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Evaluation of a Biological Agent for Control of *Helminthosporium solani*

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Abstract: Silver scurf of potatoes is an economically important disease of potato caused by *Helminthosporium solani* Durieu and Mont. Serenade ASO™, a biological control agent for *H. solani*, was tested as postharvest treatment for silver scurf control in 2004 and 2005. Serenade ASO reduced both the incidence and the severity of silver scurf under low disease pressure and the severity of silver scurf under high disease pressure. Under low disease pressure, Serenade ASO delayed the onset of silver scurf until 5 months of storage. Serenade ASO has potential as a biological control of silver scurf under low disease pressure.

Key words: *Solanum tuberosum*, postharvest, silver scurf, biological control

INTRODUCTION

Potato silver scurf, an economically important disease of potato (*Solanum tuberosum* L.), is caused by the fungus *Helminthosporium solani* Durieu and Mont. (Errampalli *et al*., 2001; Lennard, 1980). Discoloration of the tuber surface reduces the marketability of infected tubers (Jellis and Taylor, 1977; Lennard, 1980). Silver scurf lesions are contained within the tuber periderm (Heiny and McIntyre, 1983); older lesions take on a silvery appearance when moist, providing the common name for the disease. Portions of the infected tuber periderm may slough off during storage leading to weight loss.

Seed tubers are the primary source of inoculum for this disease (Jellis and Taylor, 1977; Read and Hide, 1984; Tsror and Peretz-Alon, 2004). However, soil borne propagules of *H. solani* are able to survive and cause infection (Firman and Allen, 1995; Jellis and Taylor, 1977; Merida and Loria, 1994). Tubers may become infected during the growing season and the symptoms of silver scurf may be evident before harvest (Heiny and McIntyre, 1983; Merida *et al*., 1994). Disease severity increases during long-term storage of tubers owing to repeated cycles of sporulation and infection and to lesion expansion (Jellis and Taylor, 1977; Rodriguez *et al*., 1996). Post harvest losses owing to silver scurf have increased in North America and Europe since *H. solani* developed resistance to thiabendazole (TBZ) and other benzimidazole fungicides that have been used as post harvest and seed-piece treatments on potato tubers (Bains *et al*., 1996; Firman and Allen, 1995; Hide *et al*., 1988; Kawchuck *et al*., 1994; Merida and Loria, 1990; Cunha and Rizzo, 2003). In the United States, TBZ is commonly applied to potato tubers before storage to control Fusarium dry rot. This likely provided control of silver scurf until resistance developed.

Silver scurf control in storage is needed as current chemical and cultural control strategies are inadequate. Errampalli *et al*. (2001) recently reviewed chemical control of *H. solani* with fungicides than TBZ. Tsror and Peretz-Alon (2002) reported reduced silver scurf with pre- and post-storage treatments, but high levels of the pathogen were still present. Olson *et al*. (2003) established that post harvest treatments of chlorine dioxide were not a viable control strategy for silver scurf. The interest in reducing pesticides applied directly to edible food is ongoing. Elson *et al*. (1997) and Michaud *et al*. (2002) have investigated various microorganisms of biological control of silver scurf. In this study, a biological control agent was evaluated for silver scurf control. Serenade ASO (*Bacillus subtilis* (QST 713)) was tested as a postharvest tuber treatment for silver scurf control.

MATERIALS AND METHODS

In early October 2004 and in 2005, locally grown Russet Burbank and Shepody tubers from Northern Maine were harvested 30 days past vine kill. The extended time between vine kill and harvest was to encourage infection by *H. solani*, the casual agent of silver scurf. Freshly harvested tubers of each variety were left untreated, treated with thiabendazole (Mertect 340-F™) at the rate of 12 mL per 907 kg, or treated with Serenade ASO at the rate of either 95 or 190 mL per 907 kg. All treatments were applied at a volume of 1900 mL per 907 kg. The

treated tubers were stored at 10°C with a relative humidity greater than 95% in a randomized complete block design. After six months of storage, tubers were removed and placed at room temperature in incubation chambers where they were moistened weekly. Thirty days later, the tubers were removed, washed and visually evaluated for incidence and severity symptoms of silver scurf. Data were recorded on a percentage basis and analyzed with Duncan's New Multiple Range Test.

