SOIL SOLARIZATION: A COMPONENT IN MANAGING RASPBERRY ROOT ROT.

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Soil solarization is a process that employs solar radiation to heat soil under a transparent plastic film to temperatures that are detrimental to soilborne pathogens. In Oregon field experiments, solarization reduced population densities of *Phytophthora cinnamomi* and *Verticillium dahliae* and disease incidence in susceptible hosts (Pinkerton et al., 2000). Solarization also reduced population densities of *Phytophthora fragariae* pv. *fragariae* and several other pathogens in an Oregon strawberry planting (Pinkerton et al., 2002). The objective of this research was to assess the efficacy of solarization for managing root rot caused by *P. fragariae* pv. *rubi* in several red raspberry production areas of the Pacific Northwest.

Methods. Two field trials (Pierce Co., WA and Whatcom Co., WA) with four treatments were initiated in 2003, and planted in 2004 with plants of the root rot susceptible cultivars Malahat and Qualicum. The treatments were: 1) non-treated control, 2) fungicide applications only, 3) solarization only, and 4) solarization plus fungicide applications. Soil was solarized from late July through late September 2003. Soil temperatures were recorded hourly at 10 and 30 cm soil depths. The fungicide program consists of Ridomil Gold (mefenoxam) applied to the soil at planting and then every fall and spring thereafter, plus Aliette (fosetyl-Al) applied to the foliage twice in the fall and twice in the spring. Plant survival and cane growth will be evaluated each spring and fall through 2006. Fruit yield data will be collected in 2006.

Laboratory studies were conducted to determine the lethal temperature dose for *P. fragariae* pv. *fragariae.* The fungus was inoculated on V8 medium in Petri plates and incubated at temperatures ranging from 20 to 35º C for 12, 24, 36, 48, 74, 96, 120, 144, 192, or 240 hours. Radial growth of colonies was recorded at the end of the incubation periods. After exposure to these temperature x time doses, plates were transferred to 20° C (near the optimal temperature for growth) and the colonies were observed for additional growth. No additional growth indicated that the dose was above the threshold lethal for the fungus.

PROGRESS TOWARDS OBJECTIVES:

Results. Primocanes were cut to the ground and evaluated in late fall 2004. There were more canes per hill and canes lengths and weights were greater in plots that were solarized compared to nonsolarized treatments (Table 1). Effects were similar for both locations and cultivars. Applications of fungicides in combination with solarization produced no better plant growth than solarization alone. Stand density and height were rated in June (Table 2) and August 2005. Stands of both cultivars in the Pierce Co. plots were significantly more vigorous in solarized treatments and those plots receiving fungicide applications than in the non-treated controls. Plant growth in the Whatcom Co. plots showed similar trends, but differences were not significant.

Phytophthora fragariae pv. *fragariae* colonies grew slowly at 27º and growth ceased at 29º. Exposure to 29º for greater than 192 hours was lethal. Over 200 cumulative hours of temperatures greater than 29° were recorded at 30 cm soil depth in solarized plots at both locations in 2003.

Conclusions. Data suggest that soil solarization is a viable method for controlling root rot caused by *P. fragariae* pv. *rubi* and climatic conditions in all raspberry production areas in the PNW are suitable for effective solarization.

Pinkerton, J. N K. L. Ivors, K. L., Reeser, P. W., Bristow, P. R., and Windon, G. E. 2002. Plant Disease 86:645-651.

Pinkerton, J. N., Ivors, K. L., Miller, M. L., and Moore, L. W. 2000.Plant Disease 84:952-960.

Table 1. Cane data collected in December 2004

		Cultivar							
Treatment		**Malahat**				**Qualicum**			
Solarization	Fungicide	% hill survival	Canes per hills[a]	Cane length (cm)[a]	Cane weight (g)[a]	% hill survival	Canes per hills[a]	Cane length (cm)[a]	Cane weight (g)[a]
Whatcom County experiment.									
Nonsolarized	None	88 ab	3.6 a	376 a	106 a	96 a	5.4 a	479 a	145 a
Nonsolarized	Applied	83 a	4.4 a	372 a	100 a	100 a	4.3 a	360 a	108 a
Solarized	None	88 a	5.0 a	784 b	253 b	100 a	7.1 b	831 c	275 b
Solarized	Applied	88 a	4.4 a	736 b	226 b	100 a	7.2 b	697 b	233 b
Pierce County experiment.									
Nonsolarizd	None	85 ab	2.3 a	136 a	33 a	100 a	3.1 a	188 a	45 a
Nonsolarizd	Applied	85 a	4.1 a	123 ab	51 a	100 a	4.0 ab	177 a	70 a
Solarized	None	90 a	7.5 b	642 c	222 b	100 a	5.2 bc	511 b	201 b
Solarized	Applied	90 a	5.2 b	475 bc	156 b	100 a	6.0 c	500 b	197 b

[a] number of canes, total cane length, and cane weight were for only surviving hills.
[b]Values represent means of four replications. Values within columns followed by the same letter are not significantly different according to Fisher's LSD tests ($P = 0.05$).

Table 2. Stand height and density ratings evaluated in late June 2005. Rating scale: 1 = lowest vigor and 4 = highest vigor at each site.

		Cultivar			
Treatment		**Malahat**		**Qualicum**	
Solarization	Fungicide	Height	Density	Height	Density
Whatcom County experiment					
Nonsolar	None	1.94 a	1.75 a	2.56 a	2.00 a
Nonsolar	Applied	2.88 ab	2.56 ab	3.38 ab	3.06 b
Solar	None	3.38 b	2.75 ab	3.75 b	3.56 b
Solar	Applied	2.94 ab	3.06 b	3.69 ab	3.62 b
Pierce County experiment					
Nonsolar	None	1.38 a	1.00 a	1.50 a	1.00 a
Nonsolar	Applied	2.63 b	2.25 b	3.75 b	2.38 b
Solar	None	3.00 b	3.38 c	3.75 b	3.25 bc
Solar	Applied	2.88 b	3.00 bc	3.75 b	3.50 c