

# Tandem Selection for Fusiform Rust Disease Resistance to Develop a Clonal Elite Breeding Population of Loblolly Pine

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## Abstract

The elite breeding populations of loblolly pine (*Pinus taeda* L.) in the North Carolina State University Cooperative Tree Improvement Program are intensively managed for short-term genetic gain. Fusiform rust disease, caused by the fungus *Cronartium quercuum* f. sp. *fusiforme*, is the most economically important disease in pine plantations across the southeastern United States, causing multi-million dollar annual losses. In order to cull susceptible crosses and progeny prior to field testing, seedling progeny of 51 crosses were challenged with bulked inocula of the fusiform rust fungus at the U.S. Department of Agriculture Forest Service Resistance Screening Center in Asheville, North Carolina. We used a high spore load (50,000 spores/ml) of a broad-base field inoculum that covered the entire range of deployment for these pine genotypes. Through this culling, we eliminated genotypes that may be susceptible in the field to rust, and we are able to focus on selection for growth and quality traits in the remaining population. Overall mean disease incidence was 48 percent, which was ideal for assessing genetic variation for a binary trait. Family disease means ranged from 5 percent to 81 percent. We fit a generalized linear mixed model and logit link function to partition observed variance in the response variable (1=gall, 0=no gall) into causal (additive and dominance) components. The genetic control for disease incidence was very high, with family mean heritability of 0.95, and the individual tree narrow-sense heritability was 0.5. Substantial genetic gains can be achieved for fusiform rust disease incidence in loblolly pine in a relatively short time (6 months) using greenhouse screening protocols. Subsequent to the greenhouse screening, we cloned 2,442 full-sib progeny that were non-galled for field testing to carry out selection for growth and stem quality traits. Cloned progeny have been established in various locations in 2009 and 2010 using a resolvable alpha incomplete block design.

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