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Evaluation of Potato Fungicides Applied at Planting

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The fungus, *Rhizoctonia solani* can cause serious yield and quality losses in potatoes. Early season losses occur as a result of *Rhizoctonia* stem and stolon canker; a lesion that girdles and kills potato stems emerging from the soil. Lesions on stolons can result in the loss of newly formed daughter tubers. This fungus may also develop black or dark brown propagules called sclerotia on the surface of potato tubers; a potentially serious blemish called black scurf. Tuber-borne sclerotia serve as a source of inoculum for disease when affected tubers are used as seed.

Research has shown that specific fungicides are effective as seed piece treatments in controlling the seed borne phase of the disease. Unfortunately, in some areas and soil types (Tulelake for example), *Rhizoctonia* is capable of persisting in the soil for a number of seasons. In the presence of soil borne inoculum, the protection obtained with seed piece fungicide treatments is often insufficient. Recently, field tests have demonstrated significant control of *Rhizoctonia* with fungicides sprayed on the soil directly in the seed furrow at planting.

Research was conducted in 2002, 2003 and 2004 at the Intermountain Research and Extension Center in Tulelake, to evaluate seed piece and in-furrow fungicide treatments alone, and in combination, for the control of *Rhizoctonia* caused disease. Similar experimental designs were used in each study year. All evaluated fungicide treatments were applied pre-plant or at planting. Dry powder seed piece treatments were hand applied to fresh cut potato seed a few days prior to planting. Liquid seed piece treatments were applied a few days prior to planting using a commercial recycling pressure sprayer. The in-seed-furrow fungicide treatments were applied at planting, using a nitrogen pressured sprayer with spray nozzles mounted directly between planter disc openers. The in-seed-furrow application resulted in a two inch band of fungicide applied to the soil immediately prior to seed placement. The seed furrow was then closed and packed by the press wheels. The goal was to create an envelope of treated soil around the planted seed piece. In trials that included pre-plant incorporated Vapam treatments, the Vapam was sprayed on the surface of the planting bed and immediately incorporated into the soil 3 inches deep, with a rotary power tiller. All Vapam treatments were applied three weeks prior to planting.

Each treatment was applied to four replicated plots arranged in a randomized complete block design. Individual plots consisted of four 36 inch wide potato rows, 50 feet long.

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Following planting, potatoes were grown to maturity using locally accepted cultural and pest management practices. At maturity, all plots were mechanically harvested and tubers were weighed and graded for size and quality.

The original intent in all experiments was to conduct destructive potato plant harvests during the growing season to rate the prevalence of *Rhizoctonia* stem and stolon canker symptoms. Unfortunately, in each year there was insufficient disease expression in the untreated plots to warrant full evaluation of each treated plot. Thus, measurement of treatment response is limited to the potato yield evaluation.

2002

The fungicide treatments evaluated in the 2002 experiment are shown on table 1, along with the harvest data. This trial was planted May 17 and harvested October 2. Observed differences in yield were generally not statistically significant; but, there were some interesting trends. The percentage of US #1 grade potatoes increased with the in-seed-furrow Blocker treatment, the pre-plant Vapam application and some of the combination treatments. Interestingly, the lowest total tuber yields and yields of US #1 potatoes occurred in the seed piece treatment only plots and in the untreated control plots. Yields, though not statistically significant, were increased by each of the other fungicide application and combinations (figure 1). The highest measured yield was in plots with the combination of Tops MZ seed treatment and Blocker in-seed-furrow application.

2003

The treatments evaluated and the yield results for the 2003 experiment are presented on table 2. This trial was planted on May 30 and harvested on October 13. The yield results were very similar to the 2002 study. While yield differences among treatments were generally not statistically significant, the trend for modest increases in yield with fungicide treatment was clear. The poorest yield and lowest yield of US #1 potatoes occurred in the untreated plots (figure 2). The best yield occurred in the plots treated with the combination of a seed piece treatment and in-seed-furrow applied Moncut. The Moncut combination treatments produced a 7% yield increase over the untreated control plots.

2004

The 2004 experiment was planted on May 14 and harvested on October 9. The treatments evaluated and resultant potato yields are presented in table 3. The outcomes of this trial were different from the previous two years. There was no apparent trend for an increase in total yield with fungicide application. Indeed, the total tuber yields in the untreated control plots were among the highest yields measured in the trial (figure 3). On the other hand, a few treatments, most notably the Maxium MZ/Moncut combinations, did produce a statistically significant increase in the percentage of US #1 tubers.

