



*State & Private Forestry*  
**FOREST HEALTH PROTECTION**  
*South Sierra Shared Service Area*



**FHP Report: SS10-06**

File No. 3402  
September 27, 2010

**To: Ramiro Villalvazo, Eldorado National Forest, Forest Supervisor  
Duane Nelson, Eldorado National Forest, Placerville District Ranger  
Tom Blush, Pacific Southwest Regional Geneticist  
Paul Stover, Placerville Nursery Forest Geneticist**

**From: State and Private Forestry, Forest Health Protection, South Sierra Shared Service Area.**

**Subject: Insect Activity in White Fir and Sugar Pine Plantations at Badger Hill Arboretum.**

Badger Hill Arboretum, an extension of Placerville Nursery on the Eldorado National Forest, had recently been experiencing unusual damage in white fir, ponderosa pine, and sugar pine plantations. Beverly M. Bulaon and Martin MacKenzie (Forest Health Protection, South Sierra Shared Service Area) were requested by Paul Stover to examine live and dead trees to determine possible causes of injury and mortality. An additional site visit to a nearby Douglas fir plantation was included; an infection of pitch canker (*Fusarium circinatum*) had been detected previously and precautions successfully implemented by the arboretum prevented further infection. This report covers observations, discussions, and identifications of potential damage agents at Badger Hill on September 2, 2010.

**Introduction**

Badger Hill arboretum is located in Pollock Pines, 20 miles east of the Placerville Nursery. Badger Hill sits at about 2500 feet in elevation and is considered a high site for growing trees. The arboretum covers 20 acres, broken up into separate blocks of plantations: white fir, sugar pine, ponderosa pine, and Douglas firs. Trees are only watered for the first five years after planting. Fertilizers are applied once every five years at most. Pruning and brush removal are conducted annually to prevent the potential for catastrophic wildfire decimating entire plantations. Grasshoppers (Order Orthoptera) were abundant throughout the fields and causing minor damage on smaller pines. Graft incompatibility is a common explanation for some of the mortality within the nursery, observed as misshapen boles at the graft points (Figure 1).

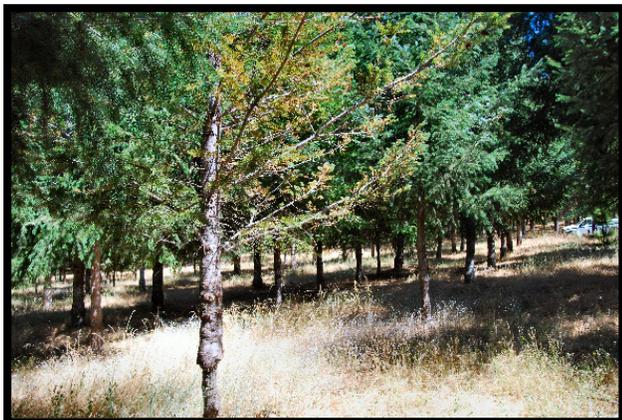


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**Figure 1.** *Graft incompatibility as the scion overgrows the root stock and in the extreme case a small percentage of the trees actually die. See figures 2 and 3*



**Figure 2** *Extreme case of graft incompatibility*



**Figure 3** *Mortality attributed to graft incompatibility*

### **Site 1: White Fir Plantation**

This 8 acre plantation is composed of tree stocks taken from various seed zones and grafted onto local fir root stock. Seeds are collected for storage and outplanting. Trees are now spaced at 10 x 10 ft, with an average diameter of 13 inches. The lowest whorls are pruned periodically to raise crown height.

In recent years, mortality in this plantation had been averaging 1-2 trees per acre, with some unusual symptoms observed. Mortality was, clustered, symptomatic of a root rot center; however no root rot pathogens were detected. Branch dieback was observed on several trees occurring from the inside outward, profuse amounts of resinous from old and new branch stubs (figure 4), “cracks” along the bole (figure 5), and sunken spots attracting large aggregations of earwigs (Order Dermaptera) beneath. Sunken spots along the trunk revealed old fir engraver (*Scolytus ventralis*) galleries underneath, estimated 4-6 years old. Beetle attacks were hidden underneath old pruning wounds not visible until bark was removed. Callus tissue developed over attacks as the tree tried to seal over the pruning scars. This discovery led to better understanding for the outpouring of resin, cracks, and dieback. Annual pruning to reduce fire hazard was attracting fir engraver to freshly pruned trees. Pruning was also being conducted during summer during peak flight periods when fir engraver adults are searching for new hosts. While most of the resin production occurred as wound response to the pruning, other resin was due to beetle attacks. Beetles were initiating their attacks at pruning scars. Boring holes were indiscernible, camouflaged by callus tissue and resin. One live tree opened at cracks and old scars revealed 3-4 engraver attacks per square foot underneath. Numerous bark beetle attacks not visible on the surface were slowly reducing vigor, eventually killing trees.

