EFFECTS OF SEEDPIECE TREATMENT WITH FUNGICIDES ON RUSSET NORKOTAH PERFORMANCE

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Abstract

Experiments were conducted at four locations in 1998 and 1999 to evaluate the effects of seedpiece treatment with several fungicides on agronomic performance of Russet Norkotah seed with high levels of silver scurf (*Helminthosporium solani*) infection. Tuber samples from each site were delivered to the Hermiston Agricultural Research and Extension Center (HAREC) after harvest and incubated for 3 weeks at 20^0C in darkness at high relative humidity to favor silver scurf development. Tubers were evaluated for incidence and severity of silver scurf infection after incubation.

At the Klamath Experiment Station (KES), effects of seed treatment fungicides on yield, grade, and tuber size distribution were not statistically significant in either year. Average U.S. No.1 yields were 317 and 464 cwt / acre in 1998 and 1999, respectively. Cold, wet soil conditions in 1998 delayed planting until June 9, 4 weeks after seed was cut and suberized. Seed vigor was uniformly reduced by the delay between cutting and planting. In 1999, seed was planted on May 20, 1 day after cutting and treating. Average total No.1 yields over 2 years ranged from 365 and 366 cwt / acre for sorbic acid and sodium carbonate treatments, respectively, to 420 and 423 cwt / acre for Tops MZ at 16 and 12 oz / cwt of cut seed, respectively.

In both years, Maxim, Tops MZ, and Quadris reduced the incidence of silver scurf relative to an untreated control. Tops 5.0, Dithane 8 percent, sorbic acid, and sodium carbonate were not effective against silver scurf infection. PCNB in combination with Maxim did not improve silver scurf control over Maxim alone.

Introduction

Silver scurf has become a significant problem affecting the quality of stored fresh market potatoes. Development of resistance to control measures used on stored crops and greater susceptibility to silver scurf in Russet Norkotah than Russet Burbank are factors in the

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increased concern for this disease in the Pacific Northwest. New, more virulent strains of *Phytophthora infestans* (late blight) have become established in all production areas of the northwest, including the Klamath Basin. Rhizoctonia (*rhizoctonia solani*) is endemic in the Klamath Basin, causing stand and tuber quality losses when favorable environments such as cool, wet spring conditions occur.

New seed treatment fungicides are being developed to protect crops from seed-borne infections of these diseases. Recent research in several potato production regions has demonstrated suppression of silver scurf with Maxim (fludioxonil), Dithane (mancozeb) products, and Quadris (azoxystrobin). Dithane and related compounds also have shown promise for control of seed-borne late blight. Formulations of Tops (thiophanate methyl) are reported to provide control of rhizoctonia. Research in the Eastern U.S. has shown some potential for control of silver scurf using sorbic acid,potassium salt, and sodium carbonate applied to tubers going into storage.

Studies were initiated in 1998 at four locations to evaluate standard and new products and formulations for control of seed-borne silver scurf. This report summarizes effects of fungicide seed treatments on yield and quality of Russet Norkotah grown at Klamath Falls, and incidence and severity of silver scurf infection following incubation of harvested tubers under conditions favorable for silver scurf development.

Procedures

Russet Norkotah seed lots with high silver scurf infection levels were obtained for evaluation at all locations both years. At KES, seed lots were hand-cut to 1.5 to 2.0 oz / seedpiece. Cut seed batches of 50 lb were treated with appropriate products and mixed between containers several times to achieve uniform distribution of product on seedpieces. One batch was left untreated. All lots were isolated from each other after treatments were applied. In 1998, cut and treated seed lots were held in storage at approximately 50^0F and 95 percent relative humidity for 33 days before planting on June 9 because of wet soil conditions. In 1999, seed was planted on May 20, the day after cutting and treating.

In both years, randomized complete block design experiments included four replications. Seed was planted at 8.7-inch spacing in 32-inch rows with a two-row, assisted-feed planter. Fertilizer was banded on both sides of rows at 160 lb N, 80 lb P_2O_5, 80 lb K_2O, and 140 lb S / acre. Individual plots were one row with 42 seedpieces. The PCNB treatment was applied in the seed furrow at planting.

Weeds were controlled with Dual, Prowl, and Matrix applied at recommended rates. Irrigation was applied according to crop needs using solid-set sprinklers arranged in a 40- by 48-foot pattern. Fungicides were applied aerially as needed for control of early blight (*alternaria solani*) and late blight. Insecticide applications included Di-syston applied at 3.0 lb ai / acre in the seed furrow at planting, and one foliar application of Monitor at 0.75 lb ai / acre in mid-season. Vines were desiccated with Diquat applied at 1.0 pt / acre on September 19, 1998 and September 6, 1999.

Potatoes were harvested with a one-row, digger-bagger on October 12, 1998 and September 21, 1999. All tubers from each plot were weighed in the field at harvest. Two 25-tuber subsamples were saved from each plot and delivered to HAREC within a few days of harvest. Subsamples were maintained in isolation in cardboard boxes until placed in incubation. Remaining tubers were graded to USDA standards at KES in October. As subsamples were taken from consecutive tubers during harvest, grades determined from remaining tubers were assumed to be representative of tubers in subsamples.