Summary and Conclusions

Due to the lack of *Rhizoctonia* symptom expression in each of the field trials, it was not possible to evaluate the efficacy of tested fungicides in controlling *Rhizoctonia* disease. However, the general trend toward modest yield increases with fungicide application suggests that some unseen level of disease (or other yield limiting factor) was partially controlled by these treatments. The data also suggests that seed treatment is important, even in the absence of visible disease and that the in-seed-furrow fungicide applications provided benefits in addition to the seed piece treatment. An interesting question is "are such fungicide applications cost effective in the absence of visible disease, or are they best considered insurance against unpredictable disease outbreaks?" The current material costs for the fungicide and fungicide combination applications evaluated, range from the extreme low of $0.21 per acre to the extreme high of $150 per acre. Assuming average yields and a fair price year, the modest 5% yield increases observed with many of these treatments would return approximately $180 per acre to the grower (based upon yields of 450 cwt per acre and an $8 per acre price). Thus, many of these fungicide treatments can be cost effective, even in the absence of any visible disease. It is assumed that the benefit would increase with increased disease pressures.

Table 1. Potato Yield and Grade. 2002 Potato Fungicide Trial (1642)

#	Treatment	Application*	Rate	Application Dates	Yield (cwt/a)							
						US #1						
					Total Yield	Total 1's	>12 oz	8-12 oz	4-8 oz	<4 oz	culls	% 1's
1	Tops MZ	ST	1 lb/100 lb seed	5/1	383	249	31	70	148	69	65	65
2	Maxim MZ	ST	0.5 lb/100 lb seed	5/1	390	254	27	70	158	87	48	65
3	Quadris	ISFS	0.6 oz/1000' of row	5/17	394	261	32	70	160	81	52	66
4	Blocker	ISFS	10 oz/1000' of row	5/17	413	289	41	84	164	78	46	70
5	Vapam	PPI	35 GPA	4/12	409	283	48	84	151	69	57	69
6	Tops MZ + Quadris	ST + PPI	1lb/100 lb seed + 0.6 oz/1000' of row	5/1 + 5/17	402	278	36	74	169	78	45	69
7	Tops MZ + Blocker	ST + ISFS	1 lb/100 lb seed + 10 oz/1000' of row	5/1 + 5/17	460	284	34	78	172	111	64	63
8	Maxim MZ + Quadris	ST + ISFS	0.5 lb/100 lb seed + 0.6 oz/1000' of row	5/1 + 5/17	394	259	27	63	169	84	51	66
9	Maxim MZ + Blocker	ST + ISFS	0.5 lb/100 lb seed + 10 oz/1000' of row	5/1 + 5/17	408	282	33	72	177	90	36	69
10	Vapam + Topz MZ	PPI + ST	35 GPA + 1 lb/100 lb seed	4/12 + 5/1	426	303	46	86	172	74	49	71
11	Vapam + Maxim MZ	PPI + ST	35 GPA + 0.5 lb/100 lb seed	4/12 + 5/1	422	287	32	82	173	80	55	68
12	Control				387	254	27	69	158	83	50	66
				Mean	407	274	34	75	164	82	51	67
				CV%	13.1	10.3	28.8	18	10.7	27	30	5
				LSD(0.05)	NS	NS	NS	NS	NS	NS	NS	2.7

* Application Code

ST = Seed Treatment

ISFS = In-Seed-Furrow-Spray

PPI = Preplant incorporated

Table 2. Potato Yield and Grade. 2003 Potato Fungicide Trial (1643)

