

RAPID-PHENOTYPING OF FUSIFORM RUST DISEASE RESISTANCE IN LOBLOLLY PINE THROUGH VIBRATIONAL SPECTROSCOPY

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Fusiform rust is one of the most economically devastating diseases in commercial pine stands in the southeast, causing massive losses in product and revenue. Significant progress has been made in selecting for rust-resistant families; however, the current method of determining fusiform rust disease resistance (i.e. phenotype) at the family level requires lengthy progeny screening trials, which usually need high levels of disease incidence to be effective. Further, this selection process does not directly test the recruitment population, but their progeny only. Thus, a more expedited approach to selection is needed. Here, we propose to use vibrational spectroscopy as an approach to real-time phenotyping for the selection of fusiform rust-resistance in loblolly pine seedlings. Vibrational spectroscopy tools such as Fourier-transform infrared (FT-IR) and near-infrared (NIR) spectroscopy allow users to obtain a comprehensive chemical fingerprint based on the bending and stretching of chemical constituents in a sample. Because pine trees mostly rely on chemical-based defense mechanisms against pathogens, the relationship between chemical makeup and resistance phenotype is promising. In this project, we are going to use a handheld NIR spectrometer to obtain chemical fingerprints from a common set of 40 different families (20 with higher rust incidence and 20 with lower rust incidence) originating from different geographic areas, sampling two non-infected trees per family at five different progeny test sites of the NC State University Cooperative Tree Improvement Program. Collected spectra will be analyzed through machine learning algorithms to build a predictive model that can discriminate the phenotype based on the chemical profile (i.e. chemotype) of a given tree. This project will establish a real-time phenotyping approach that can be used in the field to assess the recruitment population directly, regardless of the disease incidence in the area and without heavily relying on inoculation trials.