Within a few days of arrival of samples at HAREC, tubers were placed in incubation chambers at 20^0C for 3 weeks at high relative humidity in darkness. Evaluations after incubation determined the percent of tubers with silver scurf infection (incidence) and the percent of tuber surface infected. A disease symptom index (severity) was calculated as the mean percentage of infection for all tubers. The second subsample was placed in storage and maintained under typical storage conditions for 6 months followed by an incubation period as described above. Only results from short-term storage are presented in this report. Results were similar following long-term storage in 1998.

Yield and grade data were analyzed statistically using MSUSTAT software. The 2-year yield data was evaluated using a split-plot design with year as the main plot and treatment as the split-plot. Least significant differences (LSD) are based on *student's t* at the 5 percent probability level (p=0.05). Silver scurf disease incidence and severity differences among treatments were evaluated using *Fisher's* LSD (p=0.05).

Results and Discussion

Effects of seed treatments on plant emergence were minor in both years. In 1999, there appeared to be a slight delay in emergence and a slightly lower final plant stand for the sodium carbonate treatment (Table 1). Crop vigor was much better in 1999. This translated to higher yields across all treatments (Tables 2, 3, and 4). One possible reason for low yields in 1998 is the fact that seed was stored for 33 days after cutting because wet soil conditions delayed planting.

Yield and grade differences among seed treatments were small and mostly non-significant in both years. In 1999, tuber size was slightly larger in the sodium carbonate treatment. This effect probably was related to missing plants in this treatment. Averaged over 2 years, Tops MZ treatments produced the highest yields of No. 1s, and sorbic acid and sodium carbonate achieved the lowest yields. Although the differences were not significant at the 5 percent probability level, they were nearly so at the 10 percent level (p=0.10). For practical purposes, economic benefits would justify the use of Tops MZ based on yield advantages observed over 2 years.

Effects of seed treatments on silver scurf infection following incubation at favorable conditions for disease development are shown for KES samples in Table 5. Although infection levels varied between locations, treatment effect trends were similar for crops grown at the other sites. The Tops 5.0, Dithane 8 percent, sorbic acid, and sodium carbonate treat-

ments did not provide control of silver scurf. Maxim, Tops MZ, and Quadris were effective in reducing infection incidence in both years and severity in 1998. The addition of PCNB to the Maxim treatment did not improve disease control.

Summary

These trials demonstrated efficacy for control of seed-borne silver scurf for Tops MZ, Maxim, and Quadris at KES and each of the three other sites. Tops 5.0, Dithane, sorbic acid, and sodium carbonate were ineffective. Tops MZ treatment produced the highest yield over 2 years while the lowest yields were observed for sorbic acid and sodium carbonate treatments. Although yield differences were not statistically significant at the 5 percent probability level, results indicate yield performance would more than justify seed treatment costs for Tops MZ, irrespective of disease suppression.

Potato late blight has become a serious and costly problem for the northwest potato industry. Most production areas experienced infections and significant crop losses to late blight in 1997 and 1998. Seed transmission is thought to be the major source of infections. Although late blight did not occur in arid regions of the northwest in 1999, future infestations are highly likely. The availability of seed treatment products with efficacy against late blight seed transmission offers very useful protection. Additional research at other locations continues to pursue the issue of seed treatment efficacy for late blight transmission control.

Table 1. Effect of fungicide seed treatments on emergence of Russet Norkotah grown at KES, Klamath Falls, OR, 1998 and 1999.

Treatment		Emergence			
product	rate	6/30/98	7/8/98	6/16/99	6/24/99
	lb/cwt	%			
Tops 5.0	0.5	64	96	70	97
Tops MZ	1.0	66	90	62	97
Tops MZ	0.75	68	92	57	95
Maxim	0.5	61	91	71	97
Quadris	0.5	73	96	58	95
Dithane 8%	1.0	52	91	63	95
Sorbic Acid K Salt	1.0	66	93	61	92
Sodium Carbonate	1.0	61	90	48	89
Maxim + PCNB [1]	0.5	75	95	80	98
Untreated Control	---	68	96	54	96
Mean		65	90	62	95

[1] PCNB applied in seed furrow at 1.65 lb/1,000 feet of row.

Table 2. Effect of fungicide seed treatments on yield, grade, and tuber size distribution of Russet Norkotah grown at KES, Klamath Falls, OR, 1998.

