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A Comparative Analysis of Invasive Tree Decay Detection Techniques

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Abstract

Tree decay detection is a crucial component in Urban Forestry. There are invasive as well as non-invasive tools available worldwide for tree decay detection. This study is about a comparative analysis of different invasive techniques for detecting tree decay and cavities. The techniques compared here are traditional decay detection drills, radiographic techniques, acoustic detection, acoustic tomography, and electrical resistivity methods. Traditional tools such as decay detecting drills, increment borers and borescopes are suitable for preliminary investigations. Holes drilled into wood tissue by these tools may lead to fungal invasion. Radiographic techniques use X-ray or Gamma ray radiation where decay is detected by the decreasing wood density resulting from the biodegradation of cell walls. It is very effective in analyzing microscopic decay processes, but power consumption is heavy and has a high risk of radiation hazards. The resolution of radiographic methods is very high compared to other techniques. Acoustic techniques measure the increased transit time of an ultrasound or a stress wave pulse across a tree stem. Tools that use acoustic techniques can provide detailed information on wood quality with moderate to high resolution with quick results but are unable to locate and give the extent of decay. Acoustic tomography techniques generate images of internal wood structures using the principle of reduced velocity of sound waves in decayed wood. Tools such as Picus Sonic Tomograph can locate the defects, estimate their size, shape and determine the relative strength loss of degraded wood. Electrical resistivity techniques measure the reduction of electrical resistance in decayed wood due to the increasing concentration of mobile cations in the decayed region. Electrical resistivity tools such as Shigometers are most suitable for early detection of wood decay. But results should be validated with other methods such as tomography techniques for better accuracy and validation since fungal activities without decay can also cause lower electrical resistivity. In terms of the cost of these tools, radiographic tools are the most expensive while electrical resistivity meters are the cheapest. Apart from these, emerging techniques such as advanced mechanical probes, innovative ultrasonic and stress wave devices for detailed internal imaging, digital microprobes, acoustic emitting monitoring for real time decay tracking and computed tomography for three-dimensional analysis focus on reduced invasiveness alongside increased accuracy and detailing.

Keywords: *Urban forestry, Tree decay detection, Invasive, Accuracy*