#	Treatment	Application*	Rate	Application Dates	Yield (cwt/a)							
						US #1						
					Total Yield	Total 1's	>12 oz	8-12 oz	4-8 oz	<4 oz	Culls	I%
		ST	1 lb/100 lb seed	5/28	363	245	33	85	128	53	2.7	68
		ST	0.5 lb/100 seed	5/28	368	252	35	81	136	54	5.7	69
		ST	.08 fl oz/100' of row	5/28	356	218	23	67	128	56	8.3	61
		ISFS	0.6 fl oz/1000' of row	5/30	354	232	27	84	121	51	5.9	65
		ST + ISFS	1 lb/100 lb seed + 0.6 fl oz/1000' of row	5/28 + 5/30	361	230	24	84	122	54	2.7	64
		ST + ISFS	seed piece coated	5/28 + 5/30	358	223	27	70	126	49	2.4	62
		ISFS	10 fl oz/1000' of row	5/30	350	233	31	82	121	51	8.6	67
		ST + ISFS	1 lb/100 lb seed + 10 fl oz/1000' of row	5/28 + 5/30	367	250	37	84	129	48	3.9	68
		ST + ISFS	0.5 lb/100 seed + 10 fl oz/1000' of row	5/28 + 5/30	353	229	21	81	126	57	4.8	65
		ISFS	1.11 oz/1000' of row	5/30	365	225	32	77	116	51	4.2	62
		ST + ISFS	1 lb/100 lb seed + 1.11 oz/1000' of row	5/28 + 5/30	368	240	29	87	124	51	3.6	65
		ST + ISFS	0.5 lb/100 seed + 1.11 oz/1000' of row	5/28 + 5/30	373	247	29	81	137	58	7.5	66
		———	———	———	347	221	35	75	112	47	12.1	64
		———	———	———	344	209	27	71	111	49	17.7	61
				Mean	359	233	29	79	124	52	6.4	65
				CV%	4.1	10.3	30.6	16.8	9.3	9.3	142.7	8.1
				LSD (	NS	NS	NS	NS	NS	6.9	NS	NS

* Application Code

ST = Seed Treatment

ISFS = In-Seed-Furrow-Spray

Table 3. Potato Yield and Grade. 2004 Potato Fungicide Trial (1644)

#	Treatment	Application*	Rate	Application Dates	Yield (cwt/a)							
						US #1						
					Total Yield	Total 1's	>12 oz	8-12 oz	4-8 oz	<4 oz	culls	% 1's
1	Tops MZ	ST	1 lb/100 lb seed	5/13	422	309	74	98	137	54	59	73
2	Maxim MZ	ST	0.5 lb/100 lb seed	5/13	417	306	72	92	142	67	45	73
3	Maxim MZ Lq	ST	0.08 fl oz/1000' of row	5/13	415	300	63	94	142	66	49	72
4	Quadris	ISFS	0.6 fl oz/1000' of row	5/14	428	316	80	93	143	52	60	74
5	Tops MZ + Quadris	ST + ISFS	1 lb/100 lb seed + 0.6 fl oz/1000' of row	5/13 + 5/14	404	294	66	92	136	55	56	73
6	Maxim MZ + Quadris	ST + ISFS	0.5 lb/100 lb seed + 0.6 fl oz/1000' of row	5/13 + 5/14	415	294	70	82	142	65	56	71
7	Blocker	ISFS	10 fl oz/1000' of row	5/14	420	287	81	82	125	61	72	68
8	Tops MZ + Blocker	ST + ISFS	1 lb/100 lb seed + 10 fl oz/1000' of row	5/13 + 5/14	397	276	59	85	132	57	64	70
9	Maxim MZ + Blocker	ST + ISFS	0.5 lb/100 lb seed + 10 fl oz/1000' of row	5/13 + 5/14	415	290	68	87	135	69	57	70
10	Moncut	ISFS	1.11 oz/1000' of row	5/14	417	305	80	96	129	62	50	73
11	Tops MZ + Moncut	ST + ISFS	1 lb/100 lb seed + 1.11 oz/1000' of row	5/13 + 5/14	421	307	77	88	142	65	50	73
12	Maxim MZ + Moncut	ST + ISFS	0.5 lb/100 lb seed + 1.11 oz/1000' of row	5/13 + 5/14	418	312	73	93	146	64	43	74
13	Vapam	PPI	35 GPA	4/17	407	286	64	86	136	60	61	70
14	Vapam + Maxim MZ	PPI + ST	35 GPA + 0.5 lb/100 lb of seed	4/17 + 5/13	415	314	70	98	146	60	40	76
15	Vapam + Moncut	PPI	35 GPA + 1.11 oz/1000' of row	4/17 + 5/14	1	291	76	85	130	61	57	71
16	Vapam + Moncut + Maxim MZ	PPI + ISFS + ST	35 GPA + 1.11 oz/1000' of row + 0.5 lb/100 lb seed	4/17 + 5/14 + 5/13	429	320	67	95	158	65	44	75
17	Control	—	—	—	427	301	66	100	135	58	67	71
18	Control	—	—		424	297	71	95	131	59	68	70
				Mean	417	300	71			61	56	72
				CV%	5.1	6.5	19			15	20.1	3.5
				LSD(0.05)	NS	NS	NS			NS	15.8	3.5