Treatment	Yield U.S. No. 1s				Yield			
	4-8 oz	8-12 oz	>12 oz	total	Bs	No. 2s	culls	total
	cwt/acre							
Tops 5.0	208	75	29	312	85	21	16	434
Tops MZ (1.0 lb/cwt)	163	72	102	337	62	19	17	435
Tops MZ (0.75 lb/cwt)	188	69	89	346	76	27	5	454
Maxim	150	78	63	291	58	30	10	389
Quadris	182	77	73	332	52	26	19	429
Dithane 8%	186	85	55	326	64	22	16	427
Sorbic Acid K Salt	174	55	44	273	73	34	16	396
Sodium Carbonate	196	76	36	308	78	25	17	428
Maxim + PCNB	204	77	68	349	69	22	14	454
Untreated Control	183	67	52	302	63	41	14	420
Mean	184	73	61	317	68	27	14	426
CV (%)	14	27	60	14	25	57	87	12
LSD (p = 0.05)	NS	NS	NS	NS	NS	NS	NS	NS

Table 3. Effect of fungicide seed treatments on yield, grade, and tuber size distribution of Russet Norkotah grown at KES, Klamath Falls, OR, 1999.

Treatment	Yield U.S. No. 1s				Yield			
	4-8 oz	8-12 oz	>12 oz	total	Bs	No. 2s	culls	total
	cwt/acre							
Tops 5.0	166	162	147	475	31	35	7	549
Tops MZ (1.0 lb/cwt)	167	201	135	503	33	17	0	554
Tops MZ (0.75 lb/cwt)	188	173	139	500	34	31	0	565
Maxim	190	153	120	463	35	23	1	522
Quadris	158	165	108	431	33	17	0	482
Dithane 8%	200	127	122	449	39	22	0	510
Sorbic Acid K Salt	154	161	143	458	25	26	3	511
Sodium Carbonate	103	134	187	424	29	24	5	482
Maxim + PCNB	229	151	86	465	55	18	0	538
Untreated Control	178	149	142	469	28	32	0	529
Mean	174	157	133	464	34	24	2	524
CV (%)	16	20	28	9	25	55	340	8
LSD (p = 0.05)	41	NS	NS	NS	13	NS	NS	NS

Table 4. Two-year summary of effects of fungicide seed treatments on yield, grade, and tuber size distribution of Russet Norkotah grown at KES, Klamath Falls, OR, 1998 and 1999.

Treatment	Yield U.S. No. 1s				Yield			
	4-8 oz	8-12 oz	>12 oz	total	Bs	No. 2s	culls	total
	cwt/acre							
Tops 5.0	187	118	88	393	58	28	12	491
Tops MZ (1.0 lb/cwt)	165	136	119	420	48	18	8	494
Tops MZ (0.75 lb/cwt)	188	121	114	423	55	29	3	509
Maxim	170	116	91	377	47	27	5	455
Quadris	170	121	91	382	43	21	9	455
Dithane 8%	193	106	88	387	52	22	8	469
Sorbic Acid K Salt	164	108	93	365	49	30	10	453
Sodium Carbonate	149	105	111	366	53	24	11	455
Maxim + PCNB	217	114	77	407	62	20	7	496
Untreated Control	180	108	97	385	46	37	7	474
Mean	179	115	97	391	51	26	8	475
Year main effect:								
1998	184	73	61	317	68	27	14	426
1999	173	158	133	464	34	24	2	524
CV (%)	21	59	41	36	10	55	95	30
LSD (p = 0.05)	NS	49	29	100	4	NS	6	NS
Treatment effect:								
CV (%)	15	23	37	11	26	55	120	10
LSD (p = 0.05)	27	27	NS	NS	NS	NS	NS	NS

Table 5. Effect of seedpiece fungicides on the incidence and severity of silver scurf in Russet Norkotah grown at KES, Klamath Falls, OR, in 1998 and 1999.

Treatment product	rate	Silver scurf incidence [1] 11/98		Silver scurf incidence [1] 11/99		Silver scurf severity [2] 11/98		Silver scurf severity [2] 11/99	
	lb/cwt	%		%					
Tops 5.0	0.5	19	cd[3]	27	abc	4.2	cd	2.2	a
Maxim	0.5	1	a	10	a	0.2	a	0.1	a
Tops MZ	1.0	10	abc	19	a	2.1	abc	1.5	a
Qudais	0.5	3	ab	16	a	0.8	ab	1.3	a
Tops MZ	0.75	7	abc	21	ab	1.6	abc	0.9	a
Dithane 8%	1.0	23	de	47	c	5.8	d	2.9	a
Sorbic Acid	1.0	17	cd	27	abc	5.7	d	1.6	a
Sodium Carbonate	1.0	25	e	44	bc	7.0	d	3.9	a
Maxim + PCNB	0.5	3	ab	13	a	0.6	ab	0.8	a
Untreated Control	---	14	bc	23	ab	3.8	bcd	1.1	a
Mean		12		24		3.2		1.6	

[1] Average percentage of tubers showing symptoms after 3 weeks incubation at 20° C in darkness at high humidity.

[2] Formula based on percentage of tuber surface showing symptoms after 3 weeks incubation at 20° C in darkness at high humidity.

[3] Means followed by the same letter are not significantly different at p = 0.05 based on Fishers LSD (p = 0.05).