

RASPBERRY, RED (*Rubus idaeus*) cvs. 'Coho' and 'Tulameen'  
 Phytophthora root rot of raspberry; *Phytophthora rubi*  
 Crown gall; *Agrobacterium tumefaciens*  
 Root lesion nematode; *Pratylenchus penetrans*

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# **Methyl bromide alternatives for raspberry nurseries, 2008-2009.**

A trial was established 18 Sep 08 on a Skagit silt loam soil at the WSU-NWREC, Mount Vernon WA. Replicated treatments (listed in table below) were established in five randomized complete blocks, with each plot 3 x 23 m. A single bed, 0.2 m high x 1.0 m wide was formed within the length of each plot. Nylon mesh bags containing sterilized soil and laboratory-derived *P. rubi* inoculum grown on a V8 Juice-vermiculite mix were placed 15, 30 and 45 cm deep in the center of the each future planting bed in each plot prior to fumigation. A second set of bags containing soil inoculated with *A. tumefaciens* was simultaneously buried at the same three depths in the center of each planting bed, 45 cm from the *P. rubi* inoculum bags. Treatments were applied with two shanks 35 cm apart at a depth of 30 cm measured from the surface of the bed; treated beds were immediately covered with black 0.025 mm thick HDPE tarp or with black 0.031 mm thick VIF tarp (Blockade, Pliant Corp., Washington, GA). Tarps remained in place until inoculum bags were retrieved 12 Mar 09. At this time, a 6.1 m long section of each bed was planted with certified cut roots of red raspberry cv. 'Coho'. Fertilization, irrigation and pest management procedures followed commercial nursery practices for the Pacific Northwest. Environmental conditions were relatively warm for this location, with an accumulation of 902 growing degree days (base 10 C) 1 Apr - 31 Oct 09. Plants were harvested and roots and canes trimmed 2- 25 Nov 09. Survival of *P. rubi* inoculum was evaluated with a greenhouse bioassay conducted 13 Apr 09 to 26 May 09 using susceptible raspberry plants (cv. 'Tulameen') grown in D40H deepots (Stuewe and Sons, Inc, Tangent OR) with 20 ml inoculum from the corresponding plot mixed with autoclaved soil and vermiculite. The deepots were flooded for two days every two weeks. Six weeks after planting, soil was washed from the roots and the roots rated on a 0-7 scale based upon proportion of the root symptom showing symptoms of root rot, with 0 = <12.5% and 7 = >87.5% of the root system symptomatic. *A. tumefaciens* inoculum bags were evaluated by dilution plating on a selective medium. Soil samples for *P. penetrans* were collected from each plot Jan 09 and evaluated by sieve-centrifugation.

*P. rubi* inoculum from non-treated plots caused severe disease in bioassay plants. Ratings were not affected by inoculum burial depth (data not shown), so combined results from all three depths are presented. Oospores typical of *P. rubi* were observed in diseased roots from bioassay plants grown with inoculum from non-treated plots, and these roots were positive for *P. rubi* by PCR assay. *A. tumefaciens* inoculum survival was also high in non-treated plots. Control in treated plots was dependent upon inoculum depth; results from the 15 cm depth are presented, since most treatments were effective at the other depths. Soil *P. penetrans* population densities in non-treated plots exceeded the economic damage threshold of 50 per 50 g soil. Telone C-35 under VIF tarp and 392 kg/ha MIDAS 50:50 under HDPE tarp controlled all three pathogens at least as well as methyl bromide:chloropicrin. Telone C-35 under HDPE tarp controlled *P. rubi* and *P. penetrans*, but not *A. tumefaciens*. MIDAS 50:50 at 196 kg/ha under VIF or HDPE tarp controlled *P. penetrans* only. Both of the Telone C-35 treatments increased above-ground biomass and the numbers of marketable canes (the primary product for raspberry nursery) per meter of bed compared to the untreated plots, but MIDAS and methyl bromide:chloropicrin treatments did not.

Treatment, rate/ha and tarp type	<i>P. rubi</i> disease rating	<i>A. tumefaciens</i> cfu/mg soil <sup>z</sup>	<i>P. penetrans</i> <sup>z</sup> /50 g soil	Above-ground biomass (kg/m bed)	Marketable canes/m bed
Non-treated, VIF.....	7.6 d <sup>y</sup>	31,520 d	77 b	3.01 c	10.9 c
Telone C-35, 365 L HDPE.....	1.3 a	17,054 d	0 a	3.89 ab	14.0 ab
Telone C-35, 365 L, VIF.....	1.3 a	621 ab	0 a	4.26 a	15.8 a
MIDAS 50:50, 392 kg, HDPE.....	1.1 a	0 a	0 a	3.08 c	13.1 abc
MIDAS 50:50, 196 kg, HDPE.....	5.8 c	24,102 d	0 a	3.15 c	12.9 abc
MIDAS 50:50, 196 kg, VIF.....	3.5 b	7,475 cd	0 a	3.30 bc	11.0 bc
Methyl bromide:chloropicrin, 67:33, 392 kg, HDPE	1.5 a	2,381 bc	0 a	3.19 c	10.7 c

<sup>z</sup> Data for *A. tumefaciens* cfu/mg soil and *P. penetrans* population densities were log-transformed to meet analysis of variance assumptions. Means separations are based upon log-transformed data; original non-transformed means are presented.

<sup>y</sup> Within each column, means followed by the same letter are not significantly different at *P* = 0.05 as determined by Fisher's protected least significant difference.