16.0	56.5	70.0	79.0	84.0	83.0	82.5	79.0	92.0	39.7	91.1
Cut 1 day	No chemical treatment	20.5	56.0	69.0	79.5	81.5	80.0	81.0	76.5	86.5	38.9	85.5
Fresh cut - cut and treated day of planting												
	No chemical treatment	17.5	49.5	63.0	77.5	84.0	68.0	81.5	77.0	86.5	45.4	85.0
	Inoculated, not bruised (no chemical treatment))[4]	11.5	42.0	58.5	71.0	75.5	73.5	77.5	77.0	87.0	38.5	85.8
	Bruised and inoculated (no chemical treatment)[4]	7.0	31.5	45.5	61.5	70.5	72.0	78.5	78.0	87.5	39.5	84.9
	Bruised, not inoculated (no chemical treatment)	12.0	48.0	61.0	75.0	83.0	75.0	82.0	82.0	87.5	39.7	86.6
	Maxim DP-M .5% dust, 0.5 lb, at cutting	9.0	36.0	45.5	65.0	71.5	62.0	74.0	72.0	80.5	43.4	79.1
	TOPS 2.5 D, 1 lb, at cutting	7.5	43.0	63.0	75.0	81.5	77.0	82.0	77.0	90.5	41.1	89.7
	Captan, 1 lb, at cutting	13.0	45.0	63.5	70.5	77.0	72.0	82.5	78.0	85.5	41.1	85.2
	Potato Seed Treater MZ, 1 lb, at cutting	8.5	44.5	63.5	75.0	79.0	78.0	80.5	77.0	86.5	38.3	85.4
	Potato Seed Treater PS (fir bark), 1 lb, at cutting	17.0	48.5	62.0	75.5	81.5	76.0	78.5	72.5	89.5	42.3	88.8
	Potato Seed Treater PS (talc), 1 lb, at cutting	12.0	45.5	62.0	80.0	84.0	80.5	83.0	78.0	90.5	39.9	89.6
LSD ($P = 0.05$)[5]		**9.3**	**10.8**	**9.9**	**8.3**	**7.4**	**11.1**	**9.6**	**NS**	**8.1**	**NS**	**8.4**

Table 2. Effect of potato seedpiece treatment on decay (mist chamber, and field trials), and on number of stems and number and weight of daughter tubers (in the field).

Treatment and rate per cwt		% decay (mist)[1]	% decay [1]	July 14 evaluation of 10 plants per replication: % black leg Incidence (plants with symptoms	% black leg Severity (stems with symptoms)	% Rhizoctonia infection [2]	No. of stems per plant	Ave. plant height (cm)	Daughter tubers/hill Mean number	Daughter tubers/hill Weight (gm)
Cut and healed before planting to permit suberization										
Cut 11 days	No chemical treatment	15.5	4.5	0.0	0.0	3.8	3.4	57.8	4.7	81.3
Cut 8 days	No chemical treatment	12.0	8.2	0.0	0.0	3.8	2.3	57.0	3.3	58.3
	Bruised, not inoculated	16.9	23.2	0.0	0.0	7.7	2.5	49.3	3.4	65.3
	TOPS 2.5 D, 1 lb, at cutting	23.8	19.8	0.0	0.0	2.0	3.0	53.1	3.6	57.2
Cut 6 days	No chemical treatment	14.6	10.0	0.0	0.0	6.5	3.2	57.4	3.5	46.5
Cut 3 days	No chemical treatment	19.4	3.4	0.0	0.0	7.0	2.5	51.3	2.8	46.6
	Potato Seed Treater PS (fir bark), 1 lb, at cutting	13.4	36.0	0.0	0.0	2.4	2.7	52.3	3.4	68.9
	TOPS 2.5 D, 1 lb, at cutting	31.8	10.1	2.5	1.0	1.8	2.6	53.8	3.4	58.0
	Captan, 1 lb, at cutting	15.1	12.0	0.0	0.0	1.6	2.3	52.7	3.0	53.2
	Potato Seed Treater MZ, 1 lb, at cutting.	17.4	40.9	2.5	0.9	1.4	2.5	54.5	2.5	49.5
Cut 1 day	No chemical treatment	13.7	2.7	0.0	0.0	7.4	2.8	52.7	2.5	35.9
Fresh cut - cut and treated day of planting										
	No chemical treatment	37.5	17.3	0.0	0.0	8.6	3.0	50.1	2.3	40.1
	Inoculated, not bruised (no chemical)[3]	47.7	15.7	0.0	0.0	11.3	2.7	51.8	2.5	36.3
	Bruised and inoculated (no chemical)[3]	47.0	27.4	2.5	0.9	3.9	2.3	42.4	1.6	24.3
	Bruised, not inoculated (no chemical)	48.5	22.6	0.0	0.0	1.7	2.8	50.6	3.0	54.1
	Maxim DP-M .5% dust, 0.5 lb, at cutting	37.3	19.8	2.5	2.3	2.9	2.9	43.6	2.2	42.1
	TOPS 2.5 D, 1 lb, at cutting	39.5	27.5	2.5	1.0	2.5	2.8	55.1	2.5	37.9
	Captan, 1 lb, at cutting	26.6	18.0	0.0	0.0	0.7	2.3	51.7	2.4	42.7
	Potato Seed Treater MZ), 1 lb, at cutting	35.8	43.1	2.5	1.0	2.2	3.0	54.3	3.5	63.4
	Potato Seed Treater PS (fir bark), 1 lb, at cutting	20.0	50.9	0.0	0.0	2.9	2.7	47.1	2.9	47.1
	Potato Seed Treater PS (talc), 1 lb, at cutting	35.6	29.0	0.0	0.0	4.3	3.0	54.1	3.0	43.8
LSD ($P = 0.05$)[4]		**9.8**	**21.7**	**NS**	**NS**	**5.9**	**0.5**	**6.4**	**NS**	**NS**

Table 3. Effect of seedpiece treatment on yield, proportion of US#1A, undersize and cull potatoes.

Treatment and rate per acre		Total Yield	US#1A		Undersize		Culls	
		cwt/A	cwt/A	%	cwt/A	%	cwt/A	%
Cut and healed before planting to permit suberization								
Cut 11 days	No chemical treatment	343.3	288.7	84.2	11.5	3.4	43.1	12.5
Cut 8 days	No chemical treatment	322.3	264.7	82.1	13.2	4.1	44.3	13.8
	Bruised, not inoculated	332.1	268.1	80.7	12.5	3.8	51.5	15.5
	TOPS 2.5 D, 1 lb, at cutting	347.9	287.6	82.7	14.2	4.1	46.2	13.2
Cut 6 days	No chemical treatment	357.6	292.4	81.9	11.8	3.3	53.4	14.8
Cut 3 days	No chemical treatment	329.9	270.9	81.9	11.3	3.5	47.6	14.6
	Potato Seed Treater PS (fir bark), 1 lb, at cutting	358.8	294.2	82.0	11.4	3.2	53.2	14.8
	TOPS 2.5 D, 1 lb, at cutting	334.7	268.8	80.2	10.5	3.1	55.4	16.6
	Captan, 1 lb, at cutting	350.6	284.7	80.8	12.3	3.5	53.6	15.7
	Potato Seed Treater MZ, 1 lb, at cutting	301.8	249.5	80.8	10.0	3.4	42.4	15.8
Cut 1 day	No chemical treatment	314.6	257.3	80.0	12.7	4.2	44.6	15.9
Fresh cut - cut and treated day of planting								
	No chemical treatment	324.6	260.1	78.3	12.4	3.9	52.1	17.8
	Inoculated, not bruised (no chemical treatment)[1]	325.0	263.2	80.6	13.5	4.3	48.3	15.1
	Bruised and inoculated (no chemical treatment)[1]	285.9	233.8	81.0	8.3	3.0	43.8	16.0
	Bruised, not inoculated (no chemical treatment)	312.2	260.5	83.1	12.3	4.0	39.3	12.9
	Maxim DP-M .5% dust, 0.5 lb, at cutting	297.8	241.8	81.1	12.3	4.2	43.6	14.7
	TOPS 2.5 D, 1 lb, at cutting	300.7	244.8	81.0	12.6	4.2	43.3	14.8
	Captan, 1 lb, at cutting	313.5	258.5	82.6	10.9	3.5	44.0	13.9
	Potato Seed Treater MZ), 1 lb, at cutting	340.5	281.1	82.3	12.9	3.9	46.5	13.8
	Potato Seed Treater PS (fir bark), 1 lb, at cutting	311.3	258.1	82.8	11.6	3.7	41.6	13.4
	Potato Seed Treater PS (talc), 1 lb, at cutting	334.8	285.2	85.3	13.0	3.9	36.6	10.8
LSD ($P = 0.05$)[2]		**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

APPENDIX B

Evaluation of Potato Seedpiece Treatments - Hancock, 1993

Mechanically cut seedpieces of Russet Burbank, Dark Red Norland and Atlantic potatoes were planted April 30 in field trials at the Hancock Research Station, Hancock, WI to evaluate the effect of chemical and cultural treatments on seedpiece decay, emergence, stand, and yield. For some treatments, tubers were cut 2, 4, 7, 9 or 11 days prior to planting and allowed to heal in a potato storage at about 50° F and 90-95% relative humidity. Remaining seedpieces were cut the day of planting. To apply chemical treatments, seedpieces (50 lb for Atlantic and Norland; 45 lb for Russet Burbank) were placed in plastic bags with the chemical and shaken until all seedpieces were uniformly coated. If the treatment combined healing with chemical treatment, the chemical was applied to freshly cut seed and was present during the healing period. Rough treatment at various stages in the seed handling process was simulated by bruising seedpieces after cutting. A bag containing seedpieces was dropped 10 times from a height of 3 feet onto a concrete floor. Bruised seedpieces were allowed to heal or were planted immediately after bruising. To inoculate seedpieces, cut seed was placed in a large plastic bag and inoculum was sprayed over the seedpieces (10^7 colony forming units per ml of *Erwinia carotovora* pvar. *atroseptica* or 10^6 spores/ml of *Fusarium solani*; applied at 70 ml/10 lb of seedpieces). The bags were rolled back and forth during the spray application to assure uniform coverage. Seedpieces were allowed to dry before any chemical dusts were applied. Imazalil sulfate was applied at a rate of 4.6 fl oz./ton of potatoes (6.8 ml/cwt) to whole tubers before cutting. Whole seed potatoes were placed one layer deep on a sheet of plastic and sprayed with the water-imazalil sulfate solution. The potatoes were rolled and sprayed again to cover all surfaces. After the potatoes were dry, they were mechanically cut and then inoculated and/or treated with chemical as described above. Seedpieces were planted with an assist-feed planter at a depth of approximately 3 inches. Air temperature at planting was 67°F, soil temperature was 70°F at the depth of seedpiece placement and seedpiece temperature was 50°F. Soil moisture at planting was at field moisture capacity.

The experiment was designed as a randomized complete block with four replications. Each plot consisted of one 65-foot row with seedpieces planted 12 inches apart in the row and treatment rows were spaced three feet apart. Soil type was a Plainfield sand with pH 6.7. Fertilizer consisted of 150 lb/A of 0-0-50 (broadcast as a preplant application), 650 lb/A of 6-24-24 (applied in the row at planting), and sidedress applications of 33-0-0 at 300 lb/A on May 20 and June 3. Insects were controlled with Di-Syston (0.5% a.i.) incorporated in the fertilizer at planting and foliar application of Thiodan 3EC (2.7 pt/A, June 25), and Furadan 4F (2.0 pt/A, July 9). Linex 4L 1.0 pt/A was applied pre-emergence on May 11 for weed control. Foliar fungicides were applied at label rates for early and late blight control (Penncozeb DF, 1.25 lb/A, July 2; Dithane DF 1.25 lb/A, July 22; Maneb, 1.25 lb/A, July 29; Bravo 720, 1.5 pt/A - August 4, 12; Bravo Zn 2.0 pt/A, August 20, 27). Vines were killed with application of Diquat H/A, 1.0 pt/A plus Peptoil, 1.0 pt/A (Dark Red Norland on August 11; Atlantic and Russet Burbank on September 7). Rainfall accumulation (inches) was: 5.71 (May), 6.86 (June), 8.38 (July), 5.33 (August), and 2.48 (September 1-20). An additional 5.2 inches of water was applied as overhead sprinkler irrigation in 12 applications from May 21 through September 8.

A sample of seedpieces from each treatment was evaluated for seedpiece decay in the laboratory in Madison, WI. Forty seedpieces (4 replicates consisting of 10 seedpieces each) from each treatment were placed in a chamber with continuous mist at 70° F and 100% RH. The mist kept seedpiece surfaces wet throughout the incubation period.

Plastic canopies protected the seedpieces from dripping water and contamination from other samples. Severity of decay was rated after 96 hours.

Emergence in the field was recorded for the same 50-foot section of each plot nine times between May 17 and June 21. Treatments were rated June 21 for plant vigor, an assessment combining number of plants, size of plants and presence or absence of above-ground symptoms of black leg. Plants from each plot were hand harvested three times during the season and number of stems per plant, Rhizoctonia infection, incidence of black leg symptoms and extent of seedpiece decay were recorded (5 plants/plot, June 2 and June 10; 10 plants/plot June 22). In addition, daughter tuber development, and daughter tuber weight were recorded on June 22. A forty-foot section of row in each plot was mechanically harvested in September (Dark Red Norland on September 1; Atlantic and Russet Burbank on September 21) and graded into US#1A, undersize, and cull categories. Specific gravity was measured on an 8-pound sample of tubers from each plot. US#1A tubers from all plots were 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.

Conditions at planting (moist soil with temperature in the mid 50's) were ideal for in-field healing of cut seedpieces. Within 48 hours of planting, however, weather conditions deteriorated. Three consecutive days of rainfall, totaling 1.9 inches, and then 5 days of air temperatures exceeding 75° F brought soil temperatures to the mid to upper 60's, conditions ideal for the development of seedpiece decay, especially on those seedpieces inoculated with *Erwinia carotovora* pvar. *atroseptica* and *Fusarium solani.* These conditions were typical of growers in the area. Growers who continued to plant their fields with freshly cut seedpieces up to the time the rains began experienced severe seedpiece decay problems and many fields planted within this window of time were replanted about 2 weeks later.

Atlantic

Highest emergence and plant vigor was observed with seed that was cut and healed 2-11 days before planting (Table 1). Inoculation of seedpieces at the time of cutting and holding the inoculated seedpieces in an environment favorable for wound healing reduced the overall impact of the *Erwinia* pathogen on emergence and plant vigor. The use of Captan on seed that was subsequently wound healed for 7 days did not improve overall emergence or plant vigor. Planting freshly cut seed significantly reduced crop emergence and plant vigor, but inoculation of freshly cut seed at planting with *Erwinia* or *Fusarium* had an even greater impact on emergence and plant vigor. Inoculation of freshly cut Atlantic seed with *Fusarium* reduced emergence to 28% in contrast to 88% emergence for seed healed for 2 days before planting. Lowest seedpiece decay in the mist chamber and in the field was observed with healed seed (4-7 days healing seemed to be optimum). Blackleg was generally most severe in plots inoculated with *Erwinia*. Incidence of *Rhizoctonia* was variable. Stem numbers, plant height and daughter tubers per hill were greatest in plots planted with healed seedpieces (Table 2). Plants in plots grown from healed seed generally produced a more uniform size distribution of tubers than did plants in plots planted with freshly cut seedpieces. The higher proportion of tubers in the 6-13 oz. category, in plots planted with fresh cut seedpieces, is a reflection of poor stands in these plots. Yields were significantly higher in plots planted with healed seedpieces (Tables 3). Specific gravities were unaffected by seed treatment. Precutting and healing for 2 and 4 days before planting without chemical application appeared to be the optimum treatment for this cultivar. Using the fresh cut/no chemical treatment for comparison, many of the cut and healed treatments contributed to a significant improvement in crop economics. Inoculation of freshly cut seed with *Fusarium* or *Erwinia*, however, significantly reduced crop value (Table 4).

Dark Red Norland

Emergence and plant vigor was highest in plots planted with seed that was cut and healed 2-7 days before planting (Table 5). Inoculation of seedpieces with *Erwinia* severely reduced emergence and plant vigor regardless of whether the seed was healed for 7 days after inoculation or planted immediately. Application of Captan to seed before healing or to freshly cut seed just before planting did not improve emergence or plant vigor. Seedpiece decay in the mist chamber and in the field was generally highest on freshly cut seed although the application of Captan fungicide seemed to reduce decay severity. The number of stems per plant, plant height and the number of daughter tubers per hill was generally higher in plots planted with healed seedpieces (Table 6). *Erwinia* inoculation significantly reduced each of these parameters. Total yields and yields of US#1A tubers were also highest in plots planted with healed seed-pieces. Application of Captan did not improve yield above the untreated checks. Plots planted with freshly cut seedpieces produced a broader size distribution of tubers than did plots planted with healed seedpieces where the majority of tubers were in the <4 oz. and 4-6 oz. categories (Table 7). Specific gravities were unaffected by seed treatment. The optimum treatments for this cultivar included precutting and healing the seedpieces for 2-7 days before planting. In comparison with the fresh cut/no chemical treatment, the only treatment that consistently increased crop value was the treatment consisting of applying fungicide to freshly cut seed and then allowing it to heal for 7 days before planting. Inoculation of cut seed with *Erwinia* significantly reduced the market value regardless of whether the seed was healed or fresh cut at planting (Table 8).

Russet Burbank

Healing fresh cut seed for 2-11 days before planting significantly improved plant emergence and vigor over plots planted with freshly cut seed (Table 9). Inoculation of cut seed with *Erwinia* and *Fusarium* significantly reduced emergence and plant vigor. None of the chemical treatments applied to freshly cut seed at the time of planting improved crop emergence or vigor above the untreated check. Seedpiece decay in the mist chamber and in the field was lowest on seed that was cut and healed for 2-11 days before planting. Chemical treatment of cut seedpieces did not significantly reduce seedpiece decay. Blackleg was somewhat lower on plots planted with healed seedpieces, but most plots had at least one plant with blackleg symptoms. *Rhizoctonia* infection was variable, but many of the fungicide treatments appeared to provide some control of this disease. The fungicide Maxim continued to provide excellent control of Rhizoctonia and appears to be a promising new product. Stem numbers, plant height and daughter tubers appeared to be higher in plots planted with healed seed (Table 10). Yields in plots planted with healed seed were generally higher than in plots planted with freshly cut seed (Table 11). Dropping and *Erwinia* inoculation of seed that was then healed for 7 days before planting had less effect than the same treatments applied to freshly cut seed just prior to planting. Inoculation of freshly cut seed with *Erwinia* and *Fusarium* just before planting resulted in very poor emergence and yield. Specific gravities were unaffected by seed treatment. Seed treatment had a significant impact on overall sizing of tubers and the final market values of the yield. Precutting and healing for 2 and 7 days before planting without chemical application appeared to be the optimum treatment for this cultivar. Most treatments consisting of healing cut seedtubers prior to planting improved crop value when compared with the fresh cut/no chemical treatment. Of those treatments applied to freshly cut seed just before planting, only Captan improved crop values across all three value comparisons. Inoculation of freshly cut seed with *Fusarium* or *Erwinia* severely reduced crop values even when fungicides were applied prior to planting (Table 12).

Table 1. Effect of potato seedpiece treatment on field emergence and stand of Atlantic potatoes.

Treatment and rate per cwt	Percentage of Plants Emerged on: [1] 5/17	5/21	5/25	5/27	6/1	6/4	6/9	6/11	6/21	Ave Days to Emergence[2]	Vigor Rating[3]
Cut and healed before planting to permit suberization											
Cut 11 days No chemical treatment	10.0	48.5	67.5	73.0	75.0	71.0	74.0	73.0	76.0	27.0	69.8
Cut 9 days No chemical treatment	6.5	47.0	71.0	76.0	77.0	75.0	76.5	76.0	77.0	25.9	74.2
Cut 7 days No chemical treatment	5.0	51.0	74.0	77.5	77.0	76.0	78.5	79.5	81.0	26.4	77.8
Inoculated (*Erwinia*, not bruised, no chemical treatment)[4]	22.5	46.0	64.0	66.0	68.0	66.0	69.5	69.0	64.0	28.7	60.7
Captan 5D, 1.0 lb at cutting	6.5	42.5	75.5	80.5	84.5	81.0	85.0	85.5	84.0	27.4	81.4
Cut 4 days No chemical treatment	15.5	58.5	83.5	86.5	90.5	86.5	89.0	90.0	85.5	25.5	81.9
Cut 2 days No chemical treatment	22.0	72.0	88.0	89.5	90.5	87.0	90.5	92.5	88.0	25.6	86.2
Fresh cut - cut and treated day of planting											
No chemical treatment	6.0	32.5	53.5	57.5	59.0	59.0	60.0	61.0	61.5	26.1	54.2
Inoculated (*Fusarium*, not bruised, no chemical treatment)[5]	1.5	13.5	23.5	25.0	25.0	25.5	26.5	27.5	28.0	28.0	23.6
Inoculated (*Erwinia*, not bruised, no chemical treatment)[4]	6.0	22.0	32.5	33.0	34.0	33.5	36.0	37.5	39.0	27.1	31.6
Captan 5D, 1.0 lb at cutting	5.5	25.5	42.5	47.0	52.0	50.5	55.0	57.0	58.5	27.7	51.6
LSD ($P = 0.05$)[6]	**11.2**	**10.2**	**11.9**	**12.1**	**11.7**	**10.5**	**10.9**	**11.5**	**10.2**	**NS**	**10.0**

1 Percentages are calculated based on 50 seedpieces planted in 50 feet of row.

2 The average number of days to emergence was calculated for all plants which did come up.

3 An assessment of number, size and health of plants. Number of plants in each class was counted: 1= <3" tall, weak plants; 2=healthy, < 3" tall, 3=healthy, 3-6" tall; 4 = healthy, 6-9" tall; 5=healthy > 9". Based on 50 seedpieces/plot, those which failed to emerge were given a rating of 0. Average vigor/plant was calculated. Rating is expressed as a percentage of the maximum possible (50 plants in class 5).