Application Code
ST = Seed Treatment
ISFS = In-Seed-Furrow-Spray
PPI = Preplant incorporated

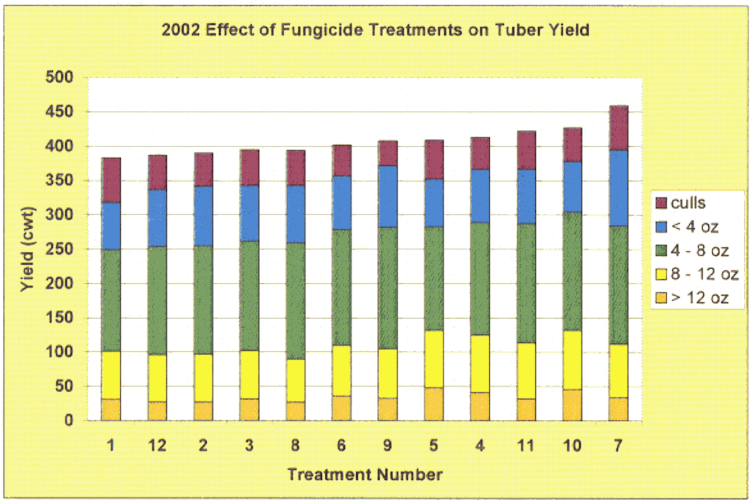

Figure 1. Results of 2002 potato tuber yield, size and grade in response to fungicide treatments. Numbered fungicide treatments are identified on table 1.

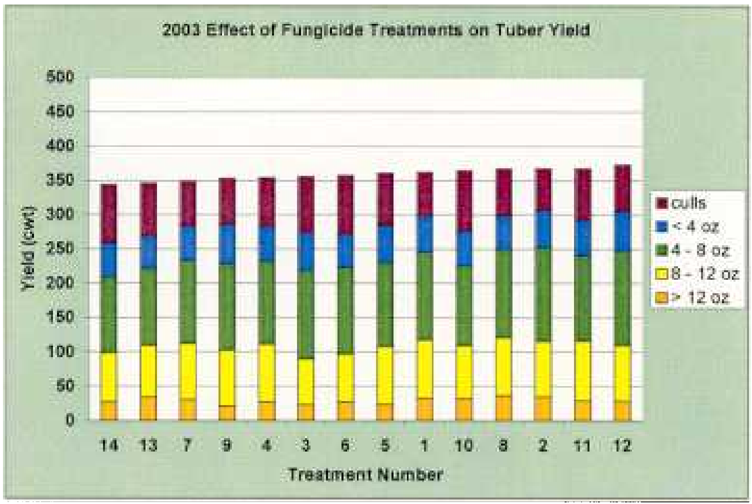

Figure 2. Results of 2003 potato tuber yield, size and grade in response to fungicide treatments. Numbered fungicide treatments are identified on table 2.

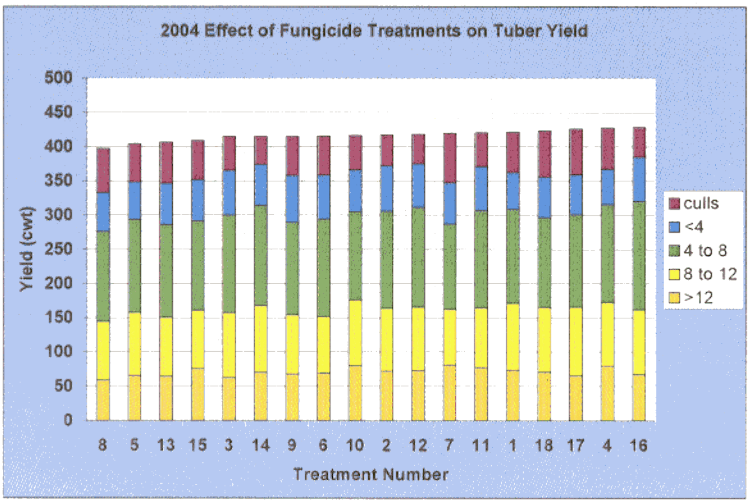

Figure 3. Results of 2004 potato tuber yield, size and grade in response to fungicide treatments. Numbered fungicide treatments are identified on table 3.