Fir engravers are not considered to be as aggressive as other native bark beetle species (e.g. mountain pine or western pine beetles), and may only target portions of trees at a time. Top kill is often associated with fir engraver activity (Figure 6). Mass attack occurs when trees are severely weakened, most often due to repetitive insect attacks, root disease or other stress factors. Fir engraver has one generation per year, peak flight season usually occurs between June and August in the Sierra Nevada. Surprisingly, larvae were still found in late stages of development and fir engraver adults were observed frantically moving about the bole. The late spring this year may have delayed development that current year adults were just (2<sup>nd</sup> September) initiating attacks, resulting in fresh resin observed during the visit.



**Figure 4** *Resin issuing from pruning scars.*



**Figure 5.** *Cracks in the bark of a living white fir.*



**Figure 6.** *Within the plantation several examples of typical fir engraver top kill could be found.*

## **Site 2: Douglas fir Plantation: a review of the Pitch Canker scare.**

In 2003, while being held quarantine in New Zealand, Douglas fir seedlings which had originated at the Badger Hill arboretum tested positive for the Pitch Canker fungus (*Fusarium circinatum*). Tracebacks indicated that two clones from Badger Hill may have been the source of infection. Suspect clones were destroyed and an extensive monitoring campaign was mounted to find any other sources of pitch canker. Thousands of subsequent samples proved negative for pitch canker and in 2006; Julie Lydick (Assistant Director for R5 FHP) declared the plantation pitch canker free. In her letter of 5 April 2006, Lydick described establishment of sentinel plantings of *Pinus monterey* by *P. attenuata* hybrids. The hybrids were planted where the original pitch canker positive Douglas fir clones once grew. After 3 years of negative results, Lydick (2006) declared the site pitch canker-free. Four years later, the hybrids are still canker-free. It is the recommendation of FHP that hybrids be retained, and FHP along with the Nursery staff continues periodic monitoring. FHP further emphasizes Lydick's final point: "*If the disease is (subsequently) detected, the flow of material from the Arboretum will cease, and the Arboretum will request technical assistance from Forest Health Protection.*" (See Appendix A)

Pacific Southwest researcher, Dr. Det Vogler (also on field visit) retains the complete history of pitch canker search at Badger Hill, and agreed to compile the history of quarantine and prevention measures undertaken. Even although Pitch Canker may not be present at Badger Hill, it is essential that Dr. Vogler's history be captured and presented as a case study.

## **Site 3: Pine Plantation**

This plantation is a combination of ponderosa and whitebark pines selected for growth potential and possible genetic resistance; however some seedlings were displaying odd symptoms or dying with no visible cause. A quarter acre gap had been repeatedly planted with various ponderosa pine stock but was not able to retain trees. Close examination of recently dead trees revealed no signs of pathogen or insect. Newly planted trees were well watered, but expired quickly. Although unlikely, nutrient deficiency or graft incompatibility may have been the cause of these failures. This mortality is still under investigation.

An example of graft incompatibility is demonstrated below. The grafted tree (Figure 7) appeared to be exhibiting nutrient deficiencies. When viewed from the other side (Figure 8), where a rootstock branch could be seen, reveals graft incompatibility and not nutrition deficit.