4 Inoculated with 10^7 colony forming units per ml of *Erwinia carotovora* pvar. *atroseptica* (350 ml/50 lb sample).

5 Inoculated with 10^6 spores per ml of *Fusarium solani* (350 ml/50 lb sample).

6 Analysis of variance was performed on data, and Fisher's protected least significant difference (LSD) was calculated. NS = not significant at the $P = 0.05$ (or $P = 0.10$) level. * = Difference between treatments were significant at $P = 0.10$, but not at $P = 0.05$.

Table 2. Effect of potato seedpiece treatment on decay (mist chamber, and field trials), and on black leg, Rhizoctonia, number of stems and number and weight of daughter tubers (in the field) for Atlantic potatoes.

Treatment and rate per cwt	% seedpiece decay [1]			Blackleg (% of plants with symptoms)		Blackleg (% of all stems with symptoms)		% Rhizoctonia infection[4]		No. stems per plant		Mean plant height (cm)		Daughter tubers/hill	
	(mist)	6/2 [2]	6/22 [3]	6/2 [2]	6/22 [3]	6/2 [2]	6/22 [3]	6/2 [2]	6/22 [3]	6/2 [2]	6/22 [3]	6/2 [2]	6/22 [3]	Mean No.	Weight (gm)
Cut and healed before planting to permit suberization															
Cut 11 days No chemical treatment	10.2	23.1	55.4	10.0	20.0	5.0	10.5	1.4	0.0	2.7	2.1	13.9	35.5	3.4	39.4
Cut 9 days No chemical treatment	17.6	44.8	40.1	10.0	0.0	6.8	0.0	0.7	1.8	1.9	2.1	12.9	35.4	4.0	44.9
Cut 7 days No chemical treatment	17.4	33.9	36.9	5.0	7.5	7.1	3.9	0.5	5.8	2.3	2.5	12.4	40.0	4.6	48.7
Inoculated (*Erwinia*, not bruised no chemical treatment)[5]	24.3	25.0	59.3	5.0	12.5	2.3	12.9	0.1	1.4	2.7	2.1	16.3	33.6	3.0	37.6
Captan 5D, 1.0 lb at cutting	15.7	20.1	27.2	5.0	2.5	2.8	1.7	0.0	0.5	2.2	2.4	14.3	45.0	4.4	52.0
Cut 4 days No chemical treatment	22.4	11.1	30.6	0.0	5.0	0.0	2.0	4.8	2.4	2.3	2.4	15.9	45.2	4.4	59.8
Cut 2 days No chemical treatment	22.6	25.5	45.3	0.0	0.0	0.0	0.0	0.0	0.4	2.6	2.6	15.8	42.3	4.6	56.5
Fresh cut - cut and treated day of planting															
No chemical treatment	38.0	46.5	95.8	5.0	15.0	4.2	13.8	1.2	3.2	2.7	1.4	12.0	26.5	2.0	24.6
Inoculated (*Fusarium*, not bruised, no chemical)[6]	48.1	72.0	97.5	10.0	5.0	53.1	7.8	0.0	0.0	1.3	0.9	8.9	13.0	1.7	13.1
Inoculated (*Erwinia*, not bruised no chemical treatment)[5]	51.9	71.3	100.0	10.0	15.0	16.7	35.7	0.0	0.0	1.3	0.5	7.2	9.5	0.3	4.1
Captan 5D, 1.0 lb at cutting	35.7	79.2	91.3	0.0	10.0	0.0	9.8	1.2	0.5	1.6	1.3	11.8	25.7	1.7	16.7
LSD ($P = 0.05$)[7]	**12.0**	**37.7**	**18.5**	**NS**	**13.4**	**NS**	**17.7**	**NS**	**NS**	**1.1***	**0.8**	**5.7***	**11.0**	**1.7**	**21.5**

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 Five plants were evaluated in each replicate plot.

3 Ten plants were evaluated in each replicate plot.

4 Severity rated on a Horsfall-Barratt scale of 0 (no infection) to 11 (death of all stems due to Rhizoctonia infection). Ratings were converted to percentages.

5 Inoculated with 10^7 colony forming units per ml of *Erwinia carotovora* pvar. *atroseptica* (350 ml/50 lb sample).

6 Inoculated with 10^6 spores per ml of *Fusarium solani* (350 ml/50 lb sample).

7 Analysis of variance was performed on data, and Fisher's protected least significant difference (LSD) was calculated. NS = not significant at the $P = 0.05$ (or $P = 0.10$) level. * = Difference between treatments were significant at $P = 0.10$, but not at $P = 0.05$.

Table 3. Effect of seedpiece treatment on yield, proportion of US#1A, undersize and cull potatoes, and specific gravity of Atlantic potatoes.

Treatment and rate per acre	Total Yield	US#1A		%	Undersize		Culls		Specific
	cwt/A	cwt/A	%	6-13oz	cwt/A	%	cwt/A	%	Gravity
Cut and healed before planting to permit suberization									
Cut 11 days No chemical treatment	338.9	276.9	81.6	41.3	13.5	4.0	48.6	14.4	1.094
Cut 9 days No chemical treatment	323.1	259.7	80.1	43.0	10.9	3.4	52.5	16.5	1.091
Cut 7 days No chemical treatment	352.7	286.6	81.0	43.5	11.9	3.4	54.2	15.6	1.091
Inoculated (*Erwinia*, not bruised, no chemical treatment)[1]	299.7	242.3	80.8	43.6	10.4	3.4	47.0	15.7	1.088
Captan 5D, 1.0 lb at cutting	380.3	321.5	84.4	34.5	12.8	3.4	46.0	12.3	1.089
Cut 4 days No chemical treatment	401.8	327.4	81.4	37.8	18.2	4.5	56.2	14.0	1.089
Cut 2 days No chemical treatment	400.3	338.3	84.6	33.9	16.7	4.2	45.3	11.3	1.092
Fresh cut - cut and treated day of planting									
No chemical treatment	292.5	242.8	83.0	51.0	9.2	2.9	40.5	14.0	1.087
Inoculated (*Fusarium*, not bruised, no chemical treatment)[2]	151.1	119.0	79.2	61.8	4.1	3.2	28.0	17.6	1.085
Inoculated (*Erwinia*, not bruised, no chemical treatment)[1]	195.4	152.8	77.1	66.9	7.4	3.8	35.3	19.1	1.089
Captan 5D, 1.0 lb at cutting	267.7	225.6	84.3	57.3	6.1	2.3	36.0	13.4	1.091
LSD ($P = 0.05$)[3]	**57.8**	**55.8**	**NS**	**12.0**	**4.2**	**NS**	**16.5**	**NS**	**NS**

1 Inoculated with 10^7 colony forming units per ml of *Erwinia carotovora* pvar. *atroseptica* (350 ml/50 lb sample).

2 Inoculated with 10^6 spores per ml of *Fusarium solani* (350 ml/50 lb sample).

3 Analysis of variance was performed on data, and Fisher's protected least significant difference (LSD) was calculated. NS = not significant at the $P = 0.05$ (or $P = 0.10$) level. * = Difference between treatments were significant at $P = 0.10$, but not at $P = 0.05$.

Table 4. Effect of experimental treatment on value per acre of Atlantic tubers.

Treatment and rate per acre		Gross Value of Yield [1]			Effect of Treatment on Value [2]		
		Fresh Market [3]	Processing [4]	Traditional [5]	Fresh Market [3]	Processing [4]	Traditional [5]
Cut and healed before planting to permit suberization							
Cut 11 days	No chemical treatment	3065.06	1263.63	1537.22	143.64	153.93	90.34
Cut 9 days	No chemical treatment	2912.71	1206.06	1470.66	-8.71	96.36	23.78
Cut 7 days	No chemical treatment	3204.10	1319.72	1621.83	282.68	210.02	174.95
	Inoculated (*Erwinia*, not bruised, no chemical treatment)[6]	2699.83	1119.75	1368.80	-221.59	10.05	-78.08
	Captan 5D, 1.0 lb at cutting	3275.13	1406.03	1651.41	353.71	296.34	204.53
Cut 4 days	No chemical treatment	3507.01	1485.47	1764.00	585.59	375.77	317.12
Cut 2 days	No chemical treatment	3442.61	1476.79	1724.56	521.19	367.09	277.68
Fresh cut - cut and treated day of planting							
	No chemical treatment	2921.42	1109.70	1446.88	0.00	0.00	0.00
	Inoculated (*Fusarium*, not bruised, no chemical treatment)[7]	1641.80	580.22	781.26	-1279.62	-529.48	-665.62
	Inoculated (*Erwinia*, not bruised, no chemical treatment)[6]	2116.00	761.42	1047.77	-805.42	-348.28	-399.11
	Captan 5D, 1.0 lb at cutting	2897.28	1038.20	1410.05	-24.14	-71.51	-36.83

1 Cost of seedpiece treatment chemicals were not included in calculations for this trial.

2 Gross value of untreated control (fresh cut, no chemical applied) minus gross value for the treatment.

3 Typical 1993 fresh market pricing: 4-6 oz. $8.50/cwt, 6-13 oz. $20.00/cwt, > 13 oz. $25.00/cwt, undersize and culls $1.50/cwt.

4 Typical 1993 processing contract pricing: Base price is $4.30/cwt for 60% US#1A, with 40% 6-13 oz. size and specific gravity of 1.076. For each 1% above or below 60% US#1A's the price increases or decreases $0.01/cwt. For each 1% above or below 40% 6-13 oz. size the price increases or decreases $0.01/cwt. For each .001 increase in specific gravity over 1.076 (to a maximum gravity of 1.081), add $0.03/cwt. Subtract $0.03/cwt for each .001 decrease in specific gravity below 1.076. Culls were not size graded in this experiment. It is assumed for these calculations that a similar proportion of culls would fall in the 6-13 oz range as US#1A's in this size range.

5 Prices used: $2.00/cwt for undersize and culls; $4.00/cwt for <6 oz US#1A tubers; $10.00/cwt for 6-13 oz US#1A tubers; $4.00/cwt for >13 oz US#1A tubers.

6 Inoculated with 10^7 colony forming units per ml of *Erwinia carotovora* pvar. *atroseptica* (350 ml/50 lb sample).

7 Inoculated with 10^6 spores per ml of *Fusarium solani* (350 ml/50 lb sample).

Table 5. Effect of potato seedpiece treatment on field emergence and stand of Dark Red Norland potatoes.

Treatment and rate per cwt	Percentage of Plants Emerged on: [1] 5/17	5/21	5/25	5/27	6/1	6/4	6/9	6/11	6/21	Ave Days to Emergence[2]	Vigor Rating[3]
Cut and healed before planting to permit suberization											
Cut 7 days No chemical treatment	6.5	38.5	77.5	84.5	89.0	85.5	89.0	89.5	90.0	26.2	88.0
Captan 5D, 1.0 lb at cutting	5.5	40.5	84.0	86.0	93.0	90.0	92.0	92.0	93.0	26.5	92.4
Inoculated (not bruised, no chemical treatment)[4]	3.0	25.0	40.5	42.5	49.5	47.0	49.5	49.0	50.5	27.7	44.0
Cut 4 days No chemical treatment	6.5	48.0	78.5	81.5	87.5	86.5	88.5	88.5	87.0	26.7	85.3
Cut 2 days No chemical treatment	1.0	41.0	66.5	82.0	86.0	83.0	89.0	88.0	88.0	28.9	84.9
Fresh cut - cut and treated day of planting											
No chemical treatment	5.5	39.5	63.5	68.5	71.5	70.0	72.5	72.5	72.5	25.9	67.4
Inoculated (not bruised, no chemical treatment)[4]	0.5	6.5	20.5	26.5	27.5	27.0	28.5	29.5	30.5	29.7	26.2
Captan 5D, 1.0 lb at cutting	1.0	15.5	48.0	58.5	65.0	61.5	64.0	65.5	66.0	28.2	60.4
LSD ($P = 0.05$)[5]	**5.5**	**14.1**	**8.8**	**8.7**	**7.6**	**7.6**	**8.0**	**7.9**	**7.0**	**NS**	**7.4**

1 Percentages are calculated based on 50 seedpieces planted in 50 feet of row.

2 The average number of days to emergence was calculated for all plants which did come up.

3 An assessment of number, size and health of plants. Number of plants in each class was counted: 1= <3" tall, weak plants; 2 = healthy, < 3" tall, 3 = healthy, 3-6" tall; 4 = healthy, 6-9" tall; 5 = healthy > 9". Based on 50 seedpieces/plot, those which failed to emerge were given a rating of 0. Average vigor/plant was calculated. Rating is expressed as a percentage of the maximum possible (50 plants in class 5).

4 Inoculated with 10^7 colony forming units per ml of *Erwinia carotovora* pvar. *atroseptica* (350 ml/50 lb sample).

5 Analysis of variance was performed on data, and Fisher's protected least significant difference (LSD) was calculated. NS = not significant at the $P = 0.05$ (or $P = 0.10$) level. * = Difference between treatments were significant at $P = 0.10$, but not at $P = 0.05$.

Table 6. Effect of potato seedpiece treatment on decay (mist chamber, and field trials), and on black leg, Rhizoctonia, number of stems and number and weight of daughter tubers (in the field) for Red Norland potatoes (in the field).

Treatment and rate per cwt	% seedpiece decay [1]			Blackleg (% of plants with symptoms)		Blackleg (% of all stems with symptoms)		% Rhizoctonia infection[4]		No. stems per plant		Mean plant height (cm)		Daughter tubers/hill	
	(mist)	6/2 [2]	6/22 [3]	6/2 [2]	6/22 [3]	6/2 [2]	6/22 [3]	6/2 [2]	6/22 [3]	6/2 [2]	6/22 [3]	6/2 [2]	6/22 [3]	Mean No.	Weight (gm)
Cut and healed before planting to permit suberization															
Cut 7 days No chemical treatment	12.9	7.2	82.1	0.0	5.0	0.0	2.2	0.0	0.5	3.3	3.8	13.8	46.7	4.7	37.4
Captan 5D, 1.0 lb at cutting	2.3	0.0	51.5	0.0	2.5	0.0	0.7	0.2	0.8	4.3	3.7	14.9	47.2	4.8	49.0
Inoculated (not bruised, no chemical treatment)[5]	17.6	71.1	98.8	45.0	15.0	33.6	20.6	5.0	0.0	2.1	1.4	11.6	18.5	1.3	11.6
Cut 4 days No chemical treatment	5.7	16.5	78.3	0.0	0.0	0.0	0.0	0.1	0.2	3.0	3.6	12.7	45.5	5.7	55.1
Cut 2 days No chemical treatment	13.2	13.2	84.9	0.0	2.5	0.0	1.4	1.3	2.8	3.6	3.1	15.1	42.3	3.3	33.6
Fresh cut - cut and treated day of planting															
No chemical treatment	30.4	34.8	97.1	10.0	10.0	6.1	4.1	0.0	0.0	2.9	3.1	10.9	39.1	3.4	31.5
Inoculated (not bruised, no chemical treatment)[5]	56.2	60.5	98.3	5.0	5.0	9.5	3.3	0.0	0.0	1.7	1.2	4.6	13.0	0.8	5.6
Captan 5D, 1.0 lb at cutting	13.8	29.4	97.7	0.0	2.5	0.0	1.0	0.0	1.5	2.9	3.1	12.0	36.4	3.7	31.5
LSD ($P = 0.05$)[6]	**10.8**	**32.8**	**11.9**	**12.0**	**NS**	**12.0**	**9.2**	**NS**	**NS**	**1.3**	**0.9**	**3.6**	**6.9**	**2.1**	**23.2**

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 Five plants were evaluated in each replicate plot.
3 Ten plants were evaluated in each replicate plot.
4 Severity rated on a Horsfall-Barratt scale of 0 (no infection) to 11 (death of all stems due to Rhizoctonia infection). Ratings were converted to percentages.
5 Inoculated with 10^7 colony forming units per ml of *Erwinia carotovora* pvar. *atroseptica* (350 ml/50 lb sample).
6 Analysis of variance was performed on data, and Fisher's protected least significant difference (LSD) was calculated. NS = not significant at the $P = 0.05$ (or $P = 0.10$) level.
* = Difference between treatments were significant at $P = 0.10$, but not at $P = 0.05$.

Table 7. Effect of seedpiece treatment on yield, proportion of US#1A, undersize and cull potatoes, and specific gravity of Dark Red Norland potatoes.

Treatment and rate per acre		Total Yield	US#1A		%	Undersize		Culls		Specific
		cwt/A	cwt/A	%	6-13oz	cwt/A	%	cwt/A	%	Gravity
Cut and healed before planting to permit suberization										
Cut 7 days	No chemical treatment	324.9	296.7	91.3	15.6	19.9	6.2	8.4	2.6	1.064
	Captan 5D, 1.0 lb at cutting	315.8	281.4	89.1	15.5	22.1	7.0	12.3	3.9	1.063
	Inoculated (not bruised, no chemical treatment)[1]	187.9	171.9	91.6	36.6	7.4	3.9	8.6	4.5	1.065
Cut 4 days	No chemical treatment	306.9	276.4	90.0	17.9	19.7	6.5	10.8	3.5	1.063
Cut 2 days	No chemical treatment	317.3	285.5	90.0	13.9	20.0	6.3	11.8	3.7	1.064
Fresh cut - cut and treated day of planting										
	No chemical treatment	273.7	248.8	90.9	29.3	14.7	5.4	10.3	3.7	1.065
	Inoculated (not bruised, no chemical treatment)[1]	152.2	132.9	87.0	43.4	7.6	5.0	11.6	7.9	1.066
	Captan 5D, 1.0 lb at cutting	268.8	242.4	90.1	26.0	13.2	4.9	13.2	5.0	1.065
LSD ($P = 0.05$)[2]		**27.1**	**27.7**	**NS**	**10.0**	**8.1**	**NS**	**NS**	**2.5**	**NS**

1 Inoculated with 10^7 colony forming units per ml of *Erwinia carotovora* pvar. *atroseptica* (350 ml/50 lb sample).

2 Analysis of variance was performed on data, and Fisher's protected least significant difference (LSD) was calculated. NS = not significant at the $P = 0.05$ (or $P = 0.10$) level. * = Difference between treatments were significant at $P = 0.10$, but not at $P = 0.05$.

Table 8. Effect of experimental treatment on value per acre of Dark Red Norland tubers.

Treatment and rate per acre		Gross Value of Yield [1]			Effect of Treatment on Value [2]		
		Fresh Market [3]	Processing [4]	Traditional [5]	Fresh Market [3]	Processing [4]	Traditional [5]
Cut and healed before planting to permit suberization							
Cut 7 days	No chemical treatment	2478.61	1037.15	1217.64	84.39	129.44	30.67
	Captan 5D, 1.0 lb at cutting	2358.35	997.51	1166.16	-35.87	89.80	-20.81
	Inoculated (not bruised, no chemical)[6]	1775.83	635.05	878.70	-618.39	-272.66	-308.27
Cut 4 days	No chemical treatment	2372.20	971.88	1171.31	-22.02	64.17	-15.66
Cut 2 days	No chemical treatment	2348.80	1005.19	1157.25	-45.42	97.48	-29.73
Fresh cut - cut and treated day of planting							
	No chemical treatment	2394.22	907.71	1186.97	0.00	0.00	0.00
	Inoculated (not bruised, no chemical)[6]	1480.31	519.56	734.21	-913.92	-388.15	-452.76
	Captan 5D, 1.0 lb at cutting	2258.56	882.48	1119.76	-135.66	-25.23	-67.21

1 Cost of seedpiece treatment chemicals were not included in calculations for this trial.

2 Gross value of untreated control (fresh cut, no chemical applied) minus gross value for the treatment.

3 Typical 1993 fresh market pricing: 4-6 oz. $8.50/cwt, 6-13 oz. $20.00/cwt, > 13 oz. $25.00/cwt, undersize and culls $1.50/cwt.

4 Typical 1993 processing contract pricing: Base price is $4.30/cwt for 60% US#1A, with 40% 6-13 oz. size and specific gravity of 1.076. For each 1% above or below 60% US#1A's the price increases or decreases $0.01/cwt. For each 1% above or below 40% 6-13 oz. size the price increases or decreases $0.01/cwt. For each .001 increase in specific gravity over 1.076 (to a maximum gravity of 1.081), add $0.03/cwt. Subtract $0.03/cwt for each .001 decrease in specific gravity below 1.076. Culls were not size graded in this experiment. It is assumed for these calculations that a similar proportion of culls would fall in the 6-13 oz range as US#1A's in this size range.

5 Prices used: $2.00/cwt for undersize and culls; $4.00/cwt for <6 oz US#1A tubers; $10.00/cwt for 6-13 oz US#1A tubers; $4.00/cwt for >13 oz US#1A tubers.

6 Inoculated with 10^7 colony forming units per ml of *Erwinia carotovora* pvar. *atroseptica* (350 ml/50 lb sample).

Table 9. Effect of potato seedpiece treatment on field emergence and stand of Russet Burbank potatoes.

