12th International Conference on Root and Butt Rots

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Black stain root disease of ponderosa pine, caused by *Leptographium wageneri* var. *ponderosum* (Harrington & Cobb) Harrington & Cobb, is increasing on many eastside pine stands in northeastern California. The disease is spread from tree to tree via root contacts and grafts but new infections are likely vectored by root feeding bark beetles (Coleoptera:Scolytidae). Soil and site relations along with disturbance are factors in the etiology of the disease. Thinning and prescribed burning are important silvicultural tools in maintaining forest health in eastside pine stands. Because soil compaction is a concern in many sites, skid trails are treated by subsoiling equipment to alleviate compaction where this might be an issue. However, little is known of the effects of these silvicultural treatments on incidence of black stain root disease on sites with high disease risk. This study was initiated in 2000 to address these concerns.

A site near Poison Lake on the Lassen National Forest in California was selected for this study. This predominantly ponderosa pine site has numerous black stain root disease centers and was thinned during the fall of 1999. Prior to thinning, the average basal area was 263 ft²/acre (80 m²/hectare) and the average QMD (quadratic mean diameter) was 7.9 inches (20 cm). Post thinning stand density was...
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121 ft² / acre (28 m² / hectare) with an average QMD of 14.8 inches (38 cm). Treatments consisting of underburning, subsoiling, underburning and subsoiling, and untreated control were completed during the 2000 season. The study design is a randomized complete block replicated four times. Each treatment plot is approximately 2.5 hectares in size. An unthinned area near the experimental plots was maintained as a comparison, but not included in the overall experimental design.

Pretreatment surveys were conducted and pre-existing mortality and symptomatic trees identified and tagged. Post treatment, during the spring of 2001 and 2002, Lindgren flight traps were deployed and trapped insects were counted and identified. Sub-samples of these species from the trap catches were subjected to DNA analyses to determine presence of *L. wageneri*. We conducted the final post-treatment survey during June 2005 and recorded data on mortality, black stain root disease, and crown symptoms.

Experiments involving large woody root inoculations were conducted to provide information on the minimum amount of spores carried by insects that are necessary to start root infection. In June 2005 and again in August, spore suspensions containing 50, 500, and 5,000, spores were injected in artificial wounds created by coring to 2 cm depth in the xylem with a 4 mm diameter increment hammer. The spore suspensions were placed into roots of randomly selected trees in the burn only and control plots. Lesions, including sterile control wounds were measured after 9 weeks. Two trees selected from each burn only and control plot were inoculated with either 5,000 spores (August 2004) or an *L. wageneri* infested wood core (June 2004). These roots were excavated in June 2005. We obtained data on stem cambial sucrose synthase (SCSS) activity, a surrogate for determining stress and carbohydrate status of the trees, during the 2002, 2003, and 2004 season.

While the study is long-term, intermediate results are interesting. Several root feeding insect species of interest, suspected to be potential vectors of *L. wageneri*, were caught during the two seasons. Among the more common species were *Hylastes macer*, *Hylurgops subcostulatus*, and *Hylurgops porosus*. Treatment differences in total insect trap catches are not obvious, although the underburn only plots tended to have slightly higher catches during the latter half of the flight season. In 2002, this trend appeared to be more marked, with greater catch numbers later in the season. Recently, DNA evidence indicates the insect species mentioned above, among others trapped on the study plots are carrying *L. wageneri*, presumably as spores (3). Such insect species have been suspected but heretofore have not been confirmed to be carrying *L. wageneri* in ponderosa pine stands. This confirms the long held notion that root feeding Scolytids serve as potential vectors of the fungus, caring longer distances.

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Findings in 2004 inoculation experiment local isolate of *L. wageneri* spores

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Potential vectors of the fungus, critical for spread of the disease over longer distances.

Between 2001 and 2005, the burn only treatment had the highest mortality. Scorching was evident on most of the mortality trees, which succumbed within two years following treatments. It has been approximately a century since fire last occurred in these stands. The subsolling and burn treatment had considerably less mortality than the burn only treatment. The subsolled skid trails may have served to mitigate at least partially fire severity or intensity in these plots. Thus, caution should be exercised when reintroducing fire to stands that have not been burned for a considerable time.

In 2005, 100% surveys of each plot showed symptomatic trees, based upon crown characteristics, were distributed evenly among treatments, and few confirmed black stain root diseased trees were found. This is to be expected due to the longer time interval we anticipate from treatment initiation to infection, colonization, and symptom expression in the trees. Thus, further long-term monitoring of these study plots is necessary and planned.

Sucrose synthase activity, a measure of tree physiological status, shows a seasonal trend between the sampled months in 2003, and 2004. Peak activity is attained during July and August and drops rapidly during September. This is consistent with other data reported earlier for ponderosa pine (2). These and future data are used to determine relationships between physiological status and infection.

Findings in 2004 inoculation experiments using the three dosages of a local isolate of L. wageneri spores (1) are summarized below.

1) The June inoculations produced larger lesions in roots after 9 weeks than the August inoculation.
2) The lowest spore dose, 50 spores, produced lesions that were significantly larger than controls (June inoculations).
3) This is noteworthy because it is consistent with the range of spore numbers found on potential insect vectors as determined by DNA analyses.
4) Underburned plots had generally smaller lesions than control plots.
5) Lesions from August inoculations were significantly smaller than June inoculations.
6) We recovered L. wageneri from lesions approximately one year (June 2005) after inoculation (June and August 2004) with either 5,000 spores or mycelial inoculum.

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REFERENCES

