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THE DETECTION OF DECAY IN TREES WITH PARTICULAR RFERENCE TO THE USE OF THE SHIGOMETER, by P.C.Mercer, revised by D. Lonsdale, Pathologist, Forestry Commission

Abstract

Numerous methods for detecting decay have been used in the past but all have had disadvantages. More recently, the Shigometer, a pulsed-current resistance meter, has been found to be a valuable instrument for detecting decay. It may be useful for practising arboriculturists. Its operation is described.

Introduction

1. Over the years a number of devices have been used to try to detect decay in standing trees-Pressler borers, augers,and X-rays, Y ray, resonance and ultrasonic detectors (Beaton er al., 1972, Habermehl & Riddler, 1978).

Destructive Methods

2. The most commonly used, the Pressler borer and the French design auger, make relatively large holes in the tree permitting entry of decay (Laflamme 1979), or outward 'escape' of existing decay fungi which hade been confined by the tree's natural defences. Both tools are tedious to operate, while samples from the French design auger- being in the form of wood chips- are difficult to interpret. The cores of wood removed from the Pressler borer show visually the presence or absence of staining and decay and allow an estimate of the extent of sound wood. In addition, the wood cores may be used to assess the rate of growth of trees and aid diagnosis of the decline of trees.

Non-destructive Methods

3. The non-destructive methods – X-ray, Y ray, resonance and ultrasonic detectors- have tended to be bulky, heavy, above all, under field conditions they produced results which were difficult to interpret other than for trees in an advanced state of decay.

The Shigometer

4. The Shigometer was introduced from the USA in the mid-1970's. This is a meter which measures the electrical resistance across the ends of a twisted wire probe. The operation of the instrument depends on the observation that the resistance of decayed and stained wood is generally lower that that of healthy wood (see Table).

Table

Typical resistance readings across a standard Shigometer junction distance for beech wood in different conditions.

Wood Condition	Resistance
Healthy	90 kilo ohms
Stained	20 kilo ohms
Decayed	8 kilo ohms
Hollow	500 + kilo ohms

5. In theory electrical resistance in wood is dependent on temperature, moisture and concentrations of free inorganic salts. But during most of the year, in the UK, moisture and temperature are not limiting, except in dried-out wood. In practice, resistance is primarily dependent on free salt concentrations and these are higher in stained and decayed wood that in healthy wood, resulting in lower resistance.

6. Operation if the instrument is simple. A 3mm diameter hole is drilled into the test tree, using flexible bits, either 20 or 30cm long. If a 30cm hole is to be drilled the 20cm bit should be used first followed by the 30cm bit, to minimise the possibility of breakage. Several battery-powered drills have been tested but the batteries were found to have inadequate storage capacity. This problem can be overcome by using a low voltage drill which can be connected to an external battery. Six volt, sealed rechargeable batteries of output about 8.o Ah (amp hours) are suitable. The drill speed preferably should be about 200 r.p.m. and should not exceed 500 r.p.m. as local overheating of the wood around the hole may occur, producing misleading results.

7. The probes (20 + 30 cm long) consist of two twisted copper wires insulated except for bared portions at the probe end. The ends of the probe should be slightly splayed before insertion into the drill hole to ensure good contact with the wood. The probe is pushed slowly into the drill hole and readings taken, on a meter, at intervals (centimetre divisions can be marked on the probe). The Shigometer is not designed to give absolute readings for tree species and wood conditions. Readings will differ at the same position within a tree from day to day. What is to be looked for is an abrupt change in reading, indicating a change of wood condition (see Table). By using the Shigometer at 4 compass points around a tree base, and idea can be gained of the internal pattern of decay (Mercer, 1979).

Limitations of the Shigometer

8. *Extensive research, mostly on* beech (*Fagus sylvatica*) but also on ash (*Fraxinus excelsior*) and Horse chestnut (*Aesculus hippocastanum*), has shown the Shigometer to be useful in detecting decay in trees. There are, however, some limitations which should be borne in mind:-

a) The drill and probes have a maximum length of 30 cm which makes the maximum tree diameter capable of being fully tested 60 cm. It also limits its use for detection of root tots.
b) As pointed out above, the operation of the Shigometer relies, among other thins, on moisture. This is not normally limiting but occasionally dry decay can give misleading results. It has been found that syringing distilled or preferably deionised water into drill holes and then, after a minute or so, removing excess water with the syringe allows satisfactory detection of dry decay.
c) Frequently, pruning wounds acquire a surface layer-often several centimetres thick- which has become dry and hard (case-hardened), but which overlies and area of extensive decay. If this is suspected a deep drill hole is required as case-hardened material frequently gives a high resistance reading even after water- soaking.
d) Drill bits obviously produce holes in trees. Although any hole is a potential danger to a tree, Shigometer holes are of a sufficiently narrow diameter to callus over within 9 months. Once a tree has closed a wound any activity of introduced micro-organism is severely reduced or stopped altogether. There is very little danger of decay being made worse by using the narrow drill bits.
e) Although not as simple to use as a Pressler borer, the Shigometer has proved a satisfactory instrument for research work during tests extending over 5 years. However, as with the chain saw, instruction and experience in the use of the Shigometer are needed to get the best out of the instrument.

Conclusion

9. The Shigometer is not a 'tool to used on every tree'; it should be regarded as a means of confirming the presence of decay suggested by externally visible symptoms (Yong 1984).

10. Within these constraints the Shigometer is a very useful fool for detecting decay. However, when considered as a complete unit of meter, power drill with flexible bits and a generator, it is expensive and for some purposed may be less informative that the Pressler borer.

11. Detailed instructions on the use of the Shigometer have been published by Shigo et al., (1977). Further details, including cost, can be obtained for the Arboricultural Advisory and Information Service at the address below.

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