FUNGICIDE OPTIONS FOR MANAGING RHIZOCTONIA CANKER

Jeff Miller and Terry Miller, Miller Research LLC

INTRODUCTION

Rhizoctonia is caused by the fungus *Rhizoctonia solani* and can be a serious problem in potato production. The fungus lives in the soil and can live on decaying plant material. The fungus can also be carried on potato seed tubers. Rhizoctonia affects stems, stolons, and tubers. Infection on underground stems and stolons is characterized by brown lesions. When infections are severe, the stem or stolon can be damaged to the point where the end of the stem or stolon is cut off completely from the plant.

Rhizoctonia does not always result in reduced yields, but can reduce the quality of a potato crop. Infections on stolons can result in tubers being clipped off from the plant, and fewer tubers are produced per plant. With fewer per tubers per plant, tubers are larger and have more malformations. Rhizoctonia can also grow on tuber surfaces. These masses of the fungal growth can develop into sclerotia (small, black structures on the tuber surface). These sclerotia look like dirt that won't wash off the tuber. This phase of the disease has been called black scurf. The black scurf blemish can be detrimental to tubers destined for the fresh market.

In some cases, the fungus can grow on the aboveground portion of the stem. In these cases, the fungus appears as a white growth at the base of the plant. This symptom has been confused with white mold at times. Unlike white mold, this fungal growth is completely superficial, can be wiped off the plant, and only occurs on the base of the main stems near the soil surface.

OPTIONS FOR MANAGING RHIZOCTONIA

The following tools can help manage Rhizoctonia:

1. Plant disease-free seed
2. Crop rotation
3. Cultural practices that promote rapid emergence
4. Fungicide applications

Since Rhizoctonia can be carried on seed, it is helpful to plant disease-free seed. Sclerotia on tuber seed pieces can be a significant source of the pathogen. Research from North Dakota State University has shown that sclerotia covering as little as 5% can significantly increase both the stem and stolon canker and black scurf phase of the disease. It may not be possible to obtain disease completely free of Rhizoctonia sclerotia. However, the cleaner the seed, the lower the disease pressure on the subsequent crop.

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Dennis Atkinson, a graduate student at the University of Idaho also showed that the level of Rhizoctonia black scurf on Ranger Russet seed tubers had a significant impact on the percentage of daughter tubers developing black scurf. For potato seed tubers planted at the Aberdeen Research and Extension Center, the level of black scurf decreased as the incidence of black scurf on seed tubers decreased. Seed with a low incidence of scurf (no visible sclerotia) resulted in 78% of the daughter tubers without scurf, while seed with a moderate (less than 10% of the tuber surface covered with sclerotia) or high incidence of scurf (more than 10% of the tuber surface covered with sclerotia) resulted 63% and 59% of tubers without scurf, respectively.

Research from Agriculture Canada has shown that the length of crop rotation can affect the severity of Rhizoctonia canker and black scurf (Peters et al., 2005). Potatoes planted in a two year rotation had significantly more diseased stolons, more severe stem canker, and more black scurf compared to potatoes planted in a three year rotation. In fact, black scurf was three times more severe on a two year rotation compared to a three year rotation. This study also evaluated the impact of tillage and found that Rhizoctonia was similar under conventional and minimum tillage practices.

Cultural practices that promote rapid plant emergence can help suppress Rhizoctonia development on stems and stolons. Seed tubers should be planted at the minimum depth necessary to avoid daughter tuber greening for the variety being planted. As soil temperatures warm up, emergence time decreases. Planting into cooler soils increases the risk of Rhizoctonia stem and stolon canker. Anything that delays emergence can result in increased Rhizoctonia.

FUNGICIDES FOR MANAGING RHIZOCTONIA

Fungicides for managing Rhizoctonia are available as either seed treatments or in-furrow sprays. Work sponsored by the Idaho Potato Commission and conducted at Miller Research the last three years has shown that fungicides can be effective in controlling stem and stolon canker, but that control decreases as the season progresses. Tables 1-3 show research results where Russet Burbank seed tubers were either treated with a seed treatment, treated with an in-furrow fungicide application at planting, or received both. Products with rates listed as fl oz/a (fluid ounces per acre) were applied as in-furrow sprays and products with rates listed as lbs or fl oz/cwt (hundredweight) were applied as seed piece treatments. The data presented in the tables represent either a disease severity rating or a percentage of the below ground portion of the stem area covered with symptoms. In both cases, the values could possible range from 0-100 with higher values indicated greater disease severity (more of the underground stems and stolons infected).

