# DECAY DETECTION IN EUCALYPTUS: AN EVALUATION OF TWO METHODS

**by L.R. Costello and J.D. Peterson**[1]

**Abstract.** A field study was conducted to evaluate the Shigometer[R] and a drilling method for detecting decay in *Eucalyptus globulus* and *E. viminalis.* A decay detection test for wood in-service (pick test) was used as a reference method. Results found that both the Shigometer and the drilling method predicted more decay than that found by the pick test. Limitations of all three tests are discussed. It is suggested that either method. Shigometer or drilling, be used with caution for detecting decay in *Eucalyptus* species.

**Résumé**. Une étude fut réalisée pour évaluer le Shigomètre et une méthode de perçage pour détecter la présence de carie dans l'*Eucalyptus globus* et *E. viminalis.* Un test de détection de la carie dans du bois transformé (test au pic) fut utilisé comme méthode de référence. Les résultats montrent que le Shigomètre et la méthode de perçage prédisent plus de carie que le test au pic. Les limites de ces trois méthodes sont discutées. Il est suggéré que la Shigomètre ou la méthode de perçage soient utilisées avec soin pour détecter la carie dans les espèces d'Eucalyptus.

Various methods have been used to detect decay in living trees. They range from the simple, such as the use of mallets, drills, or increment borers, to the more technical, such as X-rays (1), sound waves (4), or a pulsed current meter called the Shigometer[R] (11). There are limitations to the use of each of these methods: X-rays and sound waves are not yet practical for field use, mallets can generally only detect hollows, and increment borers can be difficult to use on hardwood species and usually require a microscope and much skill to examine borings. Drilling is somewhat destructive and may only detect advanced decay, while the Shigometer has been found to be useful in some cases (2, 5, 8, 9, 10, 12), and not in others (6, 15, 16, 18). The selection of an appropriate method depends on many factors, such as operator experience, tree size and species, and practicality for field use. For a recent case where a decay assessment needed to be made on mature specimens of two Eucalyptus species, the Shigometer and drilling methods were selected for use. Since there was no scientific literature validating the usefulness of either method for decay detection in any Eucalyptus species, however, a field study was conducted to evaluate each method.

## Methods

Nine *Eucalyptus globulus* and five *E. viminalis* trees growing along a major boulevard in Burlingame, California, were used for this study. These trees, ranging in height from 50 to 80 feet and in dbh from 24 to 50 inches, were part of a street planting of approximately 350 trees. In the winter of 1982-83, six trees in the planting blew over during severe wind and rain storms. Inspection of the blow-overs found extensive wood decay in their roots, root crown, and lower trunks. The cubical brown-rot fungus, *Laetiporus sulphureus,* was isolated from the blow-overs, and sporophores were found on several standing trees. When a tree safety assessment was made on 40 trees, 17 were determined to be hazardous and scheduled for removal. Prior to their removal, fourteen of these trees were tested for decay using the Shigometer and a drilling method. After testing, the trees were sectioned and further evaluated for decay.

*Shigometer Tests.* Shigometer readings were taken along 5 radii spaced equally around the outside of each tree and about 0.5m from ground level (Fig. 1). Holes were drilled using a 2.37 mm diameter bit to a depth of 30 cm. The meter (Model #OZ-67) was calibrated according to operating instructions and the probe inserted in each hole immediately after drilling. After passing through the bark, resistance readings were taken at 2.5 cm intervals. Eleven meter readings were taken along each radius, or 55 readings per tree. A resistance reading reduction of 75% or greater was interpreted as being positive for decay.

*Drilling Method.* Since no formal description of

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the drilling method could be found in the literature, procedures used were taken from personal observation. Trunk radii parallel to and approximately 2.5 cm from Shigometer radii were selected for drilling. A variable speed, reversible drill with a long auger bit (11 mm diameter, 43 cm long with 30 cm twist) for deep wood boring applications was used to collect drillings up to 30 cm deep. Drillings were collected every 7.5 cm along each radius and bagged separately for evaluation. A subjective rating of decay presence was made based on wood color and wood chip integrity. A score from 1 to 5 was given to each sample according to the following criteria:

| Score* | Description | Interpretation |
|---|---|---|
| 5 | Chip firm, long, no discoloration | Sound |
| 4 | Chip firm, long, some discoloration | Suspect early decay |
| 3 | Chip moderately firm, moderately long, some discoloration | Early decay |
| 2 | Chip moderately soft, moderate length, discolored | Early/advanced decay |
| 1 | Chip soft, short, discolored | Advanced decay |

*Scores less than or equal to 4 were considered positive for decay.