Treatment and rate per cwt	Percentage of Plants Emerged on: [1] 5/17	5/21	5/25	5/27	6/1	6/4	6/9	6/11	6/21	Ave Days to Emergence[2]	Vigor Rating[3]
Cut and healed before planting to permit suberization											
Cut 11 days No chemical treatment	4.0	46.5	75.0	79.0	82.5	79.5	82.5	81.0	81.0	27.7	77.4
Cut 9 days No chemical treatment	7.0	48.5	74.5	79.5	82.0	79.0	81.0	82.0	82.5	27.0	78.0
Cut 7 days No chemical treatment	10.5	54.0	81.0	85.0	87.5	85.5	88.0	87.5	85.5	24.8	83.3
Bruised not inoculated (no chemical)	17.0	54.0	80.5	84.0	86.0	83.0	86.0	87.5	85.5	24.9	80.6
Inoculated (*Erwinia*, not bruised, no chemical treatment)[4]	14.5	47.0	67.5	70.0	70.0	69.5	69.5	71.5	70.0	26.4	66.3
Mancozeb Potato Seed Protectant (6.0 %), 1.0 lb	13.0	51.5	77.5	80.5	83.0	81.0	84.0	85.5	85.0	26.8	81.7
Captan 5D, 1.0 lb	7.5	50.5	82.5	86.0	87.5	85.0	88.5	89.0	89.0	25.3	87.6
Cut 4 days No chemical treatment	18.0	70.5	89.5	93.5	95.5	93.5	94.0	95.0	95.0	23.7	94.4
Cut 2 days No chemical treatment	17.0	60.5	91.0	94.0	93.5	91.0	94.5	96.5	94.5	25.6	93.3
Fresh cut - cut and treated day of planting											
No chemical treatment	8.5	53.0	82.0	86.0	87.5	85.5	87.0	87.0	87.0	25.6	84.4
Bruised not inoculated (no chemical)	3.0	31.0	61.0	68.5	70.0	69.0	70.5	70.5	71.5	27.3	66.9
Inoculated (*Fusarium*, not bruised, no chemical treatment)[5]	6.0	20.5	35.0	39.5	43.0	39.5	42.5	42.5	43.5	26.8	38.4
Inoculated (*Erwinia*, not bruised, no chemical treatment)[4]	1.0	13.5	22.5	25.0	28.0	27.5	29.0	28.5	28.5	28.0	25.2
Captan 5D, 1.0 lb	2.5	37.0	74.5	76.5	81.0	79.5	82.5	82.0	83.0	28.0	77.3
TOPS 2.5 D, 1.0 lb, not inoculated	2.5	39.0	61.0	67.0	68.0	66.0	69.5	68.5	69.0	27.7	65.5
TOPS 2.5 D D, 1.0 lb, inoculated with *Fusarium* spp.[5]	1.5	12.5	24.5	29.5	31.5	29.0	32.0	31.5	32.5	28.8	29.5
TOPS 5.0 D, 0.5 lb, not inoculated	6.0	36.5	65.0	66.5	66.5	64.5	66.0	68.0	67.5	25.7	63.9
TOPS 5.0 D, 0.5 lb, inoculated with *Fusarium* spp.[5]	1.0	7.5	12.5	13.5	15.5	14.0	14.0	15.0	15.0	27.6	12.9
TOPS-MZ 2.5 D, 1.0 lb, not inoculated	1.5	31.0	57.0	65.0	68.5	68.0	72.5	73.0	73.0	25.9	65.7

Table 9. Effect of potato seedpiece treatment on field emergence and stand of Russet Burbank potatoes (continued).

Treatment and rate per cwt		Percentage of Plants Emerged on: [1]									Ave Days to Emergence[2]	Vigor Rating[3]
		5/17	5/21	5/25	5/27	6/1	6/4	6/9	6/11	6/21		
TOPS-MZ 2.5 D, 1.0 lb, inoculated with *Fusarium* spp.[5]	0.5	10.0	19.0	21.5	24.0	23.0	26.5	26.5	27.5	32.3	22.5
Imazalil sulfate, 6.8 ml, TOPS 2.5D, 1.0 lb, not inoculated	0.5	20.5	53.0	57.5	65.5	63.0	66.0	65.5	65.5	27.6	63.1
Imazalil sulfate, 6.8 ml, TOPS 2.5D, 1.0 lb, inoculated with *Fusarium* spp.[5]	0.5	8.0	19.0	22.0	23.5	23.5	24.0	25.5	24.5	26.6	22.7
Imazalil sulfate, 6.8 ml, TOPS 5.0D, 0.5 lb, not inoculated	0.5	15.0	45.5	50.5	55.5	54.0	56.0	55.5	55.0	26.8	52.4
Imazalil sulfate, 6.8 ml, TOPS 5.0D, 0.5 lb, inoculated with *Fusarium* spp.[5]	0.5	6.0	16.0	19.0	20.0	19.5	21.0	21.0	21.0	27.7	20.3
Imazalil sulfate, 6.8 ml, TOPS-MZ, 1.0 lb , not inoculated	0.0	15.5	47.5	54.5	65.0	65.0	69.5	69.5	71.5	28.8	65.1
Imazalil sulfate, 6.8 ml, TOPS-MZ, 1.0 lb , inoculated with *Fusarium* spp.[5]	0.0	3.5	15.0	18.5	22.5	22.0	25.0	25.0	26.0	29.6	20.5
Potato Seed Dust T (0.5% TBZ), 1.0 lb	0.5	23.0	42.0	43.0	45.0	44.0	46.0	47.0	46.5	26.0	42.8
Mancozeb Potato Seed Protectant (6.0 %), 1.0 lb	1.5	20.5	55.0	61.0	63.0	62.0	64.0	65.0	66.0	25.9	61.6
Mancozeb/TBZ Potato Seed Dust (6.0%/0.5%), 1.0 lb	2.5	26.0	51.5	58.0	60.5	59.5	64.5	64.0	69.5	29.6	61.4
Maxim 0.5% DP-A, 0.5 lb	4.0	41.0	64.5	70.5	73.0	71.0	74.0	73.5	74.5	26.0	69.6
LSD ($P = 0.05$)[6]	**4.9**	**11.7**	**8.7**	**9.0**	**8.8**	**8.7**	**8.6**	**8.4**	**8.7**	**3.8**	**8.7**

1 Percentages are calculated based on 50 seedpieces planted in 50 feet of row.

2 The average number of days to emergence was calculated for all plants which did come up.

3 An assessment of number, size and health of plants. Number of plants in each class was counted: 1= <3" tall, weak plants; 2 = healthy, < 3" tall, 3 = healthy, 3-6" tall; 4 = healthy, 6-9" tall; 5 = healthy > 9". Based on 50 seedpieces/plot, those which failed to emerge were given a rating of 0. Average vigor/plant was calculated. Rating is expressed as a percentage of the maximum possible (50 plants in class 5).

4 Inoculated with 10^7 colony forming units per ml of *Erwinia carotovora* pvar. *atroseptica* (315 ml/45 lb sample).

5 Inoculated with 10^6 spores per ml of *Fusarium solani* (315 ml/45 lb sample).

6 Analysis of variance was performed on data, and Fisher's protected least significant difference (LSD) was calculated. NS = not significant at the $P = 0.05$ (or $P = 0.10$) level. * = Difference between treatments were significant at $P = 0.10$, but not at $P = 0.05$.

Table 10. Effect of potato seedpiece treatment on decay (mist chamber, and field trials), and on black leg, Rhizoctonia, number of stems and number and weight of daughter tubers for Russet Burbank potatoes (in the field).

Treatment and rate per cwt		% seedpiece decay [1]			Blackleg (% of plants with symptoms)		Blackleg (% of all stems with symptoms)		% Rhizoctonia infection[3]		No. stems per plant		Mean plant height (cm)		Daughter tubers/hill	
		(mist)	6/2 [2]	6/22	6/2	6/22	6/2	6/22	6/2	6/22	6/2	6/22	6/2	6/22	Mean No.	Weight (gm)
Cut and healed before planting to permit suberization																
Cut 11 days	No chemical treatment	16.5	33.1	42.0	10.0	7.5	7.8	2.8	4.8	1.7	2.6	2.9	12.3	41.9	4.2	23.7
Cut 9 days	No chemical treatment	8.1	10.0	29.4	0.0	7.5	0.0	7.0	10.2	8.1	3.5	3.2	14.0	46.2	4.2	27.8
Cut 7 days	No chemical treatment	14.3	10.8	30.6	5.0	0.0	1.8	0.0	8.2	12.0	2.9	3.4	15.6	50.1	5.7	35.0
	Bruised, not inoculated (no chemical)	37.9	18.2	68.1	5.0	12.5	3.1	3.9	3.2	3.3	2.8	3.1	14.2	40.6	4.5	27.5
	Inoculated (*Erwinia*, not bruised no chemical treatment)[4]	20.2	29.9	68.3	5.0	17.5	6.3	12.6	3.7	4.0	2.5	3.0	12.4	43.1	5.0	29.9
	Mancozeb Potato Seed Protectant (6.0 %), 1.0 lb	22.9	9.3	57.1	0.0	2.5	0.0	1.6	5.9	1.8	3.2	2.7	14.4	46.5	6.5	40.7
	Captan 5D, 1.0 lb	6.7	5.0	21.5	5.0	0.0	4.4	0.0	2.9	2.5	2.6	2.4	15.9	48.2	4.5	30.5
Cut 4 days	No chemical treatment	14.2	0.5	28.1	0.0	0.0	0.0	0.0	12.3	6.9	3.3	3.5	16.4	51.5	6.2	44.3
Cut 2 days	No chemical treatment	6.1	5.0	32.0	0.0	0.0	0.0	0.0	2.8	6.5	3.9	3.2	15.8	51.5	5.9	46.4
Fresh cut - cut and treated day of planting																
	No chemical treatment	21.8	10.0	68.0	0.0	2.5	0.0	2.2	1.4	3.4	3.3	3.0	13.9	48.8	6.3	39.9
	Bruised, not inoculated, no chemical	57.7	50.2	81.1	20.0	5.0	11.3	2.4	0.8	2.1	2.4	2.9	11.1	45.0	4.8	30.9
	Fusarium inoc., not bruised, no chemical	45.1	47.1	97.6	10.0	7.5	5.2	13.6	5.8	5.4	2.5	1.1	10.4	15.4	1.0	6.4
	Erwinia inoc., not bruised, no chemical[4]	74.3	78.4	80.9	5.0	0.0	10.0	0.0	0.8	12.8	0.8	1.2	3.8	17.8	1.6	9.0
	Captan 5D, 1.0 lb	20.2	20.9	63.0	5.0	7.5	1.8	3.8	4.2	3.8	3.1	2.9	13.8	38.4	3.4	21.3
	TOPS 2.5 D, 1.0 lb, not inoculated	14.6	54.9	66.6	30.0	2.5	22.0	1.1	0.3	6.6	2.6	2.6	12.3	36.9	3.8	20.9
	TOPS 2.5 D D, 1.0 lb, *Fusarium* inoc.[5]	45.1	70.0	92.6	0.0	2.5	0.0	7.1	1.2	0.9	1.6	1.0	6.0	14.1	0.8	3.5
	TOPS 5.0 D, 0.5 lb, not inoculated	24.5	33.2	75.2	20.0	7.5	10.2	5.8	0.6	0.8	3.4	2.2	14.5	32.3	2.9	18.4
	TOPS 5.0 D, 0.5 lb, *Fusarium* inoc.[5]	58.1	95.0	94.9	5.0	2.5	33.3	4.8	0.0	1.6	0.4	0.5	2.0	5.7	0.3	2.3
	TOPS-MZ 2.5 D, 1.0 lb, not inoculated	29.3	47.8	68.5	5.0	12.5	5.6	8.7	0.2	1.1	2.2	2.6	9.1	31.5	2.6	14.0
	TOPS-MZ 2.5 D, 1.0 lb, *Fusarium* inoc.[5]	39.5	88.0	83.5	5.0	7.5	4.2	10.7	0.2	0.0	0.8	.9	6.5	12.3	0.8	4.7

Table 10. Effect of potato seedpiece treatment on decay (mist chamber, and field trials), and on black leg, Rhizoctonia, number of stems and number and weight of daughter tubers for Russet Burbank potatoes (in the field) (continued).

Treatment and rate per cwt	% seedpiece decay [1]			Blackleg (% of plants with symptoms)		Blackleg (% of all stems with symptoms)		% Rhizoctonia infection[3]		No. stems per plant		Mean plant height (cm)		Daughter tubers/hill	
	(mist)	6/2 [2]	6/22	6/2	6/22	6/2	6/22	6/2	6/22	6/2	6/22	6/2	6/22	Mean No.	Weight (gm)
Imazalil sulfate, 6.8 ml, TOPS 2.5D, 1.0 lb, not inoculated	23.2	20.5	65.5	0.0	5.0	0.0	3.8	2.0	7.4	2.6	2.5	12.1	33.1	1.9	11.7
Imazalil sulfate, 6.8 ml, TOPS 2.5D, 1.0 lb, inoculated with *Fusarium* spp.[5]	46.0	75.0	94.8	0.0	2.5	0.0	1.7	0.0	0.9	1.3	0.8	3.5	10.8	0.9	5.9
Imazalil sulfate, 6.8 ml, TOPS 5.0D, 0.5 lb, not inoculated	24.1	36.8	57.3	5.0	5.0	7.1	1.9	0.2	1.4	2.8	2.5	10.8	43.2	3.9	24.0
Imazalil sulfate, 6.8 ml, TOPS 5.0D, 0.5 lb, inoculated with *Fusarium* spp.[5]	45.6	68.1	95.0	5.0	0.0	25.0	0.0	12.5	0.4	1.3	0.6	6.3	8.7	1.4	7.3
Imazalil sulfate, 6.8 ml, TOPS-MZ, 1.0 l not inoculated	26.8	14.9	71.3	0.0	7.5	0.0	4.6	3.3	0.9	2.8	2.5	12.2	32.3	1.9	9.4
Imazalil sulfate, 6.8 ml, TOPS-MZ, 1.0 l inoculated with *Fusarium* spp.[5]	38.0	79.9	96.0	0.0	20.0	0.0	52.8	0.0	0.8	1.0	0.8	3.3	10.8	0.4	2.0
Potato Seed Dust T (0.5% TBZ), 1.0 lb	45.9	73.1	96.4	15.0	5.0	33.3	3.0	0.0	0.9	1.6	1.4	8.2	19.9	1.3	8.1
Mancozeb Potato Seed Protectant (6.0 %) 1.0 lb	28.9	51.2	80.3	5.0	5.0	4.2	2.1	0.0	3.8	1.8	3.0	8.6	41.7	4.0	20.6
Mancozeb/TBZ Potato Seed Dust (6.0%/0.5%), 1.0 lb	27.6	49.3	76.0	15.0	10.0	11.9	10.8	1.9	2.0	2.5	2.5	10.9	34.0	2.5	13.2
Maxim 0.5% DP-A, 0.5 lb	22.0	40.0	72.1	10.0	2.5	8.7	1.6	0.0	0.6	3.0	3.3	10.3	43.2	4.5	29.0
LSD ($P = 0.05$)[6]	**21.9**	**27.2**	**19.8**	**14.0**	**11.0**	**NS**	**15.0**	**NS**	**6.5**	**1.2**	**0.8**	**4.4**	**9.6**	**2.3**	**14.4**

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 Five plants were evaluated in each replicate plot on June 2; ten plants were evaluated in each replicate plot on June 22.

3 Severity rated on a Horsfall-Barratt scale of 0 (no infection) to 11 (death of all stems due to Rhizoctonia infection). Ratings were converted to percentages.

4 Inoculated with 10^7 colony forming units per ml of *Erwinia carotovora* pvar. *atroseptica* (315 ml/45 lb sample).

5 Inoculated with 10^6 spores per ml of *Fusarium solani* (315 ml/45 lb sample).

6 Analysis of variance was performed on data, and Fisher's protected least significant difference (LSD) was calculated. NS = not significant at the $P = 0.05$ (or $P = 0.10$) level. * = Difference between treatments were significant at $P = 0.10$, but not at $P = 0.05$.

Table 11. Effect of seedpiece treatment on yield, proportion of US#1A, undersize and cull potatoes, and specific gravity of Russet Burbank potatoes.

Treatment and rate per acre	Total Yield	US#1A		%	Undersize		Culls		Specific
	cwt/A	cwt/A	%	6-13oz	cwt/A	%	cwt/A	%	Gravity
Cut and healed before planting to permit suberization									
Cut 11 days No chemical treatment	381.2	276.1	72.4	48.4	47.7	12.9	57.4	14.8	1.086
Cut 9 days No chemical treatment	334.6	247.4	73.7	34.0	44.7	13.6	42.5	12.7	1.085
Cut 7 days No chemical treatment	399.4	301.5	75.5	48.5	52.0	13.3	45.9	11.2	1.086
Bruised, not inoculated (no chemical treatment)	397.3	305.5	76.9	44.1	46.8	11.8	44.9	11.2	1.084
Inoculated (*Erwinia*, not bruised, no chemical treatment)[1]	369.4	289.6	78.2	50.0	39.1	10.8	40.7	11.1	1.085
Mancozeb Potato Seed Protectant (6.0 %), 1.0 lb	384.5	299.6	77.5	44.9	48.1	12.8	36.8	9.8	1.086
Captan 5D, 1.0 lb	393.3	302.4	76.6	42.7	48.0	12.4	43.0	11.0	1.086
Cut 4 days No chemical treatment	388.5	271.5	69.4	44.6	68.3	18.0	48.7	12.6	1.086
Cut 2 days No chemical treatment	425.7	306.6	72.1	35.5	67.8	15.9	51.3	12.0	1.085
Fresh cut - cut and treated day of planting									
No chemical treatment	361.4	268.1	73.9	41.6	59.5	16.7	33.7	9.4	1.087
Bruised, not inoculated (no chemical treatment)	328.2	254.0	77.3	48.7	31.4	9.6	42.9	13.1	1.087
Inoculated (*Fusarium*, not bruised, no chemical treatment)[2]	233.7	160.5	67.7	50.2	11.6	5.1	61.6	27.1	1.084
Inoculated (*Erwinia*, not bruised, no chemical treatment)[1]	170.3	127.1	74.2	58.5	9.6	5.4	33.6	20.5	1.087
Captan 5D, 1.0 lb	393.6	300.0	75.8	48.4	48.3	12.6	45.3	11.6	1.086
TOPS 2.5 D, 1.0 lb at cutting, not inoculated	335.4	240.4	71.6	36.1	45.2	13.4	49.8	15.0	1.086
TOPS 2.5 D D, 1.0 lb, inoc. with *Fusarium* spp.[2]	181.2	126.5	67.7	48.2	14.0	7.1	40.7	25.2	1.085
TOPS 5.0 D, 0.5 lb, not inoculated	342.0	253.9	73.7	46.7	41.6	12.2	46.6	14.1	1.087
TOPS 5.0 D, 0.5 lb, inoculated with *Fusarium* spp. [2]	109.3	70.3	63.1	61.6	7.2	6.8	31.8	30.1	1.085
TOPS-MZ 2.5 D, 1.0 lb, not inoculated	352.4	269.1	76.5	48.0	40.2	11.3	43.2	12.2	1.086
TOPS-MZ 2.5 D, 1.0 lb, inoc. with *Fusarium* spp. [2]	157.4	93.8	59.4	51.5	10.2	6.5	53.4	34.1	1.085

Table 11. Effect of seedpiece treatment on yield, proportion of US#1A, undersize and cull potatoes, and specific gravity of Russet Burbank potatoes (continued).

Treatment and rate per acre	Total Yield	US#1A		%	Undersize		Culls		Specific
	cwt/A	cwt/A	%	6-13oz	cwt/A	%	cwt/A	%	Gravity
Imazalil sulfate, 6.8 ml, TOPS 2.5 D, 1.0 lb, not inoculated	347.7	277.3	79.8	45.6	36.6	10.5	33.7	9.7	1.085
Imazalil sulfate, 6.8 ml, TOPS 2.5 D, 1.0 lb, inoculated with *Fusarium* spp.[2]	178.6	118.9	66.6	56.6	10.3	5.7	49.4	27.7	1.086
Imazalil sulfate, 6.8 ml, TOPS 5.0 D, 0.5 lb, not inoculated	278.5	224.5	80.5	56.0	23.3	8.3	30.7	11.2	1.087
Imazalil sulfate, 6.8 ml, TOPS 5.0 D, 0.5 lb, inoculated with *Fusarium* spp.[2]	164.7	106.1	62.4	58.0	11.6	7.3	47.0	30.3	1.085
Imazalil sulfate, 6.8 ml, before cutting, TOPS-MZ, 1.0 lb after cutting, not inoculated	340.0	270.8	79.7	48.2	29.7	8.8	39.5	11.6	1.085
Imazalil sulfate, 6.8 ml, TOPS-MZ, 1.0 lb, inoculated with *Fusarium* spp.[2]	128.5	77.6	57.4	50.1	7.0	6.6	44.0	36.0	1.085
Potato Seed Dust T (0.5% TBZ), 1.0 lb at cutting	301.8	228.6	75.3	57.8	21.6	7.1	51.6	17.6	1.085
Mancozeb Potato Seed Protectant (6.0 %), 1.0 lb	332.5	254.6	76.3	48.0	30.4	9.3	47.4	14.5	1.085
Mancozeb/TBZ Potato Seed Dust (6.0%/0.5%), 1.0 lb	329.0	246.4	74.6	41.2	38.6	11.7	44.1	13.6	1.087
Maxim, 0.5 lb	341.5	270.1	78.9	45.2	33.1	9.7	38.3	11.3	1.086
LSD ($P = 0.05$)[3]	**58.2**	**56.0**	**9.6**	**13.3**	**13.0**	**4.2**	**NS**	**9.3**	**NS**

1 Inoculated with 10^7 colony forming units per ml of *Erwinia carotovora* pvar. *atroseptica* (315 ml/45 lb sample).

2 Inoculated with 10^6 spores per ml of *Fusarium solani* (315 ml/45 lb sample).

3 Analysis of variance was performed on data, and Fisher's protected least significant difference (LSD) was calculated. NS = not significant at the $P = 0.05$ (or $P = 0.10$) level. * = Difference between treatments were significant at $P = 0.10$, but not at $P = 0.05$.