An additional study was performed in 2005. The same treatments were applied at the same rate and stored as before but tubers were removed, washed and rated for severity symptoms of silver scurf after 3, 4, 5, or 6 months of storage. In this study, tubers were not placed into incubation chambers; they were visually evaluated on the day of removal. Again, data were recorded on a percentage basis and analyzed with Duncan's New Multiple Range Test.

RESULTS

The Russet Burbank tubers exhibited no symptoms of silver scurf therefore data are not presented. Incidence and severity of silver scurf on Shepody potatoes after 6 months of storage for both 2004 and 2005 appear in Table 1. Greater disease incidence and severity was present in 2004 than in 2005. In 2004, silver scurf severity was significantly reduced from the control and the Mertect 340-F application only at the highest rate of Serenade ASO. In 2005, the year with the lower disease pressure, Serenade ASO reduced the both the incidence and the severity of silver scurf at both the high and the low rate compared to control and the Mertect 340-F application.

Severity of silver scurf on Shepody potatoes during 6 months of storage in 2005 in the additional study appear in Table 2. Silver scurf appeared in the control and the Mertect 340-F treatment within 3 months of storage. Serenade ASO delayed the onset of silver scurf until 5 months of storage.

Table 1: Incidence and severity of silver scurf on Shepody potatoes after 6 months of storage, 2004 and 2005 crop

		Silver scurf			
		2004		2005	
Treatment	Rate*	Incidence (%)	Severity (%)	Incidence (%)	Severity (%)
Check	0	100a	83.75a**	100.00a	88.75a*
Mertect 340-F	12 mL	100a	87.50a	91.25b	75.00b
Serenade ASO	95 mL	100a	78.75a	51.25c	40.00c
Serenade ASO	190 mL	100a	68.75b	56.25c	45.00c

*per 907 kg

**Means followed by a different letter are significant at p = 0.05 according to Duncan's New Multiple Range Test

Table 2: Severity of silver scurf on Shepody potatoes during 6 months of storage, 2005 crop

		Months in storage			
		3	4	5	6
Treatment	Rate*	Silver Scurf Severity (%)			
Check	0	26.25a**	37.50a	71.25a	100.00a
Mertect 340-F	12 mL	6.25b	10.00b	35.00b	67.50b
Serenade ASO	95 mL	0c	0c	22.50c	36.25c
Serenade ASO	190 mL	0c	0c	22.50c	36.25c

*per 907 kg

**Means followed by a different letter are significant at p = 0.05 according to Duncan's New Multiple Range Test

DISCUSSION

This study demonstrates that Serenade ASO shows potential as a biological control of silver scurf under low disease pressure. Serenade ASO did not perform as well in the presence of higher disease pressure as it did under lower disease pressure. Serenade ASO alone may not provide adequate control for the current the market demands in all situations. Combing cultural controls with Serenade ASO may increase the efficacy of the biological control agent. Jacobsen *et al.* (2004) has promoted this concept. Serenade ASO may have a good fit as part of an Integrated Pest Management System (IPM).

Proper storage management must be a part of a silver scurf IPM. Storage situations that encourage silver scurf development such as continually overly wet conditions or conditions that fluctuate from overly wet to overly dry need to be avoided. Proper field management also must be a part of silver scurf IPM. Shortening the interval between vine killing and harvest would reduce the amount of silver scurf. This was presented by Merida *et al.* (1994). Silver scurf free seed, as discussed by Firman and Allen (1995), would greatly enhance the efficacy of Serenade ASO. Sanitation of the storage facility (Rodriguez *et al.*, 1996) would also benefit in the control of silver scurf. These cultural practices as part of an IPM program may improve the efficacy of Serenade ASO.

Tubers in this study remained in the soil for 30 days past vine killing in an effort to encourage colonization by *H. solani*. While this is not a recommended practice, poor weather conditions during harvest can force this to occur. If tubers from this scenario were stored for an extended period, current consumer demands would find many of them unacceptable for the preferred markets. Rather than a chemical control, early marketing may be a better option.

Serenade ASO may also be useful for silver scurf control under storage durations of less than 5 months. The 2-month delay of symptom onset could provide benefits for early markets.