Four samples were collected along each radius, or 20 samples per tree.

*Pick Test.* After testing with the Shigometer and drill was complete, the trees were sectioned and a 200 cm thick cross-sectional "round" at the point of testing was collected. Radial sections were then cut from each round to expose wood parallel to both the Shigometer and drilling radii (Fig. 1). Five radial sections were therefore collected from each tree.

The pick test is used by field inspectors to detect decay when advanced decay is absent. It involves using a sharp tool (awl or ice pick) to pry up a splinter from a wood sample and then, upon examining the splinter, a judgment is made about wood condition. Sound wood splinters will tend to be long and break away from the prying tool (fibrous failure), or may break above the tool with the formation of several small splinters (splintering break). Decayed wood breaks over the tool (brash failure) without splintering. Wilcox (14) found this method to be sufficiently sensitive to detect early decay (5 to 10 percent weight loss) in Douglas fir, white fir, and ponderosa pine. It was emphasized, however, that this is a subjective test and results may vary depending on the experience of the operator, latewood thickness, and grain angle.

Once radial sections were cut, the Shigometer and drill radii were located and a line was drawn parallel to these radii—with 2.5 cm increments marked up to 30 cm. An awl was pushed into the wood at each 2.5 cm mark and splinters were pried up. Splinters were evaluated at each point and assigned a score according to the following scale:

| Fiber quality score* | Description and Interpretation |
|---|---|
| 5 | Long chip or splinters; sound wood. |
| 4 | Moderate to long chip or splinter; suspect early decay. |
| 3 | Moderate chip with some brash failure; early decay likely. |
| 2 | Short chip with brash failure; suspect advanced decay. |
| 1 | No chip; advanced decay. |

*Score of 5 = sound wood, 4 or less = decay positive

### Results and Discussion

Comparisons between the Shigometer and pick test and the drilling method and pick test were made for 4 points (7.5 cm intervals) along each radius. A total of 20 points were compared for each tree, or 100 points for *E. viminalis* and 176 for *E. globulus* (data for one radius, or 4 points, are missing for *E. globulus).* Decay was considered present in an interval if any point in that interval was found decay-positive according to the test being evaluated.

The Shigometer and pick test agreed at 55 percent of the points compared in *E. globulus* (Table 1). Most of this agreement was for decayed wood presence (35%), while the remainder was for sound wood (20%). The two tests disagreed at 45% of the points compared. The points of disagreement were comprised of approximately equal numbers of false positives (i.e., the Shigometer indicated decay was present when the pick test found sound wood) and false negatives (i.e., the Shigometer found sound wood while the pick test showed decay).

Substantially similar results were found for *E. viminalis,* although a greater agreement percentage was found (65%). Again, most of this agreement was for decayed wood (52%) and the remainder for sound wood (13%). Here, however, a greater percent false negatives (22%) than false positives (13%) were found.

Other studies evaluating the Shigometer for decay detection in *Eucalyptus species have reported similar results. Wilkes (15) reported that the Shigometer correctly predicted decay in 70-80% of radii probed in several species, but concluded that the 20-30% disagreement percentage was too large for reliable decay detection. Wilson (18) presented equivalent results when using the Shigometer in red beech (Nothofagus fusca).* Wilkes and Heather (16) reported that pulsed current resistance readings were positively and significantly correlated with basic density, but weakly correlated with pH, extractives content, moisture content, and mineral concentration in several *Eucalyptus* species. They concluded that wood properties that change during decay in the eucalypts studied may not induce change in resistance readings.

Based on the results of this study, and those cited above, the Shigometer may need to be used with caution when detecting decay in *Eucalyptus* species. Indications are that electrical resistance readings in this genus may be influenced by factors other than decay.

