

# Biological Control of Tanoak and Bay Laurel Resprouts Using the Fungus, *Chondrostereum purpureum*<sup>1</sup>

Marianne Elliott,<sup>2</sup> Gary Chastagner,<sup>2</sup> Simon Shamoun,<sup>3</sup> Grace Sumampong,<sup>3</sup> Ellen Goheen,<sup>4</sup> and Alan Kanaskie<sup>5</sup>

## Introduction

In southwest Oregon, an aggressive program of cutting and burning host plants in an effort to eradicate *Phytophthora ramorum* was initiated. It was soon apparent that tanoak (*Notholithocarpus densiflorus* (Hook. & Arn.) Manos, Cannon & S.H. Oh) resprouts were highly susceptible to *P. ramorum* and that infected sprouts hamper eradication efforts by maintaining inoculum on site (Hansen and Sutton 2006). 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 (Becker et al. 2005, Bourdot et al. 2006). A preparation of mycelium of the fungus *C. purpureum* is registered under the trade name “Chontrol™ Paste” in the United States 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). Chontrol™ is not registered for use in California, so indigenous isolates of *C. purpureum* are being obtained and formulated for use on California bay laurel (*Umbellularia californica* (Hook. & Arn.) Nutt.), the host responsible for *P. ramorum* inoculum buildup in California.

In fall 2009, our research team established field trials near Brookings, Oregon to assess the bioherbicidal efficacy of the fungus *C. purpureum* on tanoak to inhibit resprouts. *Chondrostereum purpureum* was found occurring naturally on tanoak logs and stumps at other sites in the Brookings area. Laboratory testing of three California isolates of *C. purpureum* indicate that the fungus can colonize bay laurel stems, and further testing under natural conditions is planned in California. If a formulated product of *C. purpureum* and/or its mixture with other stem and wood decay fungi applied to tanoak and bay laurel 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 permitted, this biocontrol treatment would be an indispensable alternative to chemical herbicides.

---

<sup>1</sup> A version of this paper was presented at the Sudden Oak Death Fifth Science Symposium, June 19-22, 2012, Petaluma, California.

<sup>2</sup> Washington State University, Puyallup Research and Extension Center, 2606 W. Pioneer, Puyallup, WA 98371.

<sup>3</sup> Natural Resources Canada, Pacific Forestry Centre, Victoria, BC V8Z 1M5.

<sup>4</sup> USDA Forest Service, Forest Health Protection, Central Point, OR 97502.

<sup>5</sup> Oregon Department of Forestry, Salem, OR 97301.

Corresponding author: melliott2@wsu.edu.

## Methods

### Stump Treatments

Tanoak trees with a range of stem diameters from 5 to 45 cm (mean 20 cm) were felled in November 2009. Seven treatments (table 1) were applied to three blocks of between 18 and 21 trees per treatment.

The treatments were assessed approximately 1 and 2 years after application in September 2010 and 2011. Rather than single sprouts, the sprouting tended to occur in clumps of sprouts emerging from a single origin. These were treated as a unit. 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.

Similar methods will be used in the bay laurel study. Depending on laboratory results, other fungi such as *Ganoderma applanatum*, in addition to *C. purpureum*, will be tested.

**Table 1—Treatments applied to cut tanoak stumps in fall 2009; treatment efficacy against resprouting was evaluated in fall 2010 and 2011**

Treatment	Description
Control	No treatment.
Chontrol™ <sup>a</sup> liquid w/inoculum	Peat spray formulation containing <i>Chondrostereum purpureum</i> isolate PFC2139 10 <sup>5</sup> to 10 <sup>7</sup> Colony Forming Units (CFU) per L.
Chontrol™ liquid wo/inoculum	Peat spray formulation only.
Chontrol™ paste w/inoculum	Paste formulation containing <i>Chondrostereum purpureum</i> isolate PFC2139 1 x 10 <sup>2</sup> CFU per gram.
Chontrol™ paste wo/inoculum	Paste formulation only.
Garlon 3A <sup>b</sup>	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 <sup>c</sup>	Inject imazapyr (Arsenal®) cut 50-50 with water, 1 hack (1 ml solution/hack) per 7.6 cm (3 inches) diameter) plus dye using the hack-and-squirt method. Hacks will be made at or below stump height of 0.46 m (1.5 ft).

<sup>a</sup> 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.

<sup>b</sup> Garlon® 3A Herbicide produced by Dow AgroSciences LLC, 9330 Zionsville Rd., Indianapolis, IN, 46268, USA. EPA Reg. No. 62719-37.

<sup>c</sup> Arsenal® Herbicide produced by BASF Corporation, 26 Davis Drive, Research Triangle Park, NC 27709. EPA Reg. No. 241-346.

### Laboratory Testing of Isolates on Bay Laurel

The University of California (UC) Riverside sent three California native *Chondrostereum purpureum* isolates to the Pacific Forestry Center in Victoria, British Columbia. The UC Riverside identification numbers for the isolates are 2249, 2434, and 2367. These isolates were cultured on potato-dextrose-agar media. Bay laurel stems were cut and trimmed of all leaves, to a length of 8 cm. The stems were inoculated with the UC Riverside isolates and the inoculum site was sealed with parafilm. Stems were incubated in the laboratory in a moist chamber under ambient temperature and light conditions. New leaves were observed in all four groups of stems (2249, 2367, 2434, and control). Some of the stems have shown a subtle discoloration around the point of inoculation. The fungus has been re-isolated from discolored tissue.

Testing of other decay and sapwood-rotting fungi isolated from bay laurel and other hosts is ongoing. These fungi include *Ganoderma applanatum*, *G. lucidum*, and *Trametes versicolor*.

## 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 to 45 cm). 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. These results suggest that even though Garlon greatly inhibited sprout production compared to Chontrol™, the sprouts that were present on Garlon-treated stumps (presumably because of herbicide "misses") had less dieback than the Chontrol™ sprouts. With incomplete coverage of herbicide, fewer and healthier sprouts form than with an application of Chontrol™.

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 the bioherbicidal efficacy of Chontrol™ on tanoak resprouts for a third year is planned.

## Acknowledgments

The authors wish to thank Katie Coats, Katie McKeever, and Lucy Rollins, Washington State University, for molecular identification of fungi and assistance in the lab; Paul de la Bastide, MycoLogic Inc., Helga Forester, UC Riverside, for isolates; South Coast Lumber for use of the treatment site in Oregon; and Ed Orre and Angela Bernheisel, CalFire, for their assistance at the California site. Funding for this project was provided by USDA Forest Service Forest Health Protection grant #09-DG-11052021-185.

## Literature Cited

- Becker, E.M.; Shamoun, S.F.; Hintz, W.E. 2005.** Efficacy and environmental fate of *Chondrostereum purpureum* used as a biocontrol for red alder. *Biological Control*. 33: 269–277.
- Bourdot, G.W.; Barton, J.; Hurrell, G.A.; Gianotti, A.F.; Saville, D.J. 2006.** *Chondrostereum purpureum* and *Fusarium tumidum* independently reduce regrowth in gorse (*Ulex europaeus*). *Biocontrol Science and Technology*. 16: 307–327.
- Hansen, E.M.; Sutton, W. 2006.** Persistence of *Phytophthora ramorum* after eradication efforts in Oregon tanoak forests. In: Frankel, S.J.; Shea, P.J.; Haverty, M.I., tech. coords. Proceedings of the sudden oak death second science symposium: the state of our knowledge. Gen. Tech. Rep. PSW-GTR-196. Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station: 516.