The trend toward reduced pesticides on food crops will continue. Serenade ASO could have a role is some potato storage. Further studies to optimize and integrate

this postharvest treatment into production systems may be warranted.

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REFERENCES

Bains P.S., V.S. Bisht and D.A. Benard, 1996. Soil survival and thiabendazole sensitivity of *Helminthosporium solani* isolates from Alberta. Canada Potato Res., 39: 23-29.

Cunha, M.G. and D.M. Rizzo, 2003. Development of fungicide cross resistance in *Helminthosporium solani* populations from California. Plant Dis., 87: 798-803.

Elson, M.K., D.A. Schisler and R.J. Bothast, 1997. Selection of microorganisms for biological control of silver scurf (*Helminthosporium solani*) of potato tubers. Plant Dis., 81: 647-652.

Errampalli, D., J.M. Saunders and J.D. Holley, 2001. Emergence of silver scurf (*Helminthosporium solani*) as an economically important disease of potato. Plant Pathol., 50: 141-153

Firman, D.M. and E.J. Allen, 1995. Transmission of *Helminthosporium solani* from potato seed tubers and effects of soil conditions, seed inoculum and seed physiology on silver scurf disease. J. Agric. Sci., 124: 219-234.

Heiny, D.H. and G.A. McIntyre, 1983. *Helminthosporium solani* Dur. And Mont. Development on potato periderm. Am. Potato J., 60: 773-789.

Hide, G.A., S.M. Hall and K.J. Borer, 1988. Resistance to thiabendazole in isolates of *Helminthosporium solani*, the cause of silver scurf of potatoes. Plant Pathol., 37: 229- 240.

Jacobsen, B.J., N.K. Zidack and B.J. Larson, 2004. The role of *Bacillus*-based biological control agents in integrated pest management systems: Plant Dis. Phytopathol., 94: 1272-1275.

Jellis, G.J. and G.S. Taylor, 1977. The development of silver scurf (*Helminthosporium solani*) disease of potato. Ann. Applied Biol., 86: 19-28.

Kawchuck, L.M., J.D. Holley, D.R. Lynch and R.M. Clear, 1994. Resistance to thiabendazole and thiophanate-methyl in Canadian isolates of *Fusarium sambucinum* and *Helminthosporium solani*. Am. Potato J., 71: 185-192.

Lennard, J.H., 1980. Factors affecting the development of silver scurf (*Helminthosporium solani*) on potato tubers. Plant Pathol., 29: 87-92.

Merida, C.L. and R. Loria, 1990. First report of resistance of *Helminthosporium solani* to thiabendazole in the United States. Plant Dis., 74: 614.

Merida, C.L. and R. Loria, 1994. Survival of *Helminthosporium solani* in soil and *in vitro* colonization of senescent plant tissue. Am. Potato J., 71: 591-598.

Merida, C.L., R. Loria and D.E. Halseth, 1994. Effects of potato cultivar and time of harvest on the severity of silver scurf. Plant Dis., 78: 146-149.

Michaud, M., C. Martinez, A.M. Simao-Beaunoir, R.R. Belanger and R.J. Tweddell, 2002. Selection of antagonist microorganisms against *Helminthosporium solani*, causal agent of potato silver scurf. Plant Dis., 86: 717-720.

Olson, N.L., G.E. Kleinkopf and L.K. Woodell, 2003. Efficacy of chlorine dioxide for disease control on stored potatoes. Am. J. Potato Res., 80: 387-395.

Read P.J. and G.A. Hide, 1984. Effects of silver scurf (*Helminthosporium solani*) on seed potatoes. Potato Res., 27:145-154.

Rodriguez, D.A., G.A. Secor, N.C. Gudmestad and L.J. Francl, 1996. Sporulation of *Helminthosporium solani* and infection of potato tubers in seed and commercial storage. Plant Dis., 80: 1063-1070.

Tsror, L. and I. Peretz-Alon, 2002. Reduction of silver scurf on potatoes by pre- and post-storage treatment of seed tubers with imazalil. Am. J. Potato Res., 79: 33-37.

Tsror, L. and I. Peretz-Alon, 2004. Control of silver scurf on potato by dusting or spraying seed tubers with fungicides before planting. Am. J. Potato Res., 81: 291-294.