The drill method and pick test agreed at 58% and 65% of the points evaluated for *E. globulus* and *E. viminalis*, respectively (Table 1). In both cases, most of the agreement was for decayed wood. Disagreement was largely false positives in *E. globulus* and fairly evenly divided between false positives and false negatives in *E. viminalis.*

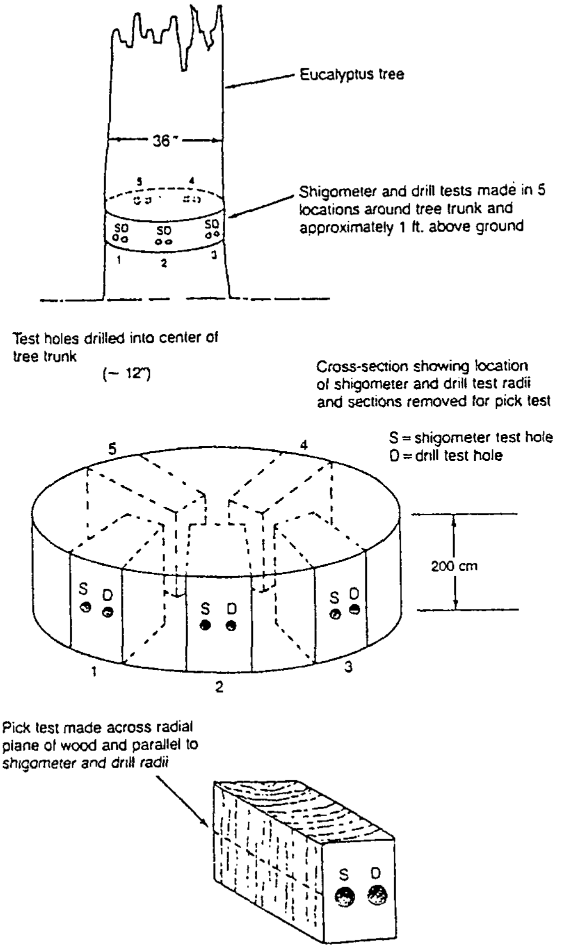


**Figure 1. Shigometer and drill test holes were made at five locations around Eucalyptus trunks. Rounds were cut after testing and sections with both test holes were evaluated for decay using the pick test.**

**Table 1. Equivalent points are compared for presence or absence of decay as indicated by each test. Values shown are percent agreement or disagreement between the two tests for all points compared.**

| | *Shigometer vs. pick test* | | *Drilling method vs. pick test* | |
|---|---|---|---|---|
| | *E. globulus* | *E. viminalis* | *E. globulus* | *E. viminalis* |
| Number of trees tested | 9 | 5 | 9 | 5 |
| Number of points compared | 176 | 100 | 176 | 100 |
| % agreement between tests | 55 | 65 | 58 | 65 |
| % decayed wood agreement | 35 | 52 | 46 | 57 |
| % sound wood agreement | 20 | 13 | 12 | 8 |
| % disagreement between tests | 45 | 35 | 42 | 35 |
| % false positives | 23 | 13 | 27 | 19 |
| % false negatives | 22 | 22 | 15 | 16 |

As with the Shigometer, the drill method essentially predicted more decay than that detected by the pick test. Although some of the disagreement between the two tests likely resulted from their subjective nature, it is difficult to reconcile all of the disagreement on this basis. The magnitude of the disagreement (35-42%) suggests that the drill method may not be a very accurate decay detection method.

Even though the pick test is considered here to be the best available field test for evaluating decay detection methods, it has a subjective basis and therefore has limited value in such evaluations. It provides some indication of the accuracy of a method, but does not give a definitive assessment. Other tests for evaluating a decay detection method are also limited: visual inspection is more subjective than the pick test; decay specific stains (17) are theoretically promising, but are not available for field use; microscopic examination (13) is the most sensitive and least subjective test, but it, too, is not suitable for field use. These limitations of reference tests restrict our ability to provide conclusive assessments of decay detection methods. Obviously, more research is needed to develop a definitive test. In the interim, caution should be used when using any method to detect decay in a species for which the method has not previously been validated.

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