Table 12. Effect of experimental treatment on value per acre of Russet Burbank tubers.

Treatment and rate per acre		Gross Value of Yield [1]			Effect of Treatment on Value [2]		
		Fresh Market [3]	Processing [4]	Traditional [5]	Fresh Market [3]	Processing [4]	Traditional [5]
Cut and healed before planting to permit suberization							
Cut 11 days	No chemical treatment	3311.58	1401.46	1695.85	275.24	88.57	141.96
Cut 9 days	No chemical treatment	2624.41	1200.84	1345.75	-411.93	-112.05	-208.15
Cut 7 days	No chemical treatment	3596.96	1477.27	1826.78	560.62	164.38	272.89
	Bruised, not inoculated (no chemical)	3492.71	1462.22	1767.55	456.37	149.33	213.66
	Erwinia inoculated., not bruised, no chemical treatment[6]	3532.62	1385.19	1769.15	496.28	72.31	215.25
	Mancozeb Potato Seed Protectant (6.0 %), 1.0 lb at cutting	3458.30	1421.71	1750.88	421.96	108.82	196.99
	Captan 5D, 1.0 lb	3387.09	1445.22	1740.58	350.75	132.33	186.69
Cut 4 days	No chemical treatment	3196.02	1403.97	1644.81	159.68	91.08	90.92
Cut 2 days	No chemical treatment	3274.54	1519.73	1692.37	238.19	203.84	138.48
Fresh cut - cut and treated day of planting							
	No chemical treatment	3036.34	1312.89	1553.89	0.00	0.00	0.00
	Bruised, not inoculated (no chemical)	3056.29	1224.02	1528.16	19.95	-88.87	-25.73
	Inoculated (*Fusarium*, not bruised, no chemical treatment) [7]	1955.27	862.07	1019.42	-1081.07	-450.82	-534.47
	Inoculated (*Erwinia*, not bruised, no chemical treatment)[6]	1758.05	645.80	833.32	-1278.29	-667.09	-720.58
	Captan 5D, 1.0 lb	3574.38	1460.35	1815.84	538.04	147.46	261.94
	TOPS 2.5 D, 1.0 lb, not inoculated	2580.84	1199.55	1326.46	-455.50	-113.34	-227.43
	TOPS 2.5 D D, 1.0 lb, inoculated with *Fusarium* spp [7]	1491.16	662.44	767.49	-1545.18	-650.45	-786.41
	TOPS 5.0 D, 0.5 lb, not inoculated	2963.51	1257.56	1516.77	-72.83	-55.34	-37.12
	TOPS 5.0 D, 0.5 lb, inoculated with *Fusarium* spp. [7]	953.79	406.95	494.38	-2082.55	-905.94	-1059.51
	TOPS-MZ 2.5 D, 1.0 lb, not inoculated	3178.36	1306.79	1611.89	142.02	-6.11	58.00
	TOPS-MZ 2.5 D, 1.0 lb, inoculated with *Fusarium* spp. [7]	1218.22	570.57	640.03	-1818.12	-742.32	-913.86

Table 12. Effect of experimental treatment on value per acre of Russet Burbank tubers (continued).

Treatment and rate per acre	Gross Value of Yield [1]			Effect of Treatment on Value [2]		
	Fresh Market [3]	Processing [4]	Traditional [5]	Fresh Market [3]	Processing [4]	Traditional [5]
Imazalil sulfate, 6.8 ml, TOPS 2.5 D, 1.0 lb, not inoculated	3227.75	1292.89	1604.79	191.41	-20.00	50.90
Imazalil sulfate, 6.8 ml, TOPS 2.5 D, 1.0 lb, inoculated with *Fusarium* spp. [7]	1543.24	663.42	793.88	-1493.11	-649.47	-760.02
Imazalil sulfate, 6.8 ml, TOPS 5.0 D, 0.5 lb, not inoculated	2890.90	1061.61	1410.85	-145.44	-251.28	-143.04
Imazalil sulfate, 6.8 ml, TOPS 5.0 D, 0.5 lb, inoculated with *Fusarium* spp.[7]	1367.13	608.48	720.80	-1669.21	-704.41	-833.10
Imazalil sulfate, 6.8 ml, TOPS-MZ, 1.0 lb not inoculated	3173.38	1272.09	1596.74	137.04	-40.80	42.85
Imazalil sulfate, 6.8 ml, TOPS-MZ, 1.0 lb inoculated with *Fusarium* spp.[7]	942.30	566.58	506.20	-2094.04	-746.31	-1047.70
Potato Seed Dust T (0.5% TBZ), 1.0 lb	2916.57	1142.93	1474.80	-119.77	-169.96	-79.10
Mancozeb Potato Seed Protectant (6.0 %), 1.0 lb	2981.78	1233.11	1509.23	-54.56	-79.78	-44.66
Mancozeb/TBZ Potato Seed Dust (6.0%/0.5%), 1.0 lb	2782.80	1199.71	1412.16	-253.54	-113.18	-141.74
Maxim, 0.5 lb	3109.20	1269.66	1569.12	72.86	-43.23	15.23

1 Cost of seedpiece treatment chemicals were not included in calculations for this trial.

2 Gross value of untreated control (fresh cut, no chemical applied) minus gross value for the treatment.

3 Typical 1993 fresh market pricing: 4-6 oz. $8.50/cwt, 6-13 oz. $20.00/cwt, > 13 oz. $25.00/cwt, undersize and culls $1.50/cwt.

4 Typical 1993 processing contract pricing: Base price is $4.30/cwt for 60% US#1A, with 40% 6-13 oz. size and specific gravity of 1.076. For each 1% above or below 60% US#1A's the price increases or decreases $0.01/cwt. For each 1% above or below 40% 6-13 oz. size the price increases or decreases $0.01/cwt. For each .001 increase in specific gravity over 1.076 (to a maximum gravity of 1.081), add $0.03/cwt. Subtract $0.03/cwt for each .001 decrease in specific gravity below 1.076. Culls were not size graded in this experiment. It is assumed for these calculations that a similar proportion of culls would fall in the 6-13 oz range as US#1A's in this size range.

5 Prices used: $2.00/cwt for undersize and culls; $4.00/cwt for <6 oz US#1A tubers; $10.00/cwt for 6-13 oz US#1A tubers; $4.00/cwt for >13 oz US#1A tubers.

6 Inoculated with 10^7 colony forming units per ml of *Erwinia carotovora* pvar. *atroseptica* (315 ml/45 lb sample).

7 Inoculated with 10^6 spores per ml of *Fusarium solani* (315 ml/45 lb sample).

APPENDIX C

Evaluation of Potato Seedpiece Treatments - Palmyra, 1993

To evaluate the effect of chemical and cultural treatment of Norland seedpieces on seedpiece decay, emergence, stand, and yield, field trials were established May 28 in a commercial grower's field at Dean Kincaid Farms, Palmyra, WI. Norland tubers were mechanically cut by the grower into approximately 2 oz seedpieces. For treatments which were cut and healed prior to planting, cut seedpieces were maintained in the grower's storage at 55° F and 90% relative humidity until the day of planting. For remaining treatments, seedpieces were cut fresh the morning of planting. To apply chemical treatment, 40 lb samples of seedpieces were placed in plastic bags with the chemical treatment and shaken until seedpieces were uniformly coated. For the treatment combining healing with chemical application, the treatment was applied immediately after cutting and was present during the healing period. Furrows were opened mechanically; seedpieces were planted by hand and covered to a depth of approximately three inches. Conditions at planting were: Air temperature, 60°F; soil temperature, 63°F at the depth of seedpiece placement; relative humidity 63% and seedpiece temperature, 62° F. The soil was slightly moist at the time of planting.

A randomized complete block design with four replications was used for this trial. Each plot contained two 25 foot rows spaced three feet apart with seedpieces planted 12 inches apart in the row. Soil type was a Houghton muck with pH 6.5. Plots were fertilized with 200 lb/A of 0-0-60 broadcast before planting and 180 lb/A of 12-30-20 in the row at planting. No insecticides or fungicides were applied and weeds were controlled by cultivation. Vines were killed with application of Diquat, 1.0 pt/A, two and three weeks prior to harvest. Total rainfall (May-August) was 15.7 inches.

A sample of seedpieces from each treatment was evaluated for seedpiece decay in our laboratory in Madison, WI. A total of 40 seedpieces from each treatment (four replicates of 10 seedpieces) were placed in a mist chamber at 70°F and 100% RH. The mist kept seedpiece surfaces wet throughout the incubation period. Plastic canopies protected the seedpieces from dripping water and contamination from other samples. Decay severity was rated after 96 hours.

Emerged plants were counted June 14, 25 and July 13. Plots were also rated on July 13 for overall plant vigor -- a combined evaluation of number and size of plants, and above-ground symptoms of black leg. Ten plants from each plot were hand harvested on July 13 and evaluated for number of stems per plant, average height, extent of seedpiece decay, symptoms of black leg and Rhizoctonia stem canker, daughter tuber development, and the formation of secondary tubers. The remaining portion of each plot was harvested September 7. The grower windrowed the plots and tubers were picked by hand and separated into US#1A, undersize, and cull categories.

Plant emergence and plant vigor were highest in plots planted with seedpieces cut and healed for 8 and 17 days before planting and in plots planted with untreated freshly cut seed. Seedpiece decay was variable between treatments and no clear-cut conclusions were drawn from the data. Seedpiece treatment had no significant impact on blackleg, Rhizoctonia stem infection, number of stems per plant, plant height or development of daughter tubers. Seedpiece treatments had no significant affect on yields.

Table 1. Effect of potato seedpiece treatment on field emergence and stand.

Treatment and rate per cwt		Percentage of plants emerged on [1] 6/15	6/25	7/13	Ave Days to Emergence[2]	Vigor Rating[3]
Cut and healed before planting to permit suberization						
Cut 17 days	No chemical treatment	70.5	86.5	85.0	24.4	81.7
Cut 8 days	No chemical treatment	65.0	83.0	81.5	23.8	77.8
	Captan (fir bark), 1.0 lb	53.5	73.0	61.5	28.4	58.3
Cut 6 days	No chemical treatment	39.0	59.5	58.5	26.5	55.4
Cut 4 days	No chemical treatment	55.0	82.5	70.0	29.9	67.9
Cut 2 days	No chemical treatment	57.5	83.0	74.5	27.2	70.9
Fresh cut - cut and treated day of planting						
	Mancozeb Potato Seed Protectant (6.0 %), 1.0 lb	44.0	79.5	67.0	30.3	63.7
	TOPS 2.5 D, 1.0 lb	49.5	82.5	78.0	26.4	76.2
	Captan 5D (5% a.i.), 1.0 lb	49.0	76.5	73.5	26.8	72.2
	Potato Seed Treater PS (fir bark, Corn Belt), 1.0 lb	43.5	77.5	74.5	27.1	72.3
	Potato Seed Treater (fir bark), 1.0 lb	41.5	69.5	67.5	26.6	65.7
	Untreated Control, 1.0 lb	48.0	86.5	84.5	26.1	83.4
LSD ($P = 0.05$)[4]		**12.5**	**12.2**	**13.9**	**NS**	**14.3**

1 Percentages are calculated based on 50 seedpieces planted in 50 feet of row.

2 The average number of days to emergence was calculated for all plants which did come up.

3 An assessment of number, size and health of plants. Number of plants in each class was counted: 1= <3" tall, weak plants; 2 = healthy, < 3" tall, 3 = healthy, 3-6" tall; 4 = healthy, 6-9" tall; 5 = healthy > 9". Based on 50 seedpieces/plot, those which failed to emerge were given a rating of 0. Average vigor/plant was calculated. Rating is expressed as a percentage of the maximum possible (50 plants in class 5).

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

Table 2. Effect of potato seedpiece treatment on decay (mist chamber, and field trials), and on number of stems and number and weight of daughter tubers (in the field).

Treatment and rate per cwt	Percent seedpiece decay [1] (mist chamber)	July 13 evaluation of 10 plants per replication						
		Percent seedpiece decay [1]	Percent of plants with black leg	Percent Rhizoctonia infection [2]	No. of stems per plant	Ave. plant height (cm)	Daughter tubers/hill	
							Mean number	Weight (gm)
Cut and healed before planting to permit suberization								
Cut 17 days No chemical treatment	4.3	87.5	0.0	0.5	3.6	30.3	1.7	13.3
Cut 8 days No chemical treatment	18.4	92.6	0.0	4.2	3.3	31.4	1.2	12.1
Captan (fir bark), 1.0 lb	18.0	95.1	0.0	4.3	2.3	27.0	1.2	9.8
Cut 6 days No chemical treatment	18.0	89.7	0.0	0.2	2.0	24.9	1.4	10.9
Cut 4 days No chemical treatment	4.3	80.5	0.0	0.4	3.6	31.9	1.8	10.1
Cut 2 days No chemical treatment	--- [3]	83.7	0.0	0.3	3.7	27.0	1.2	10.2
Fresh cut - cut and treated day of planting								
Mancozeb Potato Seed Protectant (6.0 %), 1.0 lb	24.4	97.0	0.0	1.7	2.8	29.3	0.6	2.6
TOPS 2.5 D, 1.0 lb	19.4	89.1	0.0	0.1	3.1	31.8	2.0	15.4
Captan 5D (5% a.i.), 1.0 lb	21.0	91.1	2.5	0.3	3.5	33.8	1.9	10.2
Potato Seed Treater PS (fir bark, Corn Belt), 1.0 lb	39.2	99.6	0.0	2.4	2.7	25.1	1.9	13.5
Potato Seed Treater (fir bark), 1.0 lb	29.8	99.8	2.5	0.4	2.3	19.9	0.6	2.7
Untreated Control, 1.0 lb	20.8	96.3	2.5	0.6	3.5	33.0	3.0	20.6
LSD ($P = 0.05$)[4]	**12.6**	**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 infection) to 11 (death of all stems due to Rhizoctonia infection). Ratings were converted to percentages.
3 There were not enough seedpieces for this treatment to be tested in the mist chamber.
4 Analysis of variance was performed on data, and Fisher's protected least significant difference (LSD) was calculated. NS = not significant at the $P = 0.05$ (or $P = 0.10$) level.

Table 3. Effect of seedpiece treatment on yield, proportion of US#1A, undersize and cull potatoes.

Treatment and rate per acre		Total Yield	US#1A		Undersize		Culls	
		cwt/A	cwt/A	%	cwt/A	%	cwt/A	%
Cut and healed before planting to permit suberization								
Cut 17 days	No chemical treatment	165.4	118.5	71.2	33.3	20.8	13.6	8.0
Cut 8 days	No chemical treatment	188.5	142.3	74.0	31.3	18.7	14.9	7.3
	Captan (fir bark), 1.0 lb	148.2	100.5	68.0	28.4	19.2	19.3	12.9
Cut 6 days	No chemical treatment	134.7	102.4	76.0	19.7	15.2	12.6	8.8
Cut 4 days	No chemical treatment	145.6	101.3	66.1	29.2	24.8	16.1	9.1
Cut 2 days	No chemical treatment	170.2	118.2	68.4	35.2	22.3	16.7	9.3
Fresh cut - cut and treated day of planting								
	Mancozeb Potato Seed Protectant (6.0 %), 1.0 lb	202.8	145.5	71.3	30.3	16.1	27.0	12.7
	TOPS 2.5 D, 1.0 lb	190.5	139.3	72.1	32.5	17.3	18.7	10.6
	Captan 5D (5% a.i.), 1.0 lb	180.8	132.0	72.6	31.0	18.4	17.8	9.0
	Potato Seed Treater PS (fir bark, Corn Belt), 1.0 lb	164.8	127.1	76.3	25.0	16.4	12.6	7.3
	Potato Seed Treater (fir bark), 1.0 lb	166.0	127.3	75.7	25.9	16.3	12.8	8.0
	Untreated Control, 1.0 lb	193.8	142.0	72.8	37.8	20.0	13.9	7.2
LSD ($P = 0.05$)[1]		**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

[1] Analysis of variance was performed on data, and Fisher's protected least significant difference (LSD) was calculated. NS = not significant at the $P = 0.05$ (or $P = 0.10$) level.

APPENDIX D

Evaluation of Potato Seedpiece Treatments - Spooner, 1993

Russet Burbank seedpieces were planted May 11 at the Spooner Agricultural Research Station, Spooner, WI to evaluate the effect of chemical and cultural treatments on seedpiece decay, emergence, stand, and yield and to determine the effects of bruises occurring during tuber and seedpiece handling. Tubers were mechanically cut by a commercial grower 1, 3, 4 or 15 days prior to planting or on the day of planting. The seedpieces cut in advance of planting were allowed to heal in a potato storage maintained at about 50° F and 90-95% relative humidity. The effect of rough handling of tubers was simulated by dropping a plastic bag containing 35 lb of cut seedpieces 3 feet onto a concrete floor 10 times (severe bruising) or 15 times (extremely severe bruising). Each chemical treatment was applied to a 35 lb sample of freshly cut seedpieces by shaking the seed in a plastic bag with the treatment until seedpieces were uniformly coated. Furrows were opened and fertilizer was applied mechanically. Seedpieces placed by hand at 12" intervals in the furrows were covered using hilling equipment. Air temperature at planting was 76°F with 56% relative humidity and seedpiece temperature was 74°F. Soil was slightly moist with a temperature of 74°F at the depth of seedpiece placement.

Plots consisted of two 25-foot rows spaced three feet apart with seedpieces planted 12 inches apart in the row. Treatments were arranged in a randomized complete block with four replications. Soil type was a Cromwell sandy loam, pH 6.9. Fertilizer consisted of 325 lb/A of 0-0-50 (broadcast preplant), 400 lb/A of 5-10-30 (applied in the row immediately prior to planting), and 200 lb/A of 46-0-0 (sidedress applications June 2 and 25). Insects were controlled with Temik 10G, 10 lb/A, applied in the furrow with fertilizer at planting, and foliar sprays of Pydrin July 14 (4.7 fl. oz./A) and August 20 (2.7 fl. oz./A). Lorox, 1.0 lb/A, plus Dual, 3.0 pt/A, was applied June 7 for weed control. Foliar fungicides were applied at label rates for early and late blight control (Du-Ter 30F, 10 oz/A - July 14, September 3; Bravo 720, 1 pt/A - July 23, 30 and August 6, 13, 20; Bravo 720, 1.5 pt/A - September 10). Vines were killed with an application of Diquat H/A 1.0 pt/A September 7. Rainfall accumulation (inches) was: May-5.9, June-3.4, July-3.2, August-4.9, and September-2.2 (through September 24). An additional 2.7 inches of water was applied as overhead sprinkler irrigation during the growing season.

A sample of seedpieces from each treatment was evaluated for seedpiece decay in the laboratory in Madison, WI. Forty seedpieces (4 replicates consisting of 10 seedpieces each) from each treatment were placed in a chamber with continuous mist at 70° F and 100% RH. The mist kept seedpiece surfaces wet throughout the incubation period. Plastic canopies protected the seedpieces from dripping water and contamination from other samples. Decay severity was rated after 96 hours.

Each plot was rated for emergence six times between June 6 and June 24. Treatments were rated July 1 for plant vigor, an assessment combining the number and size of plants with the presence or absence of above-ground symptoms of black leg. Ten plants from each plot were hand harvested on July 1. Number of stems per plant, average plant height, incidence of black leg and Rhizoctonia symptoms, and extent of seedpiece decay were recorded for each plant. The remaining 40 foot section of row in each plot was mechanically harvested on September 23 and graded into US#1A, undersize, and cull categories.

Soil was moderately moist at planting and soil temperatures averaged 55-60°F during the two weeks after planting. These conditions were favorable for healing of cut seed and rapid plant emergence and were not conducive to the development of seedpiece

decay. During the last eight days of May, 3.5 inches of rain was received but there had been ample time for seedpieces to heal by then. Final emergence and plant vigor were similar for all treatments. However, bruising freshly cut seed just before planting slowed early emergence of those treatments. Seedpiece decay in the mist chamber was greater on seed that was bruised. In the field, seedpiece decay was greatest on fresh cut seedpieces left untreated with fungicide dust and untreated seedpieces cut for 1 and 3 days before planting. Seedpiece treatment did not affect blackleg, Rhizoctonia stem infection, the number of stems per plant or the average plant height. Yields were not significantly affected by seedpiece treatment. Highest yields were observed in plots planted with freshly cut seed and seed that was healed for 4 days before planting.

Table 1. Effect of potato seedpiece treatment on field emergence and stand.

Treatment and rate per cwt		Percentage of plants emerged on:[1] 6/7	6/10	6/14	6/17	6/21	6/24	Ave Days to Emergence[2]	Vigor Rating[3]
Cut and healed before planting to permit suberization									
Cut 15 days	No chemical treatment	60.0	91.5	98.0	99.5	99.0	99.5	33.6	88.7
Cut 4 days	No chemical treatment	46.5	85.0	98.0	98.5	99.0	99.0	30.0	98.4
Cut 3 days	No chemical treatment	52.0	86.0	96.5	96.5	94.0	97.0	29.3	97.5
Cut 1 day	No chemical treatment	52.5	88.5	97.0	99.5	100	99.5	29.7	97.5
Fresh cut - cut and treated day of planting									
	No chemical treatment	54.0	85.0	97.0	96.5	99.0	99.0	30.1	96.7
	Dropped (severe bruising), not inoculated (no chemic treatment)	38.0	81.0	95.0	96.5	97.5	98.0	29.8	96.6
	Dropped (extremely severe bruising), not inoculated (no chemical treatment)	44.0	82.0	93.5	94.0	94.5	94.5	30.2	94.6
	Captan, 1 lb, at cutting	52.0	84.5	96.0	97.0	96.5	97.5	29.3	96.2
	TOPS 2.5 D, 1 lb, at cutting	64.5	91.0	98.0	99.0	99.0	99.0	28.7	98.9
LSD ($P = 0.05$)[4]		**14.8***	**NS**	**NS**	**NS**	**3.7***	**NS**	**NS**	**NS**

1 Percentages are calculated based on 50 seedpieces planted in 50 feet of row.

2 The average number of days to emergence was calculated for all plants which did emerge.

3 An assessment of number, size and health of plants. Number of plants in each class was counted: 1= <3" tall, weak plants; 2 = healthy, < 3" tall, 3 = healthy, 3-6" tall; 4 = healthy, 6-9" tall; 5 = healthy > 9". Based on 50 seedpieces/plot, those which failed to emerge were given a rating of 0. Average vigor/plant was calculated. Rating is expressed as a percentage of the maximum possible (50 plants in class 5).