In 2006, many treatments were effective in reducing stem and stolon canker in early June (Table 1). In-furrow fungicides such as Quadris at the low and high rate, Headline at the low and high rate, and Moncut significantly reduced disease. By July, however, Quadris at the low rate was not as effective as the high rate and Headline at both rates did not reduce disease compared to the untreated. In August, Moncut was the only in-furrow fungicide still reducing disease.

Maxim FS, Moncoat MZ, and Evolve were all effective in reducing disease in either June or July (Table 1). Maxim FS was the only seed piece treatment showing a significant reduction by August. The combination of Maxim FS with Quadris resulted in the lowest disease severity in June and July, but did not control disease by August. Mancozeb alone was not effective in reducing Rhizoctonia on stems and stolons.

In 2007, fungicide treatments only provided protection through June (Table 2). The only in-furrow fungicides to significantly reduce Rhizoctonia severity were Quadris at the high rate and Headline. In this trial all fungicides were applied using 15 gallons/acre of water volume. This is more than is typically used by growers. Previous research indicated that water volume was not important. However, using Headline at a volume more typical of commercial practices (6 gallons/acre) was as not effective as 15 gallons/a in this trial (compare treatment 8 with treatment 1).

The seed piece treatments of Maxim FS, Moncoat MZ, and an experimental product with a similar active ingredient as Moncoat MZ (NAI-3301) were effective in reducing early season Rhizoctonia (Table 2). Combinations of seed piece treatments and in-furrow fungicides were also effective. Quadris combined with Maxim FS (treatment 4, both at the low rates), or Moncoat MZ, and when Moncut was combined with Maxim FS resulted in effective Rhizoctonia control.

Disease was severe enough in 2007 that significant differences among treatments were not observed in July and August. However, treatments that did reduce Rhizoctonia in June generally had the lowest percentage of Rhizoctonia on stems and stolons in August.

Table 1. Effect of in-furrow applications and seed treatments for Rhizoctonia stem and stolon canker under high disease pressure conditions.

No.	Treatment name	Rate/acre	Rhizoctonia Disease Severity Index June 16	July 20	August 8
1	Untreated check		43 ab	58 ab	71 a
2	Quadris	5.8 fl oz/a	26 cde	49 abc	64 ab
3	Quadris	8.7 fl oz/a	19 de	44 c	63 abc
4	Headline	6 fl oz/a	30 cd	48 bc	69 ab
5	Headline	12 fl oz/a	25 cde	48 bc	72 a
6	Moncut	1 lb/a	24 cde	39 cd	48 c
7	Maxim FS Quadris	0.04 fl oz/cwt 5.8 fl oz/a	15 e	31 d	64 ab
8	Maxim FS	0.08 fl oz/cwt	33 bc	39 cd	55 bc
9	Moncoat MZ	1 lb/cwt	23 cde	40 cd	64 ab
10	Evolve	0.75 lb/cwt	31 cd	58 ab	59 abc
11	Mancozeb	1 lb/cwt	51 a	59 a	73 a
LSD (P=.10)			12.061	10.996	15.459
Standard Deviation			10.051	9.164	12.883
CV			34.55	19.69	20.14
Treatment Prob(F)			0.0011	0.0021	0.2199

Means followed by same letter do not significantly differ (P=.10, LSD)

Table 2. Effect of seed piece treatment/in-furrow applications on Rhizoctonia disease severity in 2007.

Description				Rhizoc Index		% Rhizoc
Rating Date				June 26	July 18	August 20
Days After Planting				49	71	104
Trt	Treatment		Rate			
1	Untreated check			38 a	48 a	70 a
2	Quadris	8.7	fl oz/a	23 b-e	48 a	56 a
3	Quadris	5.8	fl oz/a	25 a-e	48 a	45 a
4	Quadris	5.8	fl oz/a	14 ef	34 a	55 a
	Maxim FS	0.04	fl oz/cwt			
5	Maxim FS	0.08	fl oz/cwt	24 b-e	51 a	71 a
6	Moncoat MZ	1	lb/cwt	18 c-f	46 a	82 a
7	NAI-3301	1	lb/cwt	11 f	36 a	62 a
8	Headline*	9	fl oz/a	32 ab	43 a	61 a
9	Headline *	6	fl oz/a	28 abc	38 a	71 a
	Moncut	0.75	lb/a			
10	Quadris	5.8	fl oz/a	18 c-f	38 a	52 a
	Moncoat MZ	1	lb/cwt			
11	Moncut	1	lb/a	25 a-d	48 a	63 a
12	Moncut	0.75	lb/a	16 def	29 a	52 a
	Maxim FS	0.04	fl oz/cwt			
13	Headline	9	fl oz/a	23 b-e	43 a	60 a
LSD (P=.05)				1.21t	19.0	18.7
Standard Deviation				1.02t	15.9	15.7
CV				21.46	36.98	25.63
Grand Mean				4.75t	43.04	61.29
Treatment Prob(F)				**0.0331**	0.6791	0.1592

