Biological control of tanoak resprouts using the fungus *Chondrostereum purpureum*

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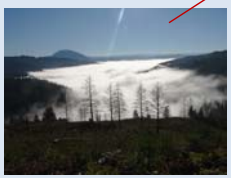
Abstract

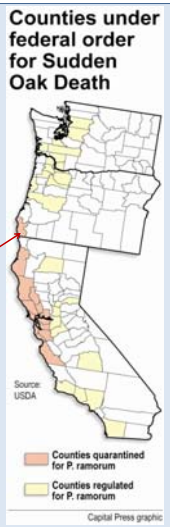
In southwest Oregon, an aggressive program of cutting and burning host plants in an effort to eradicate *Phytophthora ramorum* was begun in 2001. It was soon apparent that tanoak (*Lithocarpus densiflorus*) resprouts were highly susceptible to *P. ramorum* and that infected sprouts hamper eradication efforts by maintaining inoculum on site.

In Fall 2010, our research team established field trials near Brookings, Oregon to assess the bioherbicidal efficacy of the sap-rotting fungus *Chondrostereum purpureum* on tanoak to inhibit resprouts which can harbor *P. ramorum* and serve as a source of inoculum. Early results showed that *C. purpureum* was able to colonize the stumps of tanoak following treatment.

Tanoak resprouting after being cut for *P. ramorum* eradication.



Brookings, OR is near the coast and fog banks occur on most days. This humid environment is conducive to *P. ramorum* sporulation and spread.



Bioherbicidal activity of *C. purpureum*

The basidiomycete fungus *Chondrostereum purpureum* causes a white rot of mostly broadleaf trees and has a wide host range. It invades through fresh wounds in the xylem or cut stumps and is a weak pathogen that can survive as a saprophyte. After the host tree is weakened or killed, *C. purpureum* is quickly replaced by other, more competitive decay fungi that are naturally occurring in the environment. This fungus is used as a biological control agent for woody vegetation all over the world. A preparation of mycelium of the fungus *C. purpureum* is registered under the trade name "Chontrol™ Paste" in the US and Canada for use as a biological control agent and has been tested as a stump treatment on many hardwood species (EPA Registration No. 74200-1, 2004 ; and PMRA Registration No. REG. 2004-09, 2004). Treatment of stumps with *C. purpureum* has been shown to be effective for suppression of resprouting on several species, most notably red alder (*Alnus rubra*).

Methods

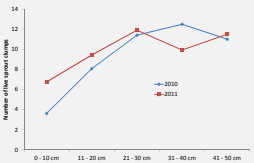
Tanoak trees with a range of diameters from 5 to 45 cm (mean 20 cm) were felled in November 2009 . Seven treatments were applied to three blocks of between 18 and 21 trees per treatment . The treatments were assessed approximately one and two years after application in September 2010 and 2011. Number of live sprout clumps, number of sprout clumps dead or with dieback, height of the tallest sprout, sprout clump width, and stump diameter were measured. In addition, presence of *C. purpureum* or other decay fungi was noted.

Treatment	Description
Control	No treatment.
Chontrol™ liquid w/inoculum	Peat spray formulation containing *Chondrostereum purpureum* isolate PFC2139 10^5 to 10^7 Colony Forming Units (CFU) per L.
Chontrol™ liquid wo/inoculum	Peat spray formulation only.
Chontrol™ paste w/inoculum	Paste formulation containing *Chondrostereum purpureum* isolate PFC2139 1 x 10^2 CFU per gram.
Chontrol™ paste wo/inoculum	Paste formulation only.
Garlon 3A	Apply triclopyr (Garlon 3A (Amine)), cut 50-50 with water, plus dye to all exposed cambium immediately after cutting (within 30 minutes). Exposed cambium includes the stump surface and bark tears that occurred during falling.
Hack and squirt	Inject imazapyr (Arsenal®) cut 50-50 with water, 1 hack (1 ml solution/hack) per 3 inches diameter) plus dye using the hack-and-squirt method. Hacks will be made at or below stump height (1.5 feet).