4 Analysis of variance was performed on data, and Fisher's protected least significant difference (LSD) was calculated. NS = not significant at the $P = 0.05$ (or $P = 0.10$) level. * = Difference between treatments were significant at $P = 0.10$, but not at $P = 0.05$.

Table 2. Effect of potato seedpiece treatment on decay (mist chamber, and field trials), and on number of stems and number and weight of daughter tubers (in the field).

Treatment and rate per cwt	Percent seedpiece decay[1] (mist chamber)	July 1 evaluation of 10 plants per replication					
		Percent seedpiece decay[1] (field)	Incidence of black leg (% of plants with symptoms)	Severity of black leg (% of all stems with symptoms)	Percent Rhizoctonia infection[2]	No. of stems per plant	Ave. plant height (cm)
Cut and healed before planting to permit suberization							
Cut 15 days No chemical treatment	1.3	4.9	0.0	0.0	5.2	4.0	43.4
Cut 4 days No chemical treatment	7.5	3.1	0.0	0.0	1.3	4.2	42.4
Cut 3 days No chemical treatment	3.7	45.4	0.0	0.0	4.5	3.9	42.4
Cut 1 day No chemical treatment	2.9	45.5	2.5	1.3	2.5	4.4	43.4
Fresh cut - cut and treated day of planting							
No chemical treatment	3.7	32.1	0.0	0.0	1.1	3.6	41.5
Dropped (severe bruising), not inoculated (no chemical treatment)	26.6	37.6	2.5	0.5	2.6	4.4	42.1
Dropped (extremely severe bruising), not inoculated (no chemical treatment)	41.1	59.1	0.0	0.0	2.2	4.4	38.9
Captan, 1 lb, at cutting	4.0	6.2	0.0	0.0	1.8	3.8	41.8
TOPS 2.5 D, 1 lb, at cutting	14.4	7.9	0.0	0.0	2.7	4.0	43.5
LSD ($P = 0.05$)[3]	**9.2**	**16.7**	**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 infection) to 11 (death of all stems due to Rhizoctonia infection). Ratings were converted to percentages.

3 Analysis of variance was performed on data, and Fisher's protected least significant difference (LSD) was calculated. NS = not significant at the $P = 0.05$ level.

Table 3. Effect of seedpiece treatment on yield, proportion of US#1A, undersize and cull potatoes.

Treatment and rate per acre	Total Yield	US#1A		Undersize		Culls	
	cwt/A	cwt/A	%	cwt/A	%	cwt/A	%
Cut and healed before planting to permit suberization							
Cut 15 days No chemical treatment	386.3	218.9	56.3	112.8	29.7	54.6	14.1
Cut 4 days No chemical treatment	410.4	253.3	61.0	109.5	27.3	47.6	11.6
Cut 3 days No chemical treatment	401.3	252.8	62.7	88.7	22.4	59.8	14.9
Cut 1 day No chemical treatment	390.4	209.8	53.3	117.5	30.4	63.1	16.0
Fresh cut - cut and treated day of planting							
No chemical treatment	416.5	229.8	55.2	111.0	26.8	75.7	18.0
Dropped (severe bruising), not inoculated (no chemical treatment)	373.7	215.8	56.6	106.5	29.0	51.4	14.3
Dropped (extremely severe bruising), not inoculated (no chemical treatment)	369.5	209.9	56.9	100.1	27.3	59.6	15.8
Captan, 1 lb, at cutting	367.6	209.4	56.5	103.9	28.8	54.3	14.7
TOPS 2.5 D, 1 lb, at cutting	372.9	201.0	52.8	119.7	33.2	52.2	14.1
LSD ($P = 0.05$)[1]	NS	NS	NS	NS	NS	NS	NS

[1] Analysis of variance was performed on data, and Fisher's protected least significant difference (LSD) was calculated. NS = not significant at the $P = 0.05$ level.

APPENDIX E

Evaluation of Biological Control of Early Blight - Hancock, 1993

Field plots were established April 26, 1993 at the Hancock Research Station, Hancock, WI using US#1A Russet Burbank tubers which were mechanically cut into approximately 2 oz. seedpieces and allowed to heal for 7 days before planting. A randomized complete block design with four replications was used. Each plot consisted of four 25-foot-long rows spaced 36 inches apart with tubers 12 inches apart in the row. Treatments were applied to the two center rows of each plot. Soil type was a Plainfield sand with pH of 7.0. Plots were fertilized with 250 lb/A of 0-0-50 broadcast before planting, 500 lb/A of 6-24-24 in the row at planting and sidedress applications of 33-0-0 at 300 lb/A on May 20 and June 3. Insects were controlled with Di-Syston incorporated in the fertilizer applied at planting (0.5% a.i.) and with foliar sprays of Thiodan 3EC (2.7 pt/A, June 25) and Furadan 4F (1 qt/A, July 9). Linex 4L was applied May 11 at 1 pt/A for weed control. Experimental treatments were applied in water at 40 psi with a CO_2 backpack sprayer equipped with hollow cone nozzles using a standard linear boom (4 nozzles, 18" spacing, top application). Treatments began June 30 (300 P-Days) and were applied once or twice a week according to treatment protocol until August 26 for a total of 9 weeks . All treatments were applied in the evening to provide the maximum period of leaf wetness to enhance survival of the biocontrol organisms immediately after application. Penncozeb and Bravo Zn treatments were included in the trial at standard label rates for comparison. In addition to the untreated control plot, NBY broth alone (the medium in which the AMMD strain was grown) provided an additional control. The biocontrol treatment was *Pseudomonas cepacia* strain AMMD (obtained from Ann Joy, Dr. J. L. Parke's Lab, UW-Madison, Plant Pathology; bacteria were grown by a fermentation process and maintained frozen until use). The AMMD preparation and NBY broth were thawed at room temperature before use and sprayed at full strength or 0.1 strength. No vine killer was applied as all foliage was dead by the end of August. The two center rows of each plot (a total of 50 feet of row) were machine harvested on September 1 and graded into 3 categories - US#1A, undersize, and culls. All potatoes in the US#1A category from each treatment plot were 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. Rainfall measured during the growing season (inches) was April (April 26-30) 0.45, May 5.71, June 6.86, July 8.38 and August 5.33. An additional 5.53 inches of water was applied as overhead sprinkler irrigation in 12 applications from June 4 through August 27.

Rainfall, irrigation and cool weather combined to favor the spread and development of early blight in these plots. A tall windbreak to the immediate west of these plots may have prolonged foliage wetting after rains and irrigation and contributed to the overall development of early blight. The severity of early blight in untreated control plots exceeded 76% foliage infection by the August 11 rating. Treatment with the Penncozeb and Bravo Zn fungicides provided reasonable control of early blight until mid-August. The application of AMMD at 0.1 strength each week or at full strength twice per week and the weekly application of a compost extract controlled early blight as well as the standard fungicide treatments on the August 2 rating. While differences in the relative AUDPC's and yields between treatments were not significant at the $P = 0.05$ level, there were interesting trends in the data. Relatively low AUDPC's and high yields in plots treated with AMMD at 0.1 strength each week or at full strength twice per week or treated weekly with the compost extract provide incentive to repeat this trial during 1994. Suggested treatments would include application of the AMMD at full strength, once, twice or three times per week and the weekly application of selected compost extracts in comparison with standard fungicides.

Table 1. Effect of treatment on early blight severity (percent foliage infection).

Treatment and rate per acre	Percent foliage infection [1]								Relative AUDPC [2]
	7/6	7/12	7/19	7/26	8/2	8/11	8/18	8/23	
Untreated Control	0.4	1.2	2.0	4.7	25.1	76.4	94.7	99.2	0.35
Pseudomonas cepacia strain AMMD, full strength, once/week after 300 P-Days [3]	0.2	1.5	2.5	5.9	21.2	75.1	94.7	99.2	0.34
Pseudomonas cepacia strain AMMD, 0.1 strength, once/week after 300 P-Days	0.6	1.4	2.1	4.0	12.2	72.3	94.7	98.4	0.32
Pseudomonas cepacia strain AMMD, full strength, twice/week after 300 P-Days	0.2	0.9	2.0	3.2	12.9	67.7	93.2	98.8	0.31
Broth (growth medium for bacteria), once/week after 300 P-Days	0.5	1.5	2.8	5.3	25.2	78.6	96.6	99.8	0.36
Broth (growth medium for bacteria), twice/week after 300 P-Days	0.5	1.2	2.6	4.0	24.1	71.3	96.1	99.5	0.34
Compost extract, once/week after 300 P-Days	0.1	1.1	1.8	3.3	15.9	65.6	92.4	97.9	0.31
Penncozeb 75 DF, 1.5 lb, once/week after 300 P-Days	0.0	1.2	1.9	2.5	10.3	61.1	85.0	97.2	0.28
Bravo Zn, 2.125 pt, once/week after 300 P-Days	0.2	1.1	1.6	2.6	7.5	58.8	77.4	95.9	0.26
LSD ($P = 0.05$) [4]	**0.6**	**1.2**	**0.8**	**2.8**	**16.2**	**NS**	**10.6**	**NS**	**NS**

1 Severity rated on a Horsfall-Barratt scale of 0 (no infection) to 11 (all foliage and stems dead). Ratings were converted to percentages.

2 Relative area under the disease progress curve.

3 Potato Crop Management software was used to calculate daily P-Day accumulations.

4 Analysis of variance was performed on data, and Fisher's protected least significant difference (LSD) was calculated. NS = not significant at the $P = 0.05$ (or $P = 0.10$) level.
* = Difference between treatments were significant at $P = 0.10$, but not at $P = 0.05$.

Table 2. Effect of treatment on yield, proportion of US#1A, undersize and cull potatoes, and specific gravity.

Treatment and rate per acre	Total Yield	US#1A		% 6-	Undersize		Culls		Specific
	cwt/A	cwt/A	%	13 oz	cwt/A	%	cwt/A	%	Gravity
Untreated Control	301.8	232.3	76.8	27.2	51.3	17.1	18.2	6.1	1.082
Pseudomonas cepacia strain AMMD, full strength, once/week after 300 P-Days	302.8	234.0	77.4	26.5	48.8	15.8	20.0	6.8	1.083
Pseudomonas cepacia strain AMMD, 0.1 strength, once/week after 300 P-Days	350.0	258.9	73.6	23.6	65.8	19.1	25.4	7.3	1.084
Pseudomonas cepacia strain AMMD, full strength, twice/week after 300 P-Days	347.8	257.0	73.4	28.1	66.0	19.4	24.7	7.2	1.082
Broth (growth medium for bacteria), once/week after 300 P-Days	307.0	234.4	76.6	34.7	46.5	14.9	26.1	8.5	1.082
Broth (growth medium for bacteria), twice/week after 300 P-Days	314.9	249.7	79.3	26.1	46.8	14.8	18.5	5.9	1.085
Compost extract, once/week after 300 P-Days	323.7	239.0	73.7	24.0	59.9	18.4	24.8	7.8	1.084
Penncozeb 75 DF, 1.5 lb, once/week after 300 P-Days	351.2	265.6	75.0	23.9	60.3	17.5	25.3	7.5	1.085
Bravo Zn, 2.125 pt, once/week after 300 P-Days	341.0	265.4	77.9	32.8	45.8	13.0	29.8	9.1	1.080
LSD ($P = 0.05$) [1]	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**8.1***	**NS**	**NS**

[1] Analysis of variance was performed on data, and Fisher's protected least significant difference (LSD) was calculated. NS = not significant at the $P = 0.05$ (or $P = 0.10$) level.
* = Difference between treatments were significant at $P = 0.10$, but not at $P = 0.05$.

APPENDIX F

Evaluation of Disease Resistance in Potato Cultivars and Breeding Selections - Hancock, 1993

Field trials were established April 26 at the Hancock Agricultural Research Station to evaluate 60 potato cultivars and breeding selections for early blight resistance. Small whole tubers and hand-cut seedpieces (2 oz) were mechanically planted in a randomized complete block design with three replications. Each replication consisted of a 5-foot section of row for each cultivar or selection. Test plots were separated within the row by 4-foot sections of Red Norland. Red Norland, a very susceptible cultivar, helped provide a uniform source of inoculum throughout the trial. Rows for containing test lines for evaluation were separated by rows of Russet Burbank to minimize interplot interference. Spacing was 12 inches within the row and 36 inches between rows. Soil type was a Plainfield sand, pH 6.2. Plots were fertilized with 150 lb/A of 0-0-50 broadcast preplant, 650 lb/A of 6-24-24 in the row at planting and sidedress applications of 33-0-0 at 300 lb/A on May 20 and June 3. Insects were controlled with Di-Syston incorporated in the fertilizer applied at planting (0.5% a.i.) and with foliar applications of Thiodan 3 EC (2.7 pt/A) on June 25 and Furadan 4F (1 qt/A) on July 9. Linex 4L (1 pt/A) was applied pre-emergence on May 11 for weed control. No fungicides were applied at any time during the season. Disease severity was rated weekly from July 6 until August 30 using the Horsfall-Barratt system. Vines were killed on September 7 with an application of Diquat H/A (1 pt/A) plus Peptoil (1 pt/A). Tubers were harvested between September 22 and October 1, manually separated into "B size" (those that passed through a 1.9-inch screen), US#1A size (>1.9"), and culls (misshapen or with green or decayed areas). Rainfall (inches) was 0.45 (April 26-30), 5.71 (May), 6.86 (June), 8.38 (July), 5.33 (August), and 2.48 (September 1-20). An additional 5.22 inches of water was applied as overhead sprinkler irrigation in 12 applications from May 21 until September 8.

Symptoms of early blight were initially observed during the first week of July, and by the first week of August, 76% of the foliage on Red Norland, the known susceptible cultivar, exhibited typical early blight symptoms. Disease developed more slowly on W84-75R than on Red Norland resulting in a significantly lower area under the disease progress curve (AUDPC) value for this breeding line in the early maturity group. Atlantic showed a significantly lower AUDPC than any other entry in the early-medium maturity class. NY95 and Snowden had AUDPC values significantly lower than many other cultivars or breeding lines and produced good yields. In the medium-to-late maturity class, C75, a pentaploid resulting from the cross of the somatic hybrid A206 x Katahdin showed outstanding early blight tolerance. Several of the lines derived from crosses of similar material to Katahdin and Atlantic (C75- and C31- series) had AUDPC values significantly lower than Russet Burbank with good yields with C75-5-297 producing 17 lb/5 ft of row. Several cultivars and breeding lines in the late maturity group (CT 88-2, 324-1, 342-2, T450, Ontario, 324-2, 30-6R and FL 1815) also had AUDPC values significantly lower than Russet Burbank. Of these, CT88-2 and Ontario had the highest yield. Total yields were highest for FL 1533, FL 1291, C75-5-297, AC 80545, AF 1060-2, CKatahdin, C75-5-277, Ontario and Russet Burbank with yield equivalent to 350 cwt/A or greater. FL 1291, St. Johns, AC 80545, CT 60-1, AF 1060-2, CT 133-5, W 971, FL 1815 and FL 1625 all had over 80% of the yield in the US#1A size category.

Table 1. Early blight severity and yield of potato cultivars and breeding selections arranged by maturity.

Maturity Group/ Cultivar or breeding selection	Percent foliage infection [1]					Relative AUDPC [2]	Total Yield (lb) [3]	%		
	7/6	7/19	8/2	8/18	8/30			#1A Size	Under-size	Culls
Early										
W 84 -75R [4]	0.3	4.8	57.1	100.0	100.0	0.52	3.9	9.6	90.4	0.0
FL 1780 [5]	0.6	9.7	47.3	99.7	100.0	0.53	5.4	75.0	13.3	11.7
FL 1850 [5]	1.1	11.9	63.5	87.5	100.0	0.56	5.2	73.6	24.4	2.0
Norland	0.9	13.4	76.5	99.8	100.0	0.59	8.1	49.6	48.3	2.1
Early-Medium										
Atlantic	0.6	2.8	11.9	85.6	100.0	0.37	11.0	68.2	29.9	1.9
CAtlantic [6]	0.3	3.0	10.5	90.0	100.0	0.38	9.0	79.8	19.2	1.0
Gold Rush [4]	0.0	5.0	38.8	99.8	100.0	0.47	8.9	59.7	33.7	6.6
NYE 55-44 [7]	0.6	4.4	37.5	99.8	100.0	0.48	8.8	76.6	18.1	5.3
FL 617 [5]	1.4	11.9	39.6	98.0	100.0	0.48	8.5	44.3	48.7	7.1
NY 96 [7]	0.6	5.9	40.8	100.0	100.0	0.51	5.8	57.4	42.6	0.0
ND 2225 - 1R [4]	0.6	7.0	45.8	100.0	100.0	0.52	8.2	51.4	48.6	0.0
Medium										
NY 95 [7]	2.7	7.0	19.2	75.0	99.8	0.35	10.2	73.5	25.2	1.3
Snowden	2.0	3.1	15.6	76.7	98.3	0.37	11.5	64.0	35.8	0.3
NY 84 [7]	0.5	3.9	24.3	84.8	100.0	0.40	10.3	78.3	17.8	3.9
FL 1533 [5]	0.9	7.5	19.4	82.2	99.8	0.41	12.5	78.9	19.4	1.7
FL 1291 [5]	0.9	4.8	34.6	89.1	99.7	0.44	12.3	83.5	14.4	2.1
MN 13540 [4]	0.6	6.6	31.7	98.0	100.0	0.46	8.1	60.6	37.8	1.6
Medium-Late										
C75 [8]	0.3	1.6	4.7	23.1	57.1	0.14	5.6	27.0	67.6	5.4
C31-5-30 [9]	0.5	2.5	7.5	45.8	76.3	0.20	5.0	0.0	100.0	0.0
C31-5 [10]	0.9	2.0	6.2	61.7	99.1	0.26	5.8	0.0	97.3	2.7
C31-5-37 [9]	0.0	1.4	5.5	61.7	94.1	0.26	5.0	3.2	96.8	0.0
C75-5-269 [9]	0.8	3.4	10.9	62.9	94.7	0.27	10.1	27.6	69.1	3.3
C75-5-297 [9]	0.0	2.7	12.5	60.8	80.3	0.27	17.0	37.9	61.3	0.8
C75-5 [10]	0.8	2.2	10.6	60.0	99.1	0.28	8.6	8.6	90.5	0.9
A 82119-3 [4]	0.5	2.5	7.5	70.0	99.5	0.30	10.9	68.5	29.6	1.9
NYE 55-35 [7]	0.3	2.7	10.9	82.0	99.5	0.34	10.3	53.1	45.1	1.8
A 80559-2 [4]	1.2	2.7	14.8	71.7	98.8	0.34	9.8	76.7	16.5	6.8
St. Johns (AF 828-5) [4]	0.5	2.5	10.0	71.3	99.8	0.34	11.3	84.5	15.3	0.2
C75-5-295 [9]	0.8	5.3	11.9	73.8	99.8	0.34	11.3	28.7	68.6	2.8
NYE 11-45 [7]	0.6	4.2	10.0	77.3	100.0	0.35	9.3	58.7	40.2	1.1
AC 80545 [4]	0.5	4.8	13.7	73.8	95.8	0.35	16.1	91.5	2.7	5.8
CT 60-1 [11]	0.2	2.7	11.4	87.7	98.9	0.36	10.9	84.5	14.4	1.1
Ranger Russet	1.4	5.8	13.4	82.8	100.0	0.37	8.0	12.4	74.0	13.5
AF 1060-2 [4]	0.2	4.2	12.8	76.3	99.8	0.37	12.4	81.9	6.8	11.3
C31-5-115 [9]	0.8	5.0	20.0	84.7	99.8	0.37	10.8	37.0	59.5	3.5
C 31 [8]	0.3	3.1	12.8	83.3	99.8	0.38	5.6	0.0	98.3	1.7
CT 133-5 [11]	0.5	3.1	14.4	88.8	100.0	0.39	11.7	82.0	6.2	11.8
CKatahdin [6]	0.9	3.7	23.1	82.5	98.9	0.39	13.5	70.4	27.7	1.9
AO 82611-7 [4]	0.5	2.5	18.1	92.3	100.0	0.40	7.9	18.3	80.4	1.3
C31-5-120 [9]	0.8	3.3	21.2	84.3	99.7	0.40	10.6	16.1	82.7	1.2
NY 87 [7]	1.1	4.1	20.0	94.2	100.0	0.41	10.3	77.9	21.0	1.1
COO 83008-1 [4]	1.4	4.8	25.0	90.3	100.0	0.41	5.0	54.2	37.8	8.0

Table 1. Early blight severity and yield of potato cultivars and breeding selections arranged by maturity (continued).

