Root Disease and Other Unforeseen Variables that Confound Restoration Efforts

William J. Otrosina, Shi-Jean S. Sung, Stanley J. Zarnoch, Brian T. Sullivan and Charles H. Walkinshaw.

USDA Forest Service, Southern Research Station, Institute of Tree-Root Biology, Athens, GA, USA, Corresponding Author's E-mail: wotrosina@fs.fed.us

Unanticipated disease problems thwarting restoration efforts can emerge in forest ecosystems. An example is the longleaf pine (*Pinus palustris* Mill.) ecosystem. This species once occupied nearly 30 million ha but now its range is reduced to approximately 1.5 million ha. Restoring longleaf pine to many sites in its former range is an important goal involving several natural resource organizations. Longleaf pine has evolved with frequent fires and is dependent upon fire for successful regeneration and for maintenance of stand health. However, increased mortality associated with prescribed fire has been observed in certain 30-40 year-old longleaf pine stands. Preliminary studies show several species of root infecting fungi (*Leptographium* species, *Heterobasidion annosum*) and certain root colonizing insects are associated with mortality (Otrosina, et al. 1995), although longleaf pine is considered highly tolerant to these pathogens. We hypothesize many sites no longer possess specific edaphic and environmental conditions under which the species evolved because of altered fire regimes, changes in soil conditions, or other factors that render trees susceptible to root pathogens.

We conducted an experiment designed to study effects of different prescribed burning intensities on 40 year-old longleaf pine at the Savannah River Site near New Ellenton, South Carolina, USA. The randomized complete block study had four blocks containing three burning intensities and an unburned control treatment. Each treatment plot was 2.2 ha. A 100% survey was conducted to mark and note mortality and symptomatic trees immediately prior to treatment initiation and periodically thereafter. Woody roots of symptomatic trees were sampled by methods previously described (Otrosina et al. 1999) prior to treatment initiation and as symptomatic trees appeared during the three years post-treatment. Crown symptoms were evaluated using a rating 5 scale rating system (Otrosina et al. 2002). Fine roots were also evaluated (Otrosina et al. 2002). After the third year post-treatment, selected trees representing each crown symptom class within all treatments were excavated and root systems were evaluated for health, stems were cored at breast height, and cambial samples were analyzed (Otrosina et al 1996).

Significantly greater mean cumulative mortality occurred in the hot burn treatment (29 stems, P=0.05) compared to the control (5 stems) three years

after burning, indicating this effect was not due to acute fire damage, such as severe bole scorching. All three burn treatments had significantly more trees changing from less severe to more severe crown classes (p=0.04, Chi-Square=8.36, 3 df). Isolations from woody roots yielded several species of Ophiostomoid fungi such as *Leptographium terebrantis*, *L. procerum*, and *Sporothrix* species. The *Leptographium* species were widespread throughout the study regardless of crown symptoms or treatment. We found extensive fine-root damage in the upper mineral soil layer and organic layer associated with the hot burn treatment. Also, large woody roots tended to be highly resinous as symptom severity increased. *Heterobasidion annosum* is widespread in the experimental plots and was associated with root disease of symptomatic trees in addition to *Leptographium* species. Growth in periodic annual increment (PAI) declined during the four years after burning as crown symptoms severity increased (P=0.003). This decline in PAI was also evident four year prior to treatment (P=0.03) with increasing crown symptoms. We attribute the decline of longleaf pine of these sites to a complex of factors driven by interactions of root disease, fire damaged fine roots, and soil/site conditions. These factors have an adverse effect on longleaf pine restoration goals.

Otrosina, W.J., White, L.W., and Walkinshaw, C.H. (1995):
Heterobasidion annosum and blue stain fungi are associated with increased mortality following prescribed burning. Phytopathology 85: 1197. (Abstr.).

Otrosina, W.J., Sung, S.S., and White, L.W. (1996):
Effect of subsoiling on lateral roots, sucrose metabolizing enzymes, and soil ergosterol in two Jeffrey pine stands. Tree Physiology 15: 1009-1013.

Otrosina, W.J., Bannwart, D., and Roncadori, R.W. (1999):
Root-infecting fungi associated with a decline of longleaf pine in the southeastern United States. Plant and Soil 217: 145-150.

Otrosina, W.J., Walkinshaw, C.H., Zarnoch, S. J., Sung, S.S., and Sullivan, B.T. (2002):
Root disease, longleaf pine mortality, and prescribed burning. Proceedings of the 11th Biennial Southern Silvicultural Research Conference; 2001 March 20-22: Knoxville, TN, Gen. Tech Rep. SRS, Asheville, NC: US Department of Agriculture, Forest Service, Southern Research Station. (In press).

Skov & Landskab

Reports
No. 11 • 2002

Proceedings of the IUFRO Conference on Restoration of Boreal and Temperate Forests

Documenting Forest Restoration Knowledge and Practices in Boreal and Temperate Ecosystems

Compiled by: Emile S. Gardiner and Lynne J. Breland

Ministry of the Environment
Danish Forest and Landscape Research Institute