Means followed by same letter do not significantly differ (P=.05, LSD)
t=Mean descriptions are reported in transformed data units (log[x+1]), and are not de-transformed.
Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL. Significant values are bolded.
*Applied using 6.16 gal/acre spray mix. All other treatments applied at 15 gal/acre.

Rhizoctonia disease pressure was low in 2008 (Table 3). Disease severity was only 11% in the untreated check in June and only progressed to 46% by August. (For comparison, the severity index and percentage of disease was in 2006 and 2007 was over 70 by August). The combination of Quadris and Maxim FS, Headline, and the combination of a biological in combination with Maxim MZ resulted in significant disease reduction all season long.

Table 3. Effect of seed piece treatments and in-furrow applications on severity of Rhizoctonia stem and stolon canker.

Description		% Rhizoctonia Stem and Stolon Canker		
Rating Date		June 23	July 16	Aug 5
Trt Treatment	Rate			
1 Untreated check		11 a	36 a	46 a
2 Quadris	8.7 fl oz/a	3 d	15 c	24 cd
Maxim	0.04 fl oz/cwt			
3 Headline	9.2 fl oz/a	6 bc	12 c	29 bcd
4 Maxim MZ	0.5 lb/cwt	8 ab	19 c	40 ab
5 Biological	4 fl oz/cwt	11 ab	34 ab	37 abc
6 Biological	4 fl oz/a	9 ab	41 a	36 a-d
7 Biological	4 fl oz/cwt	9 ab	22 bc	47 a
MZ Dust	1 lb/cwt			
8 Biological	4 fl oz/cwt	4 cd	15 c	22 d
Maxim MZ	0.5 lb/cwt			
LSD (P=.10)		0.2t	13.0	14.1
Standard Deviation		0.2t	10.8	11.8
CV		20.83	51.09	34.57
Grand Mean		0.89t	21.21	34.05
Treatment Prob(F)		**0.0046**	**0.0019**	**0.0682**

Means followed by same letter do not significantly differ (P=.10, LSD).
t=Mean descriptions are reported in transformed data units (log[x+1]), and are not de-transformed. Back transformed data are listed in the columns.
Mean comparisons performed only when ANOVA Treatment Prob(F) is significant at the pre-determined mean comparison level (<0.10). Significant values are bolded.

The results of these three trials show that fungicides can be used effectively to reduce stem and stolon canker. Control of black scurf on the tubers has been much more difficult to obtain. The work of Dennis Atkinson cited earlier in this article also evaluated the impact of seed treatment and in-furrow fungicides on black scurf. His work showed that a seed piece treatment (Maxim MZ) was more effective than an in-furrow fungicide (Quadris) in reducing black scurf on Ranger Russet tubers. However, reports from growers in the field indicate that some varieties are more susceptible and that fungicide treatments have not been successful in reducing black scurf.

SUMMARY

Although it has not been possible to completely control Rhizoctonia, some control in the early part of the season will reduced tuber malformation and therefore increase the percentage of US #1 tubers.

As the amount of Rhizoctonia on seed increased, the efficacy of the fungicides will decrease. Managing Rhizoctonia requires utilizing all management techniques. Growers need to plant clean seed, practice good crop rotation (at least 3 years or more), promote

rapid emergence, and use effective seed piece treatments and in-furrow fungicides in order to obtain the most effective disease control.

REFERENCES

Peters, R. D., Carter, M. R., Sanderson, J. B., Reddin, R., MacIsaac, K. A., Macdonald, I. K., Carragher, D., Darrach, D., Power, M. I., and Sturz, A. V. 2005. Influence of crop rotation and tillage practices on Rhizoctonia canker and black scurf, 2003. Plant Disease Management Reports (online) Report 20:PT001.