Maturity Group/ Cultivar or breeding selection	Percent foliage infection [1]					Relative AUDPC [2]	Total Yield (lb) [3]	%		
	7/6	7/19	8/2	8/18	8/30			#1A Size	Under-size	Culls
Medium-Late (continued)										
W 971 [11]	0.2	3.7	21.9	87.8	99.2	0.41	11.2	82.2	15.8	2.0
C75-5-277 [9]	0.3	4.4	25.0	98.4	100.0	0.44	12.9	33.0	48.1	18.9
W1099 [11]	0.9	7.0	47.5	99.7	100.0	0.50	6.9	36.4	63.6	0.0
Late										
CT 88-2 [11]	0.5	2.0	5.2	57.5	73.8	0.22	10.7	75.9	20.2	3.9
324-1 [11]	0.0	2.0	4.1	52.5	84.2	0.23	3.2	0.0	95.3	4.7
342-2 [11]	1.1	2.3	9.7	49.6	96.9	0.25	5.2	19.4	80.6	0.0
T450 [12]	0.6	3.0	9.4	63.8	95.3	0.26	9.6	65.9	25.2	8.9
Ontario	0.0	3.1	10.0	62.5	82.0	0.28	13.3	73.2	13.9	12.9
324-2 [11]	0.9	4.1	7.3	63.3	99.7	0.29	3.4	9.4	84.2	6.5
30-6 R [11]	0.8	1.4	3.4	84.8	100.0	0.30	0.8	21.6	78.4	0.0
FL 1815 [5]	0.8	5.0	17.9	61.8	97.3	0.31	9.8	81.4	14.4	4.2
345-3 [11]	0.9	5.0	9.7	71.3	100.0	0.33	3.1	0.0	100.0	0.0
Genesee [7]	0.5	2.5	12.5	76.9	99.7	0.36	10.7	67.1	27.0	5.9
345-4 [11]	0.6	3.7	20.3	80.5	99.2	0.36	2.0	0.0	100.0	0.0
Russet Burbank	0.5	5.6	13.7	83.0	100.0	0.38	12.0	14.2	85.0	0.8
FL 1625 [5]	1.4	5.8	33.7	83.1	100.0	0.43	9.9	80.3	18.7	1.0
Very Late										
A206 [13]	0.0	1.7	7.0	66.5	86.3	0.28	1.2	0.0	90.5	9.5
CR4#2 [6]	0.8	3.7	25.8	96.3	100.0	0.43	7.3	21.8	69.5	8.7
LSD ($P = 0.05$) [14]	**1.0**	**3.4**	**14.6**	**13.6**	**6.8**	**0.06**	**3.2**	**20.1**	**19.6**	**NS**

[1] Severity rated on a Horsfall-Barratt scale of 0 (no infection) to 11 (all foliage and stems dead). Ratings were converted to percentages.

[2] Relative area under the disease progress curve. Treatments are arranged in the table (within each maturity group) in order by ascending AUDPC.

[3] Yield from a 5-foot section of row. Tubers were placed on a 1.9-inch screen; those that went through were classed as B-size, and those that did not were classed as US#1A size or culls.

[4] Provided by D. Curwen, Department of Horticulture, Univ. of WI-Madison. A = developed at USDA-ARS Potato Breeding Program, Univ. of Idaho, Aberdeen, ID 83210; MN = developed at Univ. of Minnesota, Dept. of Hort. Sci., St. Paul, MN 55108; ND = Developed at N. Dakota State Univ., Fargo, ND 53105.

[5] Experimental breeding line obtained from M. Grasmick, Frito-Lay, Rhinelander, WI.

[6] Crossing clone provided by USDA Plant Resistance Laboratory, UW-Madison, J. Helgeson; Atlantic, Katahdin, CR4#2= *S. tuberosum* PI 203900.

[7] Cultivar or breeding line obtained from R. Plaisted, Cornell University, Ithaca, NY.

[8] Pentaploid progeny resulting from the cross of A206 (a somatic hybrid) x Katahdin

[9] Progeny resulting from [pentaploid (C31 or C75) backcrossed to Katahdin] x Atlantic.

[10] Progeny resulting from a pentaploid (C31 or C75) backcrossed to Katahdin.

[11] Breeding line from S. Peloquin, UW-Madison Horticulture Potato Breeding Program.

[12] Somatic hybrid (*S. brevidens* + potato PI 203900 backcrossed twice to CKatahdin) obtained from USDA Plant Resistance Laboratory, UW-Madison, J. Helgeson

[13] Somatic hybrid (*S. brevidens* + potato PI 203900) from USDA Plant Resistance Lab., UW-Madison, J. Helgeson

[14] Analysis of variance was performed on data, and Fisher's protected least significant difference (LSD) was calculated. NS = not significant at the $P = 0.05$ (or $P = 0.10$) level.

Appendix G

Evaluation of Chemical and Biological Treatments to Control Common Scab - Antigo, 1993

Field trials were established May 18 at the Langlade County Research Area, Antigo, WI to evaluate the efficacy of chemical and biological treatments to control common scab. The trial was planted in a field where common scab had been a persistent problem. Tubers of cultivar Snowden and LaChipper showing severe scab symptoms were mechanically cut by commercial growers into approximately 2 oz seedpieces. Snowden seedpieces were healed 6 days before planting and LaChipper seedpieces were cut the day before planting. The two breeding lines FL 1533 and FL 1625 were cut by hand. All chemical treatments were evaluated on both Snowden and LaChipper. Two chemicals, Potato Seed Treater MZ and Maxim 0.5% DP-A were applied to 20 lb seedpiece samples before planting, by shaking cut seedpieces in plastic bags with the chemical treatment until all seedpieces were uniformly coated. Fluazinam was applied in water as a furrow drench at 1 pt/A and 2 pt/A rates using a CO_2 backpack sprayer with a hand held boom equipped with a single LF3 809 nozzle delivering 42 GPA at 40 psi. For plots being treated with EXP60135A 10G, soil was raked over the seedpieces and the chemical was shaken in a 7" band over the row. Fluazinam was also applied as a foliar spray at the rate of 1 pt/A July 27, August 5 and 16. Application was made in water using a CO_2 backpack sprayer with a hand held boom equipped with four hollow cone nozzles delivering 33.3 GPA at 40 psi. Two nonpathogenic strains of *Streptomyces scabies,* obtained from Dr. Neil Anderson, University of Minnesota, Dept. of Plant Pathology, St. Paul, MN 55108, were evaluated for potential biological control activity on Snowden, LaChipper, FL 1533 and FL 1625. Inoculum was prepared on a vermiculite carrier and approximately 35 ml of inoculum was placed on top of each seedpiece before seedpieces were covered with soil. For all treatments, seedpieces were planted by hand and covered using hilling disks. At the time of planting air temperature was 56°F and soil temperature was 61°F at the depth of seedpiece placement.

Each plot contained two 15 foot rows spaced three feet apart with seedpieces planted 12 inches apart in the row. Plots were arranged in a randomized complete block design with four replications. Soil type was an Antigo silt loam with pH 5.9. Plots were fertilized with 250 lb/A of 0-0-62 broadcast before planting, 500 lb/A of 6-24-24 in the row at planting, and 100 lb/A of 33-0-0 as a prehill topdress application on June 28. Insects were controlled with a foliar spray of Asana XL at 0.4 pt/A on July 20. Weeds were controlled by pre-emergence application of Linex 50DF, 2 lb/A, June 4. A standard foliar fungicide program for early and late blight control included: Bravo 90DG (1.0 lb/A - July 28, August 13), and Manzate 200 DF (1.0 lb/A - July 20, Aug. 6; 2.0 lb/A - August 19, 25) . Vines were killed with application of Diquat, 1.0 pt/A + Valent X-77 spreader, 1.0 pt/100 gal., on August 25 and September 1. Total accumulation of rainfall during the growing season (May 18 - September 15) was 11 inches. No additional irrigation was applied to the plots.

For each treatment involving application of a chemical to the seedpiece, a sample was evaluated for seedpiece decay in our laboratory in Madison, WI. A total of forty seedpieces from each treatment (four replicates of 10 seedpieces) were placed in a mist chamber at 70°F and 100% RH. The mist kept seedpiece surfaces wet throughout the incubation period. Plastic canopies protected the seedpieces from dripping water and contamination from other samples. Decay severity was rated after 96 hours.

Emergence in the field was recorded for each plot June 24, July 1, July 8 and July 14. Treatments were also rated on July 14 for overall plant vigor -- a combined evaluation of

number, size and health of plants. Plots were mechanically harvested September 8. Approximately 60 tubers were chosen at random from each treatment plot and assessed for scab severity (area covered by lesions and lesion type). The total yield from each plot was graded into US#1A, undersize, and cull categories.

Treatment of four potato cultivars with a range of chemical and biological materials had little effect on seedpiece decay, plant emergence and plant vigor. Cultivars differed in their susceptibility to scab as evidenced by differences in the lesion area index and the lesion type index between cultivars. LaChipper appeared to be more susceptible than Snowden, FL1533 and FL1625. The most effective treatments on LaChipper for reducing the scab lesion area index included Potato Seed Treater MZ as a seed treatment and EXP60135A 10G in the furrow at planting. Application of *Streptomyces scabies* strains SS-2 and 93 appeared to increase scab severity on the LaChipper cultivar. Potato Seed Treater MZ, EXP60135A 10G in the furrow at planting, Maxim 0.5% DP-A and Fluazinam 2 pt/acre as a furrow drench at planting and Fluazinam applied as a foliar spray significantly reduced scab level on the Snowden cultivar. *S. scabies* strains also provided a modest level of scab control on this cultivar. The *S. scabies* strains reduced the scab lesion area index when applied to FL1533 and FL1625, but application of the strains to these cultivars had no effect on the scab lesion type index. Highest yields of LaChipper and Snowden were generally associated with the most effective chemical treatments. Treatment of FL1533 and FL1625 did not affect total yield or yield of US#1A tubers. Treatment of these cultivars with the *S. scabies* strains tended to increase the yield of undersize tubers. Application of *S. scabies* strains to three of the four cultivars provided some control of common scab. Chemical treatments generally provided better control than the biological materials. The potential for improved control by combining treatments, e.g. seedpiece treatment with Potato Seed Treater MZ and furrow application of EXP60135A, or *S. scabies* combined with a fungicide seed treatment, should be explored in future experiments.

Table 1. Effect of treatment on seedpiece decay, emergence and plant vigor.

Treatment and rate per acre	Percent Seedpiece Decay (mist chamber) [1]	Percentage of Plants Emerged on [2]				
		June 24	July 1	July 8	July 14	Vigor Rating[3]
LaChipper						
Untreated Control	7.7	71.7	76.3	80.4	90.4	86.7
Seed Shield Potato Seed Treater M-Z, seedpiece treatment, 1 lb/cwt	13.4	82.5	85.0	90.0	99.2	93.0
Fluazinam, furrow drench at planting, 2 pt/A	--	79.2	81.7	88.3	96.7	90.7
Fluazinam, furrow drench at planting, 2 pt/A	--	69.2	77.5	80.8	90.0	84.7
Fluazinam, foliar spray - 300, 450, 600 P-Days, 1pt/A [4]	--	62.5	65.8	76.7	90.0	84.7
EXP60135A 10G, 7" band in furrow, 33.6 oz./1000 row feet [5]	--	74.2	80.0	85.0	92.5	88.7
Maxim 0.5% DP-A, seedpiece treatment, 0.5 lb/cwt	17.9	70.0	78.3	85.0	92.5	86.7
Strain SS-2, applied to seed piece in row after planting, 35 ml/ seedpiece	--	71.7	78.3	75.0	80.0	75.5
Strain 93, applied to seed piece in row after planting, 35 ml/ seedpiece	--	68.3	72.5	72.5	82.5	78.5
LSD (LaChipper) ($P = 0.05$) [6]	**NS**	**8.1**	**10.2**	**7.4**	**7.9**	**8.2**
Snowden						
Untreated Control	17.8	92.5	93.8	96.3	97.5	96.3
Seed Shield Potato Seed Treater M-Z, seed treatment, 1 lb/cwt	8.3	88.3	92.5	90.8	97.5	96.7
Fluazinam, furrow drench at planting, 1 pt/A	--	95.8	96.7	96.7	99.2	97.8
Fluazinam, furrow drench at planting, 2 pt/A	--	93.3	92.5	91.7	98.3	97.3
Fluazinam, foliar spray - 300, 450, 600 P-Days, 1 pt/A [4]	--	92.5	95.0	96.7	98.3	97.2
EXP60135A 10G, 7" band in furrow, 33.6 oz./1000 row feet [5]	--	94.2	95.8	96.7	100.0	99.7
Maxim 0.5% DP-A, seedpiece treatment, 0.5 lb/cwt	15.1	91.7	93.3	90.8	94.2	93.5
Strain SS-2, applied to seed piece in row after planting, 35 ml/ seedpiece	--	92.5	96.7	95.8	96.7	96.2
Strain 93, applied to seed piece in row after planting, 35 ml/ seedpiece	--	95.8	98.3	95.0	100.0	98.7
LSD (Snowden) ($P = 0.05$) [6]	**NS**	**NS**	**NS**	**5.5***	**NS**	**NS**

Table 1. Effect of treatment on seedpiece decay, emergence and plant vigor (continued).

Treatment and rate per acre	Percent Seedpiece Decay (mist chamber) [1]	Percentage of Plants Emerged on [2]				Vigor Rating[3]
		June 24	July 1	July 8	July 14	
FL1533						
Untreated Control	--	38.3	43.3	50.0	64.2	58.0
Strain SS-2, applied to seed piece in row after planting, 35 ml/ seedpiece	--	67.5	78.3	80.0	83.3	80.3
Strain 93, applied to seed piece in row after planting, 35 ml/ seedpiece	--	73.3	85.0	81.7	90.0	86.0
LSD (FL1533) ($P = 0.05$) [6]	--	**NS**	**41.9***	**NS**	**NS**	**NS**
FL1625						
Untreated Control	--	80.0	87.5	89.2	87.5	84.8
Strain SS-2, applied to seed piece in row after planting, 35 ml/ seedpiece	--	85.8	79.2	93.7	95.8	91.8
Strain 93, applied to seed piece in row after planting, 35 ml/ seedpiece	--	82.5	79.2	85.0	90.8	87.8
LSD (FL1625) ($P = 0.05$) [6]	--	**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. Only treatments applied to the seedpiece were evaluated for seedpiece decay in the mist chamber.

2 Based on 30 seedpieces planted per plot.

3 An assessment of number, size and health of plants. Number of plants in each class was counted: 1= <3" tall, weak plants; 2=healthy, < 3" tall, 3=healthy, 3-6" tall; 4 = healthy, 6-9" tall; 5=healthy > 9". Based on 30 seedpieces/plot, those which failed to emerge were given a rating of 0. Average vigor/plant was calculated. Rating is expressed as a percentage of the maximum possible (30 plants in class 5).

4 Potato Crop Management software was used to calculate daily P-Day accumulations.

5 Bio-Dac formulation of Mocap.

6 Analysis of variance was performed on data, and Fisher's protected least significant difference (LSD) was calculated. NS = not significant at the $P = 0.05$ (or $P = 0.10$) level. * = Differences between treatments were significant at the $P = 0.10$ level, but not at $P = 0.05$.

Table 2. Effect of treatment on scab severity (percent tuber surface affected), lesion type, total yield, and proportion of US#1A, undersize and cull potatoes.

Treatment and rate per acre	Lesion Area Index [1]	Lesion Type Index [2]	Total Yield cwt/A	US#1A		Undersize		Culls	
				cwt/A	%	cwt/A	%	cwt/A	%
LaChipper									
Untreated Control	22.1	31.0	276.8	206.9	74.3	15.0	5.5	54.9	20.2
Seed Shield Potato Seed Treater M-Z, seedpiece treatment, 1 lb/cwt	13.1	18.6	305.3	236.8	78.1	17.9	5.8	50.6	16.2
Fluazinam, furrow drench at planting, 1 pt/A	23.2	32.2	297.9	225.4	76.1	12.9	4.6	59.5	19.3
Fluazinam, furrow drench at planting, 2 pt/A	17.9	25.8	293.7	200.6	68.0	14.3	4.9	78.8	27.0
Fluazinam, foliar spray - 300, 450, 600 P-Days, 1 pt/A [3]	24.8	32.5	282.4	198.2	70.1	15.2	5.6	69.0	24.3
EXP60135A 10G, 7" band in furrow, 33.6 oz./1000 row feet [4]	11.9	16.6	309.5	225.9	73.1	22.6	7.3	61.0	19.6
Maxim 0.5% DP-A, seedpiece treatment, 0.5 lb/cwt	19.1	28.1	325.1	220.8	67.6	16.3	5.1	88.0	27.3
Strain SS-2, applied to seed piece in row after planting, 35 ml/ seedpiece	26.3	42.0	232.1	166.7	71.1	16.0	7.0	49.4	21.9
Strain 93, applied to seed piece in row after planting, 35 ml/ seedpiece	36.0	40.7	221.8	142.8	64.3	12.6	5.8	66.4	29.9
LSD (LaChipper) ($P = 0.05$) [5]	**5.9**	**9.5**	**50.6**	**50.7**	**NS**	**6.0***	**NS**	**25.3**	**NS**
Snowden									
Untreated Control	14.0	21.8	280.1	224.0	80.0	30.3	10.9	25.9	9.1
Seed Shield Potato Seed Treater M-Z, seed treatment, 1 lb/cwt	8.1	12.8	317.5	267.8	84.2	24.4	7.9	25.3	7.9
Fluazinam, furrow drench at planting, 1 pt/A	10.5	18.1	329.6	263.2	79.8	29.6	9.0	36.8	11.2
Fluazinam, furrow drench at planting, 2 pt/A	9.9	11.9	319.2	261.5	81.8	25.9	8.1	31.8	10.0
Fluazinam, foliar spray - 300, 450, 600 P-Days, 1 pt/A [3]	8.4	11.7	293.7	234.6	79.7	24.1	8.1	35.0	12.1
EXP60135A 10G, 7" band in furrow, 33.6 oz./1000 row feet [4]	10.9	16.9	311.1	270.9	86.8	28.7	9.4	11.5	3.8
Maxim 0.5% DP-A, seedpiece treatment, 0.5 lb/cwt	7.0	12.6	321.7	267.0	83.0	32.8	10.2	21.9	6.8
Strain SS-2, applied to seed piece in row after planting, 35 ml/ seedpiece	11.9	15.5	257.1	211.8	82.2	28.6	11.4	16.8	6.4
Strain 93, applied to seed piece in row after planting, 35 ml/ seedpiece	13.2	20.9	247.0	203.4	81.8	31.2	12.9	12.3	5.2
LSD (Snowden) ($P = 0.05$) [5]	**4.9**	**NS**	**39.9**	**47.3**	**NS**	**NS**	**2.9**	**NS**	**NS**

Table 2. Effect of treatment on scab severity (percent tuber surface affected), lesion type, total yield, and proportion of US#1A, undersize and cull potatoes (continued).

Treatment and rate per acre	Lesion Area Index [1]	Lesion Type Index [2]	Total Yield	US#1A		Undersize		Culls	
			cwt/A	cwt/A	%	cwt/A	%	cwt/A	%
FL1533									
Untreated Control	24.2	25.4	160.7	118.2	73.4	7.9	4.9	34.6	21.7
Strain SS-2, applied to seed piece in row after planting, 35 ml/ seedpiece	15.7	24.2	206.2	154.4	75.3	14.2	6.9	37.6	17.8
Strain 93, applied to seed piece in row after planting, 35 ml/ seedpiece	14.7	17.9	227.7	171.0	75.3	12.9	5.6	43.8	19.1
LSD (FL1533) ($P = 0.05$) [5]	**8.2**	**NS**	**NS**	**NS**	**NS**	**5.3***	**1.8***	**NS**	**NS**
FL1625									
Untreated Control	15.0	18.4	155.8	131.4	84.3	8.7	5.6	15.7	10.0
Strain SS-2, applied to seed piece in row after planting, 35 ml/ seedpiece	7.9	9.3	176.1	147.7	84.0	6.7	3.8	21.7	12.3
Strain 93, applied to seed piece in row after planting, 35 ml/ seedpiece	10.9	17.2	171.5	143.7	84.1	10.8	6.4	16.9	9.5
LSD (FL1625) ($P = 0.05$) [5]	**5.7**	**NS**	**18.2***	**NS**	**NS**	**3.4***	**2.1***	**NS**	**NS**

1 Lesion area index Lesions were rated on a 5 point scale with: 0 = no lesions; 1 = 1-10% of the surface area of the tuber affected; 2 = 10-25% affected; 3 = 25-50% affected; 4 = 50-75% affected; 5 = > 75% affected. The lesion area index was calculated by summing the number in each class times the class number / 5 times the total number of tubers rated. The lesion index represents a percentage of the worst possible case (where all tubers were rated 5).

2 Lesion type index. Lesions were rated on a 5 point scale with: 0 = no lesions; 1 = superficial less than 10 mm; 2 = superficial, greater than 10 mm; 3 = raised, less than 10 mm; 4 = raised, greater than 10 mm; 5 = pitted scab. The type lesion index was calculated by summing the number in each class times the class number / 5 times the total number of tubers rated. The lesion index represents a percentage of the worst possible case (where all tubers were rated 5).

3 Potato Crop Management software was used to calculate daily P-Day accumulations.

4 Bio-Dac formulation of Mocap.

5 Analysis of variance was performed on data, and Fisher's protected least significant difference (LSD) was calculated. NS = not significant at the $P = 0.05$ (or $P = 0.10$) level. * = Differences between treatments were significant at the $P = 0.10$ level, but not at $P = 0.05$.