**Figure 7.** Tree possibly exhibiting nutrient deficiency



**Figure 8.** View from the other side, branch originating from below graft union has normal foliage color.

#### **Site 4: Sugar Pine Plantation**

Scattered twig tip death was noted on two large sugar pines at the edge of this plantation. Two to three inches of dead branch tips (current year's needles) were hollowed and contained a small burrowing beetle. Samples of the beetle were shown to taxonomist James LaBonte (Oregon Department of Agriculture) for identification. LaBonte identified the insect in the genus *Conophthorus*, a genus containing mainly cone feeding beetles. Question: is a low level of a *Conophthorus* species significant in a clonal seed orchard where the product is the cones of sugar pines? Answer: no, not if insects just attack limbs. According to LaBonte, two species of *Conophthorus* are known to attack branches *C. banksianae* and *C. resinosa*. But neither of these has been recorded from *Pinus lambertiana*. One species of *Conophthorus* that is known and attacks sugar pine is *C. ponderosae*. Our specimens were black, while *P. ponderosae* is brown in color. These specimens were also too large to be *C. banksianae*. As species in the genus are difficult to identify and Oregon Dept of Agriculture collections were not extensive enough to provide a final identification, the insect is identified only as *Conophthorus sp.* The specimens with the appropriate collection data are to be deposited in the Oregon State University

collection. LaBonte feels it will take a molecular taxonomist to truly separate these species. FHP will continue to monitor beetle populations in the plantation.

### **General Discussion**

In light of the above discussion on pitch canker and the initial thought that the *Conothorus* species might have been an invasive, was the recent 2010 California Pest Council field tour to Placerville a good idea? Should researchers, foresters and geneticists from all over country, be allowed unrestricted access to Badger Hill? Would it not be prudent to insist that foreign scientists do not bring their normal field gear into our clonal orchards? If an Eastern forester accidentally brought *Tomicus pinperda* into the Badger Hill plantation, would CDFA with APHIS backing quarantine the Arboretum? While the risk of this happening is low, the New Zealand government has spent millions in combating the American needle cast fungus *Dothistroma pini*. Sensitized by the expense of their experience with *D. pini*, New Zealand forest industry has a heightened sense of “biosecurity”. Increased vigilance led to the original detection of pitch canker on Badger Hill stock.

FHP highly recommends that any staff working in a nursery or other areas where high-value trees are located should consider taking additional precautions to prevent unwanted introductions of diseases or insects. FHP would like to offer their help to the Placerville Nursery in developing commonsense protocols designed to protect the health of the arboretum. Such protocols might involve full suit coveralls being available for visitors who have worked on pests not known in California. Nursery personnel might inquire of the locations previously visited by their guests. Pathogen spores or insects may be embedded on cars, clothing, or tools from known infection sites could easily transfer to new hosts or locations if not cleaned or sanitized. A closed gate policy is not necessary, but common sense should be applied. If unusual symptoms or signs develop on trees or plants, please report location and information to Forest Health Protection.

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CC: Julie Lydick  
Sheri Smith  
Phil Cannon  
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**Appendix 1 Julie Lydick's 2006 letter to the Placerville Nursery.**



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File Code:

Date: April 5, 2006

Subject: Badger Hill Breeding Arboretum

To: Tom Blush, Regional Geneticist

In November 2003 pitch canker fungus, *Fusarium circinatum*, was recovered from scion wood collected from the Douglas-fir clone bank at the Badger Hill Breeding Arboretum while held in quarantine in New Zealand. The normal flow of scion, pollen and seed for all species managed at the site immediately stopped as a result of that detection. Monitoring resulted in four additional detections between November 12, 2003 and February 19, 2004.

Two infected Douglas-fir clones were destroyed in March 2004. Since February 19, 2004, more than 1000 samples of foliage, cones, pollen, seed, leaf litter and soil have been evaluated for presence of the fungus. All have been negative.

As the leader for forest health protection activities in Region 5 it is my determination that pitch canker has been controlled at the Bader Hill Breeding Arboretum. Normal operations may resume with the prevention and monitoring strategy that you propose. That strategy includes the following:

- Inspect all Douglas-fir within the Arboretum and sample surrounding conifers three times annually in spring, summer and winter for symptoms of infection by pitch canker fungus.
- Collected material will be analyzed in cooperation with Dr. Tom Gordon's lab, UC Davis and other State and Federal forest pathologists as needed.
- Biological material moved from the site will be documented and tracked to their destination. The five groups of KxM seedlings planted and other susceptible species will be monitored monthly. Suspected infections will be further evaluated with laboratory work.
- If the disease is detected, the flow of material from the Arboretum will cease and you will request technical assistance from forest health protection staff.

Thank you for the actions you and your staff have taken to respond and suppress this disease at the Badger Hill Breeding Arboretum.

/s/ JULIE LYDICK

JULIE LYDICK

Assistant Director, State and Private Forestry

cc: Andi Koonce  
Pete Angwin  
Sheri Smith  
William Woodruff  
James R Allison  
Michael Landram