Product information

Chontrol™ produced by Mycologic, Inc., c/o IDC, The University of Victoria, Victoria, BC Canada V8W 2Y2. EPA Reg. No. 74200-2, EPA Est. No. 074200-CAN-001.
Garlon 3A Herbicide produced by Dow AgroScien ces LLC, 9330 Zionsville Rd., Indianapolis, IN, 46268, USA. EPA Reg. No. 62719-37.
Arsenal® Herbicide produced by BASF Corporation, 26 Davis Drive, Research Triangle Park, NC 27709. EPA Reg. No. 241-346.

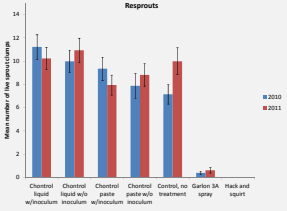
Results



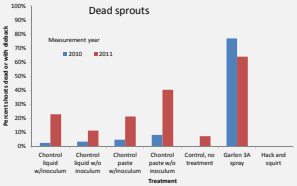
There was a positive correlation between stump diameter and number of live sprout clumps (R^2 = 0.685 in 2010, 0.553 in 2011). There was no significant difference in stump diameter among the treatments. Mean stump diameter was 20 cm (range 5 – 45 cm).

Living and dead sprouts in 2011 on stumps treated with Chontrol™ paste + inoculum.

C. purpureum fruiting in 2010 on stump treated with Chontrol™ liquid + inoculum.



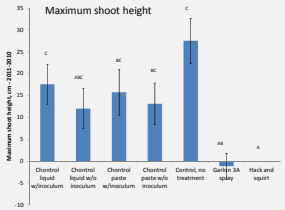
Fewer live sprout clumps were found on tanoak stumps that received the inoculum treatments in 2011 but these differences were not significant. The two herbicide treatments had the fewest live sprout clumps.



Stumps treated with Chontrol™ formulations with and without inoculum had more dead sprouts than in the Garlon spray treatment, where there were more live sprouts in 2011.

Stump treated with Chontrol™ paste without inoculum shows chlorotic, stunted sprouts, possibly due to toxicity of the formulation.

Stumps with the hack and squirt herbicide treatment had no live sprouts in both 2010 and 2011.



Differences in maximum shoot height 2011 – 2010. Shoots on Chontrol™ treated stumps had less growth than untreated stumps but these differences were not significant.

Decay fungi on tanoak

Fruiting bodies of fungi observed on decaying tanoak logs and stumps were collected and taken to WSU-Puyallup. These fungi were cultured on basidiomycete selective media. PCR of the ITS rDNA region was done on cultures and fruiting bodies and the PCR product was sequenced. A BLAST search was done on each sequence and the fungi were identified based on these results and observations of the fruiting body morphology. We will use markers developed for the strain PFC 2139 to determine if *C. purpureum* isolated from treated stumps is naturally occurring or is identical to the isolate originally applied during treatment.

Basidiomycete fungi from other sites collected were *Chondrostereum purpureum, Lenzites betulinum, Stereum hirsutum*, and *Trametes versicolor.* Of these fungi, *C. purpureum, L. betulinum*, and *T. versicolor* are not reported on tanoak in the SMML Fungus-Host database.
http://nt.ars-grin.gov/fungaldatabases/fungushost/fungushost.cfm

Tanoak is not listed as a host for *C. purpureum*, but the fungus was found occurring naturally on tanoak logs and stumps at some other sites we visited in Brookings.

Trametes versicolor fruiting on tanoak stump.

Lenzites betulinum fruiting on charred log at a site where tanoak was cut and burned.

Conclusions

Chontrol™ formulations appear to have some effect on reducing resprouting in tanoak, but the most effective treatment is the hack and squirt method of applying the herbicide imazapyr. Over time, applications of Chontrol™ may be a more permanent solution as the stumps become decayed. Monitoring these field trials for a third year will give us better results for the bioherbicidal efficacy of Chontrol™ on tanoak resprouts.

If a formulated product of *C. purpureum* and/or its mixture with other stem and wood decay fungi applied to tanoak stems and stumps does inhibit the trees from growing new sprouts, this *P. ramorum* inoculum reservoir would be reduced or eliminated in the ecosystem. In areas where the application of herbicides is not prudent or not permitted, this biocontrol treatment would be an indispensable alternative to chemical herbicides.

Acknowledgements

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