APPENDIX H

Evaluation of Early Blight Control with Fungicides - Hancock, 1993

Field plots were planted April 26, 1993 at the Hancock Research Station, Hancock, WI. US#1A Russet Burbank tubers were mechanically cut into approximately 2 oz. seedpieces and allowed to heal for 3 days before planting. The experiment was designed as a randomized complete block with four replications. Each plot consisted of four 25-foot-long rows spaced 36 inches apart with tubers 12 inches apart in the row. The design included additional pairs of drive rows so that soil in treatment rows would not be compressed by application equipment. Treatments were applied to all four rows of each plot. Soil type was a Plainfield sand with pH of 6.4. Plots were fertilized with 150 lb/A of 0-0-50 broadcast before planting, 650 lb/A of 6-24-24 in the row at planting and sidedress applications of 33-0-0 at 300 lb/A on May 21 and June 3. Insects were controlled with Di-Syston incorporated in the fertilizer applied at planting (0.5% a.i.) and with foliar sprays of Tiovel (2.7 pt/A, June 25) and Furadan 4F (1 qt/A, July 9). Weed control applications included: Linex 4L (1 pt/A, May 11) and Poast (1.5 pt/A) plus Peptoil (2 pt/A) on June 30. Fungicide treatments were applied at a rate equivalent to 26 gal water/A at 100 psi with a tractor-mounted boom sprayer pressurized with CO_2 and equipped with Tee Jet disc-type cone nozzles. Treatments began June 30 (300 P-Days) and continued at 7-day intervals, depending on treatment protocol, until August 25 for a total of 9 weeks. Treatment protocols using EBDC materials (Penncozeb, Maneb and Manzate) were designed to insure application of no more than 11.2 lb a.i. for the entire treatment period. Disease severity was rated weekly from July 6 until August 30 using the Horsfall-Barratt rating scale. Leaf tissue samples from plots treated with Bravo Zn, Bravo 720 (with no zinc), ASC66897 SDG, Penncozeb, Terranil (6L and 90 DF), TRA 0018 6L, and Maneb and the untreated control plots were submitted for analysis of zinc content on July 26 and August 23. The fourth or fifth leaf (petiole and leaflets) was collected from 20 plants in each replicate plot of these treatments. Leaves were washed in a 1% solution of mild detergent and samples were submitted to Agvise, Northwood, ND for analysis. Tissue from each plot was analyzed separately to permit analysis of variance. Vines were killed with an application of Diquat H/A (1 pt/A) plus Peptoil (1 pt/A) on September 7. The two center rows of each plot (a total of 50 feet of row) were machine harvested on September 20 and graded into 3 categories - US#1A, undersize, and culls. All potatoes in the US#1A category from each treatment plot were 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. Rainfall measured during the growing season (inches) was April (April 26-30) 0.45, May 5.71, June 6.86, July 8.38, August 5.33, and September 2.48 (through September 20). An additional 5.22 inches of water was applied as overhead sprinkler irrigation in 12 applications from May 21 until September 8.

Frequent rainfall combined with cool weather favored the spread and development of early blight in these field plots. Early blight was observed during the first week of July and the severity of early blight infection in unsprayed control plots exceeded 68% by August 11 and vines were rapidly defoliated by this disease subsequent to this rating. Significant differences between treatments in early blight severity were observed on July 26 and Aug. 11-30. The area under the disease progress curve (AUDPC) provides a convenient method to compare season-long disease progress between plots. Using the AUDPC to judge overall disease control, treatments that included EXP10386B, EXP10385B, Bravo 720 (1.5 pt/acre), Bravo Zn (1.5 and 2.13 pt/acre), Bravo 825 and ASC 66897 provided the best control. The addition of $ZnSO_4$ to Penncozeb sprays did not improve control when compared to plots treated with Penncozeb alone. Treatment with either Penncozeb, Maneb or Manzate 200 provided a similar level of control. Control in plots treated with mixtures of Penncozeb and Super-Tin did not differ from control in plots treated with

alternating sprays of Penncozeb and Super-Tin. With the exception of Fluazinam fungicide, most treatments provided good to excellent control of early blight through the August 11 rating. Yields were significantly affected by plot treatment. Lowest yields were observed in plots with the poorest early blight control. Differences in total yield between the highest yielding plots (370 cwt/acre) and the untreated control (298.7) represent a 23.9% increase in yield. Treatment with some fungicides significantly increased yield of US#1A tubers, but did not affect the yields of undersize and culls. Specific gravity also was not affected by treatment. While fungicide treatment did not have a significant impact on the size grades of potato tubers, higher numbers of tubers in the 6-10 oz size category for some treatments are reflected in large positive net treatment values. Using a fresh market pricing scheme to compare treatment values, several treatments exceeded $500 per acre in value.

Table 1. Effect of treatment on early blight severity (percent foliage infection).

Treatment and rate per acre	Percent foliage infection [1]					Relative AUDPC [2]
	7/6	7/19	8/2	8/18	8/30	
Untreated Control	0.4	2.2	19.5	91.4	99.1	0.41
Penncozeb 75DF 1.5 lb (a,b), Bravo Zn 4.4 F 0.75 pt + Super-Tin 80 WP 0.16 lb (c,d,e,f,g,h), Penncozeb 75DF 2.0 lb (i) [3]	0.5	2.7	15.0	77.5	97.8	0.33
Penncozeb 75DF 1.5 lb (a), 1.75 lb (b), Penncozeb 75DF 1.25 lb + Super-Tin 4F 4 fl oz (c,d,e,f,g,h), Penncozeb 75DF 2.0 lb (i)	0.5	2.8	10.6	76.8	98.1	0.32
Penncozeb 75DF 1.5 lb (a), 1.75 lb (c), 2.0 lb (e,g,i), Super-Tin 80 WP 0.16 lb (b,d,f,h)	0.4	1.9	11.7	74.2	98.0	0.32
Bravo Zn 4.4F 1.5 pt (a,b), Bravo Zn 4.4F 0.75 pt + Super-Tin 80 WP 0.16 lb (c,d,e,f,g,h), Bravo Zn 4.4 F 0.16 lb (i),	0.5	1.9	13.6	75.2	97.1	0.31
Kocide DF 2.0 lb (a,b), Penncozeb 75DF 1.25 lb + Super-Tin 80 WP 0.16 lb (c,d,e,f,g,h), Penncozeb 75DF 2.0 lb (i)	0.2	2.3	10.5	77.5	97.9	0.33
Penncozeb 75DF 2.0 lb (a,b), Penncozeb 75DF 1.25 lb + Super-Tin 80WP 0.16 lb (c,d,e,f,g,h), Penncozeb 75DF 2.0 lb (i)	0.5	2.1	10.1	79.8	98.0	0.34
Bravo 720 1.0 pt (a,b,c,d,e,f,g,h,i)	0.6	1.6	14.1	69.8	98.7	0.32
Bravo 720 1.5 pt (a,b,c,d,e,f,g,h,i)	0.2	1.9	7.8	74.2	97.0	0.30
Bravo Zn 4.4F 1.0 pt (a,b,c,d,e,f,g,h,i)	0.5	2.0	12.9	80.8	98.4	0.35
Bravo Zn 4.4F 1.5 pt (a,b,c,d,e,f,g,h,i)	0.1	1.9	9.7	71.1	98.4	0.30
Bravo Zn 4.4F 2.13 pt (a,b,c,d,e,f,g,h,i)	0.5	1.9	9.6	66.6	96.8	0.30
Bravo 825 1.4 lb (a,b,c,d,e,f,g,h,i)	0.5	1.9	6.3	73.0	98.5	0.30
ASC 66897 SDG 1.125 lb (a,b,c,d,e,f,g,h,i)	0.2	1.9	8.2	74.7	97.1	0.29
ASC 67098-Z 1.4 lb (a,b,c,d,e,f,g,h,i)	0.4	2.3	15.9	82.9	98.5	0.35
Terranil 6L 1.5 pt (a,b,c,d,e,f,g,h,i)	0.0	1.9	13.6	78.9	98.2	0.34
Terranil 90DF 1.25 lb (a,b,c,d,e,f,g,h,i)	0.4	2.6	12.7	80.3	97.8	0.33
TRA 0018 6L 1.5 pt (a,b,c,d,e,f,g,h,i)	0.8	2.0	14.5	77.9	98.4	0.34
Rovral 4 SC 1.5 pt + Triton AG98 8.33 1pt/100 gal (a,c,e,g)	0.6	1.8	11.4	84.5	99.3	0.35
EXP10370B 50WG 1.5 lb + Triton AG98 8.33 1pt/100 (a,c,e,g)	0.2	1.9	14.9	79.8	97.5	0.34
EXP10386B 4 SC 3.0 pt + Triton AG98 8.33 1pt/100 gal (a,b,c,d,e,f,g,h,i)	0.4	2.0	9.0	68.1	93.1	0.27
EXP10385B 4 SC 3.0 pt + Triton AG98 8.33 1pt/100 gal (a,b,c,d,e,f,g,h,i)	0.1	1.5	13.3	74.0	97.0	0.30
Penncozeb 75 DF 1.0 lb (a,b), 1.25 lb (c), 1.5 lb (d), 1.75 lb (e,f,g), 2.0 lb (h,i)	0.4	2.3	11.9	78.4	97.4	0.33
Penncozeb 75 DF 1.5 lb (a,b,c,d,e,f,g,h,i)	0.7	2.3	11.2	78.9	97.8	0.33
Maneb 75 DF 1.0 lb (a,b), 1.25 lb (c), 1.5 lb (d), 1.75 lb (e,f,g), 2.0 lb (h,i)	0.6	2.9	16.9	80.1	98.1	0.35
Penncozeb 75 DF 1.5 lb + $ZnSO_4$ 0.28 lb (a,b,c,d,e,f,g,h,i)	0.2	2.3	11.1	74.7	98.2	0.32
Manzate 200 DF 1.0 lb (a,b), 1.25 lb (c), 1.5 lb (d), 1.75 lb (e,f,g), 2.0 lb (h,i)	0.7	2.0	13.1	82.2	98.1	0.35
Fluazinam 500 1.0 pt (a,e,i)	0.5	2.5	20.6	90.6	99.4	0.40
LSD ($P = 0.05$) [4]	**NS**	**NS**	**NS**	**10.0**	**1.5**	**0.04**

1 Severity rated on a Horsfall-Barratt scale of 0 (no infection) to 11 (all foliage and stems dead). Ratings were converted to percentages.

2 Relative area under the disease progress curve.

3 Application dates: a = 30 Jun (300 P-Days), b = 7 Jul (350 P-Days), c = 14 Jul (400 P-Days), d = 21 Jul (450 P-Days), e = 28 Jul (500 P-Days), f = 4 Aug (550 P-Days), g = 11 Aug (600 P-Days), h = 18 Aug (650 P-Days), i = 25 Aug (700 P-Days). Potato Crop Management software was used to calculate daily P-Day accumulations.

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

Table 2. Effect of fungicide treatment on yield, proportion of US#1A, undersize and cull potatoes, and specific gravity.

Treatment and rate per acre	Yield (cwt/A)		Yield (%)			Specific
	Total	US#1A	6-13 oz	B	Culls	Gravity
Untreated Control	298.7	189.2	16.8	25.3	11.4	1.083
Penncozeb 75DF 1.5 lb (a,b), Bravo Zn 4.4 F 0.75 pt + Super-Tin 80 WP 0.16 lb (c,d,e,f,g,h), Penncozeb 75DF 2.0 lb (i) [1]	335.4	220.3	20.6	22.8	11.9	1.081
Penncozeb 75DF 1.5 lb (a), 1.75 lb (b), Penncozeb 75DF 1.25 lb + Super-Tin 4F 4 fl oz (c,d,e,f,g,h), Penncozeb 75DF 2.0 lb (i).	345.5	233.5	26.2	19.7	13.0	1.083
Penncozeb 75DF 1.5 lb (a), 1.75 lb (c), 2.0 lb (e,g,i), Super-Tin 80 WP 0.16 lb (b,d,f,h)	345.7	235.3	27.6	21.6	10.9	1.083
Bravo Zn 4.4F 1.5 pt (a,b), Bravo Zn 4.4F 0.75 pt + Super-Tin 80 WP 0.16 lb (c,d,e,f,g,h), Bravo Zn 4.4 F 0.16 lb (i),	341.6	222.7	20.3	23.8	11.0	1.083
Kocide DF 2.0 lb (a,b), Penncozeb 75DF 1.25 lb + Super-Tin 80 WP 0.16 lb (c,d,e,f,g,h), Penncozeb 75DF 2.0 lb (i)	346.4	227.7	21.9	21.8	12.7	1.082
Penncozeb 75DF 2.0 lb (a,b), Penncozeb 75DF 1.25 lb + Super-Tin 80WP 0.16 lb (c,d,e,f,g,h), Penncozeb 75DF 2.0 lb (i)	348.7	236.1	17.2	20.4	12.3	1.082
Bravo 720 1.0 pt (a,b,c,d,e,f,g,h,i)	334.0	225.8	24.1	21.7	10.8	1.085
Bravo 720 1.5 pt (a,b,c,d,e,f,g,h,i)	356.6	246.4	25.8	20.6	10.5	1.084
Bravo Zn 4.4F 1.0 pt (a,b,c,d,e,f,g,h,i)	323.9	207.6	21.8	25.5	11.0	1.084
Bravo Zn 4.4F 1.5 pt (a,b,c,d,e,f,g,h,i)	349.6	233.8	26.8	21.3	12.1	1.080
Bravo Zn 4.4F 2.13 pt (a,b,c,d,e,f,g,h,i)	357.0	233.6	20.4	22.4	12.4	1.082
Bravo 825 1.4 lb (a,b,c,d,e,f,g,h,i)	361.1	253.4	25.2	18.7	11.2	1.082
ASC 66897 SDG 1.125 lb (a,b,c,d,e,f,g,h,i)	360.4	252.9	30.2	18.3	12.0	1.084
ASC 67098-Z 1.4 lb (a,b,c,d,e,f,g,h,i)	320.7	206.3	21.6	22.0	13.6	1.081
Terranil 6L 1.5 pt (a,b,c,d,e,f,g,h,i)	345.5	232.4	20.5	20.9	12.1	1.084
Terranil 90DF 1.25 lb (a,b,c,d,e,f,g,h,i)	324.1	211.4	27.7	23.1	11.9	1.083
TRA 0018 6L 1.5 pt (a,b,c,d,e,f,g,h,i)	327.1	207.9	16.6	25.6	11.3	1.084
Rovral 4 SC 1.5 pt + Triton AG98 8.33 1pt/100 gal (a,c,e,g)	306.5	197.0	19.2	25.9	9.9	1.084
EXP10370B 50WG 1.5 lb + Triton AG98 8.33 1pt/100 (a,c,e,g)	337.9	214.1	13.3	24.7	13.0	1.084
EXP10386B 4 SC 3.0 pt + Triton AG98 8.33 1pt/100 gal (a,b,c,d,e,f,g,h,i)	370.0	251.0	25.2	20.0	12.4	1.086
EXP10385B 4 SC 3.0 pt + Triton AG98 8.33 1pt/100 gal (a,b,c,d,e,f,g,h,i)	345.5	225.7	20.2	23.0	12.1	1.083
Penncozeb 75 DF 1.0 lb (a,b), 1.25 lb (c), 1.5 lb (d), 1.75 lb (e,f,g), 2.0 lb (h,i)	332.9	225.2	20.3	21.1	11.2	1.083
Penncozeb 75 DF 1.5 lb (a,b,c,d,e,f,g,h,i)	359.7	242.7	28.9	20.0	12.7	1.084
Maneb 75 DF 1.0 lb (a,b), 1.25 lb (c), 1.5 lb (d), 1.75 lb (e,f,g), 2.0 lb (h,i)	331.4	222.4	22.3	21.2	12.1	1.080
Penncozeb 75 DF 1.5 lb + $ZnSO_4$ 0.28 lb (a,b,c,d,e,f,g,h,i)	348.7	228.6	20.5	23.6	11.3	1.083
Manzate 200 DF 1.0 lb (a,b), 1.25 lb (c), 1.5 lb (d), 1.75 lb (e,f,g), 2.0 lb (h,i)	332.9	208.0	24.7	26.1	12.3	1.083
Fluazinam 500 1.0 pt (a,e,i)	309.1	186.5	13.5	26.7	13.3	1.083
LSD ($P = 0.05$) [2]	**33.1**	**39.4**	**NS**	**NS**	**NS**	**NS**

1 Application dates: a = 30 Jun (300 P-Days), b = 7 Jul (350 P-Days), c = 14 Jul (400 P-Days), d = 21 Jul (450 P-Days), e = 28 Jul (500 P-Days), f = 4 Aug (550 P-Days), g = 11 Aug (600 P-Days), h = 18 Aug (650 P-Days), i = 25 Aug (700 P-Days). Potato Crop Management software was used to calculate daily P-Day accumulations.

2 Analysis of variance was performed on data, and Fisher's protected least significant difference (LSD) was calculated. NS = not significant at the $P = 0.05$ level.

Table 3. Effect of experimental treatment on value per acre of Russet Burbank tubers.

Treatment and rate per acre	Cost of Chemicals per Acre [1]	Gross Value of Yield			Effect of Treatment on Value [5]		
		Fresh Market [2]	Processing [3]	Traditional [4]	Fresh Market	Processing	Traditional
Untreated Control	0.00	2149.03	1249.05	1168.48	0.00	0.00	0.00
Penncozeb 75DF 1.5 lb (a,b), Bravo Zn 4.4 F 0.75 pt + Super-Tin 80 WP 0.16 lb (c,d,e,f,g,h), Penncozeb 75DF 2.0 lb (i) [6]	41.84	2610.40	1428.67	1402.37	419.53	137.78	192.05
Penncozeb 75DF 1.5 lb (a), 1.75 lb (b), Penncozeb 75DF 1.25 lb + Super-Tin 4F 4 oz (c,d,e,f,g,h), Penncozeb 75DF 2.0 lb (i)	40.28	2887.82	1501.07	1534.25	698.52	211.75	325.49
Penncozeb 75DF 1.5 lb (a), 1.75 lb (c), 2.0 lb (e,g,i), Super-Tin 80 WP 0.16 lb (b,d,f,h)	30.29	2929.54	1504.92	1560.64	750.22	225.58	361.86
Bravo Zn 4.4F 1.5 pt (a,b), Bravo Zn 4.4F 0.7 pt + Super-Tin 80 WP 0.16 lb (c,d,e,f,g,h), Bravo Zn 4.4 F 0.16 lb (i),	50.52	2587.09	1445.26	1397.66	387.54	145.69	178.65
Kocide DF 2.0 lb (a,b), Penncozeb 75DF 1.25 lb + Super-Tin 80 WP 0.16 lb (c,d,e,f,g,h), Penncozeb 75DF 2.0 lb (i)	43.90	2697.29	1468.54	1448.41	504.36	175.59	236.02
Penncozeb 75DF 2.0 lb (a,b), Penncozeb 75D 1.25 lb + Super-Tin 80WP 0.16 lb (c,d,e,f,g,h), Penncozeb 75DF 2.0 lb (i)	44.50	2679.71	1472.64	1428.83	486.18	179.09	215.85
Bravo 720 1.0 pt (a,b,c,d,e,f,g,h,i)	57.96	2713.55	1441.28	1446.67	506.56	134.27	220.23
Bravo 720 1.5 pt (a,b,c,d,e,f,g,h,i)	86.94	3018.95	1551.50	1598.34	782.98	215.51	342.92
Bravo Zn 4.4F 1.0 pt (a,b,c,d,e,f,g,h,i)	37.17	2561.46	1385.42	1373.15	375.26	99.20	167.50
Bravo Zn 4.4F 1.5 pt (a,b,c,d,e,f,g,h,i)	55.76	2890.03	1493.92	1547.08	685.25	189.11	322.84
Bravo Zn 4.4F 2.13 pt (a,b,c,d,e,f,g,h,i)	79.17	2740.57	1498.23	1471.39	512.37	170.01	223.74
Bravo 825 1.4 lb (a,b,c,d,e,f,g,h,i)	100.17	3047.95	1570.16	1611.24	798.75	220.94	342.59
ASC 66897 SDG 1.125 lb (a,b,c,d,e,f,g,h,i)	--[7]	3198.95	1585.42	1685.99	--	--	--
ASC 67098-Z 1.4 lb (a,b,c,d,e,f,g,h,i)	--[7]	2473.39	1350.42	1320.73	--	--	--
Terranil 6L 1.5 pt (a,b,c,d,e,f,g,h,i)	86.94	2738.31	1483.13	1456.89	502.34	147.14	201.47
Terranil 90DF 1.25 lb (a,b,c,d,e,f,g,h,i)	89.44	2670.86	1397.33	1427.89	432.40	58.84	169.97
TRA 0018 6L 1.5 pt (a,b,c,d,e,f,g,h,i)	--[7]	2393.08	1380.44	1298.04	--	--	--
Rovral 4 SC 1.5 pt + Triton AG98 8.33 EC 1pt/100 gal (a,c,e,g)	63.68	2281.96	1298.19	1232.94	69.25	-14.54	0.78
EXP10370B 50WG 1.5 lb + Triton AG98 8.3 EC 1pt/100 (a,c,e,g)	--[7]	2373.78	1416.87	1291.88	--	--	--
EXP10386B 4 SC 3.0 pt + Triton AG98 8.33 EC 1pt/100 gal (a,b,c,d,e,f,g,h,i)	--[7]	3065.90	1603.13	1625.45	--	--	--
EXP10385B 4 SC 3.0 pt + Triton AG98 8.33 EC 1pt/100 gal (a,b,c,d,e,f,g,h,i)	--[7]	2651.4	1474.13	1431.08	--	--	--
Penncozeb 75 DF 1.0 lb (a,b), 1.25 lb (c), 1.5 lb (d), 1.75 lb (e,f,g), 2.0 lb (h,i)	35.00	2594.47	1423.54	1386.78	410.44	139.49	183.30
Penncozeb 75 DF 1.5 lb (a,b,c,d,e,f,g,h,i)	33.75	3081.14	1567.91	1632.41	898.36	285.11	430.18
Maneb 75 DF 1.0 lb (a,b), 1.25 lb (c), 1.5 lb (d), 1.75 lb (e,f,g), 2.0 lb (h,i)	21.70	2658.43	1402.88	1419.55	487.70	132.13	229.37
Penncozeb 75 DF 1.5 lb + $ZnSO_4$ 0.28 lb (a,b,c,d,e,f,g,h,i)	34.43	2697.27	1482.61	1443.26	513.81	199.13	240.35
Manzate 200 DF 1.0 lb (a,b), 1.25 lb (c), 1.5 1 (d), 1.75 lb (e,f,g), 2.0 lb (h,i)	35.00	2557.47	1416.70	1395.99	373.44	132.65	192.51
Fluazinam 500 1.0 pt (a,e,i)	--[7]	2076.38	1277.47	1149.49	--	--	--

Table 3. Effect of experimental treatment on value per acre of Russet Burbank tubers (continued).

[1] Season-long cost of chemicals/Acre (rate, number of applications and retail cost are included in calculation). Retail prices used include:

Bravo 720 - $51.56/gal	Manzate 200 DF - $2.50/lb	Terranil 6L - $40.45/gal
Bravo 825 - $7.95/lb	Penncozeb - $2.50/lb	Terranil 90 DF - $6.93/lb
Bravo Zn - $33.00/gal	Rovral 4 SC - $81.44/gal	Triton AG98 - $20.00/gal
Kocide - $2.35/lb	Super-Tin 4F - $44.80/gal	$ZnSO_4$ - $0.27/lb
Maneb 75 DF - $1.55/lb	Super-Tin 80WP - $11.20/lb	

No price information was available for the experimental products:

ASC 66897 SDG	Fluazinam 500 F
ASC 67098-Z	TRA 0018 6L

[2] Typical 1993 fresh market pricing: 4-oz. $8.50/cwt, 6-13 oz. $20.00/cwt, > 13 oz. $25.00/cwt, undersize and culls $1.50/cwt.

[3] Typical 1993 processing contract pricing: Base price is $4.30/cwt for 60% US#1A, with 40% 6-13 oz. size and specific gravity of 1.076. For each 1% above or below 60% US#1A's the price increases or decreases $0.01/cwt. For each 1% above or below 40% 6-13 oz. size the price increases or decreases $0.01/cwt. For each .001 increase in specific gravity over 1.076 (to a maximum gravity of 1.081), add $0.03/cwt. Subtract $0.03/cwt for each .001 decrease in specific gravity below 1.076. Culls were not size graded in this experiment. It is assumed for these calculations that a similar proportion of culls would fall in the 6-13 oz range as US#1A's in this size range.

[4] Prices used: $2.00/cwt for undersize and culls; $4.00/cwt for <6 oz US#1A tubers; $10.00/cwt for 6-13 oz US#1A tubers; $4.00/cwt for >13 oz US#1A tubers.

[5] Gross value minus cost of chemicals applied was calculated and then the value of the check minus the value for the treatment was calculated.

[6] Application dates: a = 30 Jun (300 P-Days), b = 7 Jul (350 P-Days), c = 14 Jul (400 P-Days), d = 21 Jul (450 P-Days), e = 28 Jul (500 P-Days), f = 4 Aug (550 P-Days), g = 11 Aug (600 P-Days), h = 18 Aug (650 P-Days), i = 25 Aug (700 P-Days). Potato Crop Management software was used to calculate daily P-Day accumulations.

[7] Price information was not available. Calculations could not be done for net value or effect of treatment on value.

APPENDIX I

Effect of Ridomil Application in Grower Fields on Severity of Field and Storage Decay - 1993

Field trials were established to evaluate the effect of Ridomil applied to potato foliage during the growing season on decay caused by *Pythium* and *Phytophthora* species during tuber storage. The experiment was conducted on Russet Burbank potatoes in two grower production fields in cooperation with Ore-Ida personnel. Two spray widths in each field were treated twice with Ridomil MZ58 (in addition to the grower's normal fungicide treatment protocol); the remainder of the field received only the normal protectant fungicide sprays. Problems with *Pythium* and *Phytophthora* decay are expected to be more severe with soil compaction. Sampling sites were positioned to include the compacted drive rows used for all spray applications (compacted, +/- Ridomil) and rows located away from the drive rows (non-compacted, +/- Ridomil). Rows immediately adjacent to drive rows represented maximum soil compaction in the field with accompanying potential for poor drainage and bruising of tubers. Four replicate subplots, each 100 feet long and four rows wide, were arranged in a strip in each of the four treatment areas: Ridomil applied, compacted soil; no Ridomil applied, compacted soil; Ridomil applied, non-compacted soil; no Ridomil applied, non-compacted soil.

All fungicide treatments were applied by the grower and all other cultural practices were done according to standard grower practices. Each field was rated weekly for early blight development, from onset of disease to vinekill. At harvest, two strips were windrowed through each plot and all potatoes were collected from 60 feet of row in each plot for yield determination. These potatoes were graded into 3 categories - US#1A, undersize, and culls. All potatoes in the US#1A category from each treatment plot were 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. Specific gravity was determined for an 8-lb sample from each plot. In addition, at harvest 6 20-lb samples of US#1A size tubers were selected at random from each plot and stored at an Ore-Ida, Inc. storage at Plover, WI. Tubers will be evaluated for decay in January, 1994. The number of healthy and rotted tubers will be counted for each bag and the severity of decay assessed for each tuber with rot. Tubers from each plot will also be subjected to challenge inoculation with *Pythium* and *Phytophthora* spp. Another 40 lb sample was collected from each plot at harvest for evaluation of decay in the mist chamber. Four replicates (10 tubers each) from every plot were placed at 70 ° F, 100 % RH (continuous mist). These tubers were evaluated for bacterial soft rot, leak, and pink eye after 9 days.

Field #1

Seedpieces were planted May 1-10 in rows spaced 3 feet apart with 12 inch spacing within the row. Plots were fertilized with preplant broadcast application of 400 lb/A of 0-0-60, 500 lb/A of 9-25-14 in the row at planting, sidedress applications of 34-0-0, 67 lb/A, and 140 lb/A nitrogen (28% UAN; divided into five applications through the irrigation system). Insects were controlled with foliar application of Pounce 3.2 EC, 7 fl. oz./A, July 8. Weeds were controlled with application of Sencor DF, 0.5 lb/A, on June 2. Fungicide treatments were applied at a rate equivalent to 20 gal water/A at 40 psi. Fungicide treatments included Penncozeb 80W, 2.0 lb/A July 3 and July 18 (only areas not treated with Ridomil, on this date), Penncozeb 80W, 2.0 lb, + Super-Tin 4L, 3 fl. oz., July 29 and August 5 and Bravo 720, 1.5 pt/A, August 12. In addition, Ridomil MZ58, 2 lb/A, was applied to portions of the field July 18 and August 2. Irrigation was applied as needed. Plots were rated for severity of early blight on July 19, 16 and August 5, 19 and 23. Diquat, 1.0 pt, plus Penetrate 2, 1.0 pt, was

applied August 28 and September 7 to kill the vines. Plots were harvested and graded September 20 - September 28.

Early blight was first observed in mid-July. There was significantly less disease observed throughout the season in the plots located on non-compacted soil which received no Ridomil than in any of the other three treatments (Table 1). Only bacterial soft rot was observed on tubers incubated in the mist chamber for nine days and there were no significant differences among treatments for decay (Table 2). Incidence of decay was extremely low for all treatments and there were no significant differences between treatment means. Mean severity of decay showing symptoms typical of *Pythium* or *Phytophthora* was highest in compacted soil which did not receive Ridomil treatment but the difference was not significant due to the high level of variability between replicate plots for this treatment. There were significant differences between treatment means for yield (Table 3). Total yield was significantly higher for non-compacted soil where Ridomil treatment was applied. The yield of US#1A size tubers was significantly lower in compacted soil but there was no effect of Ridomil treatment on US#1A tubers. The non-compacted soil/no Ridomil treatment plots had significantly higher yield of tubers in the 6-13 oz category and lower yield of tubers less than 4 oz.

Table 1. Effect of Ridomil treatment and soil compaction on early blight severity (percent foliage infection).

Treatment		Percent foliage infection [1]					Relative
		7/19	7/26	8/5	8/19	8/23	AUDPC [2]
Ridomil	Compacted soil	0.5	1.1	2.3	10.7	52.4	0.7
Ridomil	Non-compacted soil	1.4	1.5	2.5	11.7	50.8	0.7
No Ridomil	Compacted soil	1.1	1.1	1.9	11.7	54.8	0.7
No Ridomil	Non-compacted soil	1.5	1.4	2.3	7.3	32.2	0.5
LSD ($P = 0.05$) [3]		**0.5**	**0.4***	**NS**	**4.1***	**14.3**	**0.2**
Ridomil treated (pooled for soil areas)		0.9	1.3	2.4	11.2	--[4]	--[4]
No Ridomil (pooled for soil areas)		1.3	1.2	2.1	9.5	--[4]	--[4]
LSD ($P = 0.05$) [3]		**0.4**	**NS**	**NS**	**NS**		
Compacted soil (pooled for Ridomil)		0.8	1.1	2.1	11.2	--[4]	--[4]
Non-compacted soil (pooled for Ridomil)		1.5	1.4	2.4	9.5	--[4]	--[4]
LSD ($P = 0.05$) [3]		**0.4**	**0.3**	**NS**	**NS**		

1 Severity rated on a Horsfall-Barratt scale of 0 (no infection) to 11 (all foliage and stems dead or complete decay). Ratings were converted to percentages.

2 Relative area under the disease progress curve.

3 Analysis of variance was performed on data, and Fisher's protected least significant difference (LSD) was calculated. NS = not significant at the $P = 0.05$ (or $P = 0.10$) level. * = differences between treatments were significant at the $P = 0.10$ level, but not at $P = 0.05$.

4 There was significant interaction between Ridomil treatment and soil condition on this date so it is inappropriate to pool data.

Table 2. Effect of Ridomil treatment and soil compaction on tuber decay.

Treatment		Mean Tuber Decay (mist chamber) [1,2]	Storage Decay [3]	
			% of tubers with any decay	Mean severity of rot [1,4]
Ridomil	Compacted soil	0.6	0.5	4.4
Ridomil	Non-compacted soil	1.9	0.1	0.0
No Ridomil	Compacted soil	0.7	0.7	25.2
No Ridomil	Non-compacted soil	1.4	0.8	9.9
LSD ($P = 0.05$) [5]		**NS**	**NS**	**NS**
Ridomil treated (pooled for soil areas)		1.3	0.3	2.2
No Ridomil (pooled for soil areas)		1.0	0.7	17.6
LSD ($P = 0.05$) [5]		**NS**	**NS**	**NS**
Compacted soil (pooled for Ridomil)		0.6	0.6	14.8
Non-compacted soil (pooled for Ridomil)		1.7	0.5	5.0
LSD ($P = 0.05$) [5]		**NS**	**NS**	**NS**

1 Severity rated on a Horsfall-Barratt scale of 0 (no infection) to 11 (complete decay). Ratings were converted to percentages.

2 Tubers were evaluated after 9 days in the mist chamber. Decay was due to bacterial soft rot only.

3 Tubers were placed in a commercial storage immediately after harvest. They were evaluated for decay on Jan. 4, 1994.

4 Only tubers with symptoms typical of *Phytophthora* or *Pythium* decay are included in this assessment.

5 Analysis of variance was performed on data, and Fisher's protected least significant difference (LSD) was calculated. NS = not significant at the $P = 0.05$ (or $P = 0.10$) level. * = differences between treatments were significant at the $P = 0.10$ level, but not at $P = 0.05$.

6 There was significant interaction between Ridomil treatment and soil condition on this date so it is inappropriate to pool data.

Table 3. Effect of fungicide treatment on yield, proportion of US#1A, undersize and cull potatoes, and specific gravity.

Treatment		Yield (cwt/A)		Yield (%)				Specific Gravity
		Total	US#1	US#1	6-13 oz	B	Culls	
Ridomil	Compacted soil	343.6	208.6	60.5	17.9	23.7	15.8	1.081
Ridomil	Non-compacted soil	448.7	312.5	69.6	25.9	15.9	14.5	1.085
No Ridomil	Compacted soil	343.4	205.2	59.0	15.0	21.8	19.1	1.086
No Ridomil	Non-compacted soil	385.0	306.7	79.1	38.9	7.6	13.3	1.083
LSD ($P = 0.05$) [1]		**51.4**	**49.4**	**6.9**	**10.1**	**5.1**	**4.7***	**0.003**
Ridomil treated (pooled for soil areas)		396.2	260.6	--[2]	--[2]	--[2]	15.2	1.083
No Ridomil (pooled for soil areas)		364.2	256.0	--[2]	--[2]	--[2]	16.2	1.085
LSD ($P = 0.05$) [1]		**36.4**	**NS**				**NS**	**NS**
Compacted soil (pooled for Ridomil)		343.5	206.9	--[2]	--[2]	--[2]	17.5	1.083
Non-compacted soil (pooled for Ridomil)		416.9	309.6	--[2]	--[2]	--[2]	13.9	1.084
LSD ($P = 0.05$) [1]		**36.4**	**34.9**				**3.3**	**NS**

1 Analysis of variance was performed on data, and Fisher's protected least significant difference (LSD) was calculated. NS = not significant at the $P = 0.05$ (or $P = 0.10$) level. * = differences between treatments were significant at the $P = 0.10$ level, but not at $P = 0.05$.

2 There was significant interaction between Ridomil treatment and soil condition on this date so it is not appropriate to pool data.

Field #2

Seedpieces were planted April 25 in rows spaced 3 feet apart with 12 inch spacing within the row. Plots were fertilized with preplant broadcast application of 600 lb/A of 0-0-60, 700 lb/A of 8-20-20 in the row at planting and sidedress application on May 28 of 350 lb/A 34-0-0. 28% UAN was applied through the irrigation system (total of 475 lb nitrogen/A). Insects were controlled with foliar applications of Thiodan 3EC, 1 qt/A June 28. Lexone 75 DF, 0.6 lb/A, plus Prowl 4L, 1.8 pt/A, was applied pre-emergence (May 25) for weed control. Fungicide treatments were applied at a rate equivalent to 20 gal water/A at 50 psi. Fungicide treatments included Penncozeb 75DF, 1.0 lb/A, plus Super-Tin 4L, 4 fl. oz./A applied weekly from June 28 to August 13 and Bravo 720, 2.0 pt/A, August 20. In addition, Ridomil MZ58, 2 lb/A, was applied to portions of the field June 28 and July 13. Plots were rated for early blight severity on July 19, 26, August 2, 12, 18, 23 and 30. Diquat, 1.0 pt/A, was applied September 3 and 11 to kill the vines. Plots were harvested September 29 and graded into US#1A, undersize and cull categories. Total rainfall for the season was 33.9" ; irrigation was applied as needed.

Early blight was first observed in mid-July. There were no significant differences between treatments for early blight severity observed on most of the rating dates (Table 4). The only decay observed on tubers incubated in the mist chamber for nine days was a low level of bacterial soft rot (Table 5). Incidence of decay after storage was slightly higher for field 2, but overall incidence was still very low. Mean severity of decay typical of *Pythium* or *Phytophthora* was highest in plots in non-compacted soil which was not treated with Ridomil, but there were no significant differences between means for either measure of storage decay. Yield was greater on non-compacted soil than on compacted and in plots not receiving Ridomil than on Ridomil treated plots (Table 6). The yield of US#1A size tubers was significantly lower in compacted soil but there was no effect of Ridomil treatment on US#1A tubers. The non-compacted soil/no Ridomil treatment plots had significantly higher yield of tubers in the 6-13 oz category and lower yield of tubers less than 4 oz.

Table 4. Effect of Ridomil treatment and soil compaction on early blight severity (percent foliage infection).

Treatment		Percent foliage infection [1]							Relative
		7/19	7/26	8/2	8/12	8/18	8/23	8/30	AUDPC [2]
Ridomil	Compacted soil	1.6	2.0	3.2	2.7	6.7	20.0	61.5	0.11
Ridomil	Non-compacted soil	0.8	1.5	2.9	2.6	5.4	19.5	63.6	0.10
No Ridomil	Compacted soil	1.5	1.3	2.6	2.5	4.4	19.8	67.5	0.10
No Ridomil	Non-compacted soil	1.5	1.5	2.2	2.7	6.2	21.0	68.1	0.11
LSD ($P = 0.05$) [3]		**0.5**	**NS**	**0.6**	**NS**	**NS**	**NS**	**NS**	**NS**
Ridomil treated (pooled for soil areas)		--[4]	1.8	3.1	2.7	6.0	19.8	62.5	0.10
No Ridomil (pooled for soil areas)		--[4]	1.4	2.4	2.6	5.3	20.4	67.8	0.11
LSD ($P = 0.05$) [3]			**NS**	**0.4**	**NS**	**NS**	**NS**	**6.1***	**NS**
Compacted soil (pooled for Ridomil)		--[4]	1.7	2.9	2.6	5.3	20.0	64.5	0.10
Non-compacted soil (pooled for Ridomil)		--[4]	1.5	2.6	2.7	5.8	20.3	65.9	0.11
LSD ($P = 0.05$) [3]			**NS**	**0.4***	**NS**	**NS**	**NS**	**NS**	**NS**

1 Severity rated on a Horsfall-Barratt scale of 0 (no infection) to 11 (all foliage and stems dead or complete decay). Ratings were converted to percentages.

2 Relative area under the disease progress curve.

3 Analysis of variance was performed on data, and Fisher's protected least significant difference (LSD) was calculated. NS = not significant at the $P = 0.05$ (or $P = 0.10$) level. * = differences between treatments were significant at the $P = 0.10$ level, but not at $P = 0.05$.

4 There was significant interaction between Ridomil treatment and soil condition on this date so it is inappropriate to pool data.

Table 5. Effect of Ridomil treatment and soil compaction on tuber decay.

Treatment		Mean Tuber Decay (mist chamber) [1,2]	Storage Decay [3] % of tubers with any decay	Storage Decay [3] Mean severity of rot [1,4]
Ridomil	Compacted soil	2.7	2.0	20.2
Ridomil	Non-compacted soil	1.8	1.4	18.8
No Ridomil	Compacted soil	0.0	1.9	13.3
No Ridomil	Non-compacted soil	1.2	1.8	29.7
LSD ($P = 0.05$) [5]		**1.7**	**NS**	**NS**
Ridomil treated (pooled for soil areas)		2.3	1.7	19.5
No Ridomil (pooled for soil areas)		0.6	1.8	21.5
LSD ($P = 0.05$) [5]		**1.2**	**NS**	**NS**
Compacted soil (pooled for Ridomil)		1.4	2.0	16.8
Non-compacted soil (pooled for Ridomil)		1.5	1.6	24.2
LSD ($P = 0.05$) [5]		**NS**	**NS**	**NS**

1 Severity rated on a Horsfall-Barratt scale of 0 (no infection) to 11 (complete decay). Ratings were converted to percentages.

2 Tubers were evaluated after 9 days in the mist chamber. Decay was due to bacterial soft rot only.

3 Tubers were placed in a commercial storage immediately after harvest. They were evaluated for decay on Jan. 4, 1994.

4 Only tubers with symptoms typical of *Phytophthora* or *Pythium* decay are included in this assessment.

5 Analysis of variance was performed on data, and Fisher's protected least significant difference (LSD) was calculated. NS = not significant at the $P = 0.05$ (or $P = 0.10$) level. * = differences between treatments were significant at the $P = 0.10$ level, but not at $P = 0.05$.

6 There was significant interaction between Ridomil treatment and soil condition on this date so it is inappropriate to pool data.

Table 6. Effect of fungicide treatment on yield, proportion of US#1A, undersize and cull potatoes, and specific gravity.

Treatment		Yield (cwt/A) Total	Yield (cwt/A) US#1	Yield (%) US#1	Yield (%) 6-13 oz	Yield (%) B	Yield (%) Culls	Specific Gravity
Ridomil	Compacted soil	391.9	294.5	75.0	51.6	9.1	15.8	1.086
Ridomil	Non-compacted soil	464.3	381.3	82.1	53.8	5.9	11.9	1.088
No Ridomil	Compacted soil	438.0	315.1	71.9	44.4	10.0	18.1	1.087
No Ridomil	Non-compacted soil	488.1	390.7	80.2	44.4	10.2	9.6	1.087
LSD ($P = 0.05$) [1]		**56.5**	**42.9**	**4.3**	**7.9**	**2.4**	**4.2**	**NS**
Ridomil treated (pooled for soil areas)		428.1	337.9	78.6	52.7	--[2]	13.9	1.087
No Ridomil (pooled for soil areas)		463.0	352.9	76.1	44.4	--[2]	13.8	1.087
LSD ($P = 0.05$) [1]		**40.0***	**NS**	**3.1***	**5.6**		**NS**	**NS**
Compacted soil (pooled for Ridomil)		415.0	304.8	73.5	48.0	--[2]	16.9	1.087
Non-compacted soil (pooled for Ridomil)		476.2	386.0	81.2	49.1	--[2]	10.8	1.087
LSD ($P = 0.05$) [1]		**40.0**	**30.3**	**3.1**	**NS**		**3.0**	**NS**

1 Analysis of variance was performed on data, and Fisher's protected least significant difference (LSD) was calculated. NS = not significant at the $P = 0.05$ (or $P = 0.10$) level. * = differences between treatments were significant at the $P = 0.10$ level, but not at $P = 0.05$.

2 There was significant interaction between Ridomil treatment and soil condition on this date so it is not appropriate to pool data.