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EFFECT OF ORIENTATION OF WOOD BLOCKS IN SOIL BURIAL FOR TESTING WOOD PRESERVATIVES AND NATURAL DURABILITY

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Introduction

Moreschi and Willeitner (1984) while using pure cultures, found that the most suitable block face to be laid on the agar substrate was the transverse one. This resulted in a larger fungus response and better relationship to the preservative retention than either radial or tangential faces. Corbett (1963) found that the transverse faces of wood blocks were more easily penetrated than any other block faces. Mwanza (1989) determined the natural durability of Juniperus procera (Cedar) and Eucalyptus microcorys using soil burial test. The durability of these woods is limited by deterioration from soil detriogens. And a soil burial test evaluates the destructive capacity of the deteriogens.

It is known that moisture can move up to 100 times faster in the longitudinal direction than in the transverse directions, below 100°C (Wengert and Skaar, 1978). The flow can be influenced by the grain angle, i.e. the slope of the longitudinal cell elements in the net flow direction as shown below in Figure 1.1

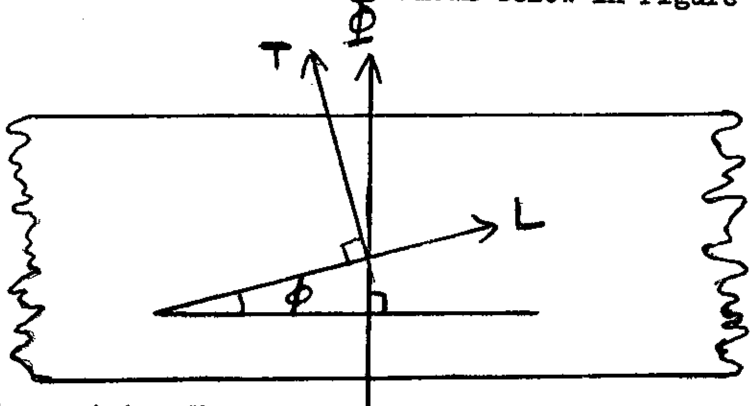


Figure 1.1: The influence of grain angle on flow of moisture.

Axis orientation for net flow in the Φ direction with grain angle ϕ. Longitudinal direction is L; transverse direction is T; K is the moisture conductivity coefficient. (After Wengert and Skaar, 1978).

Wengert and Skaar (1978) suggest that effect of the grain angle can be demostrated as follows:-

Let F be a flux and C be a concentration. The concentration gradients are thus:

$$\frac{\partial C}{\partial L} = \frac{\partial C}{\partial \Theta} \sin \phi \qquad \frac{\partial C}{\partial T} = \frac{\partial C}{\partial \Theta} \cos \phi$$

The Flux in the Θ direction, F_O, is the sum of the Θ - components of the F_T and F_L fluxes:

$$F\Theta = F_T \operatorname{Cos} \phi + F_L \sin \phi$$

from Fizks law,

$$F_T = K_T \frac{\partial C}{\partial T}$$

$$F_L = k_L \frac{\partial C}{\partial L}$$

$$F\phi = k\phi \frac{\partial C}{\partial O}$$

Combining these equations algebraically the following expression is obtained:

$$\frac{k\Theta}{k_T} = \operatorname{Cos}^2\phi + \frac{kL}{k_T} \sin^2\phi$$

This provides the ratio of the conductivity in Θ direction (i.e., the experimentally measured conductivity) to the conductivity in the transverse direction (i.e. the desired conductivity) as a function of the grain angle, ϕ, and the ratio of the longitudinal to transverse conductivities.

Although moisture will flow by circuitous paths, alternating between longitudinal and transverse flow and overall effect of grain angle can be observed by examining $(F_L \sin\phi)/F\Theta$ - the flux that moves in the Θ direction by a longitudinal path compared with the total net flux where

$$(F_L \sin\phi) / F_\phi = \frac{1}{\frac{kT}{kL}\cos^2\phi + 1}$$

The grain angle will affect the apparent measured variation of the "transverse" coefficient with moisture content since the transverse flow is dominated by cross wall diffusion that increases as moisture contents increase (at constant temperature). The longitudinal mechanism is dominated by vapour diffusion in the cell lumen that decreases as moisture contents increase as shown in the equation:

$$\frac{\partial C}{T} = \frac{\partial C}{\partial \text{L}} \cos\phi$$

Moisture will move primarily by longitudinal paths and the rate will be primarily influenced by the behaviour of the longitudinal conductivity coefficient even though the net flow is assumed to be across the grain. For practical uses, only longitudinal coefficient is important.

When a wood sample is in total soil burial, all faces are vulnerable to the microbes and it is not known whether some faces would suffer from preferential attack. The net flow of moisture in the wood sample will be influenced by the way it is planted in the soil. This experiment was designed to see if this factor affects the degradation of the wood samples.

Materials and Methods

The initial oven dry weights of 72 labelled wood blocks were determined. The dimensions of the wood blocks were 30mm. long and 10 x 5mm. 36 of these wood blocks were *Pinus patula* and 36 were *Cupressus lusitanica*

6 *C. lusitanica* blocks were vertically planted on their 5 x 10mm. face (transverse) inside a mini-soil bed containing a 100g. of Muguga soil prewetted to its 95% W.h.c. The blocks were planted at 20mm depth in the soil. This was repeated to provide 12 replicates. This procedure was repeated again using pine.

The same operation was carried out again but the 72 wood blocks were laid down on their 30 x 5mm. (RL) and a further 72 on their 30 x 10mm. (TL) faces as shown in Figure 1.2. All the samples were buried at 20mm depth in the soil and the soil beds incubated at 28°C and 100% relative humidity for 12 weeks.

After incubation the wood blocks were weighed when wet, leached in water overnight, oven dried overnight at 103°C and weighed.

RESULTS AND DISCUSSIONS

Differences between the weight losses in C. lusitanica at radial longitudinal, transverse, and transverse longitudinal orientations were insignificant (Tab. 1) at P= 0.001 (F = 2.1) were as those for pine were insignificant at P = 0.001 (F = 1.8). This showed that degradation of wood blocks in soil burial is independent of wood orientation. Probably, this was because when the woodblocks were totally buried in soil, they could absorb moisture from all faces. In contrast to this Savory and Bravery (1970) fround that placing the blocks on the soil surface limits the amount of block surface in contact with the soil medium which in turn restricts the already limited entry of water and mineral salts as well as the colonisation by the soil mycoflora.

This experiment shows that when buried at 20mm beneath the soil surface that there is no significant difference between different orientations.

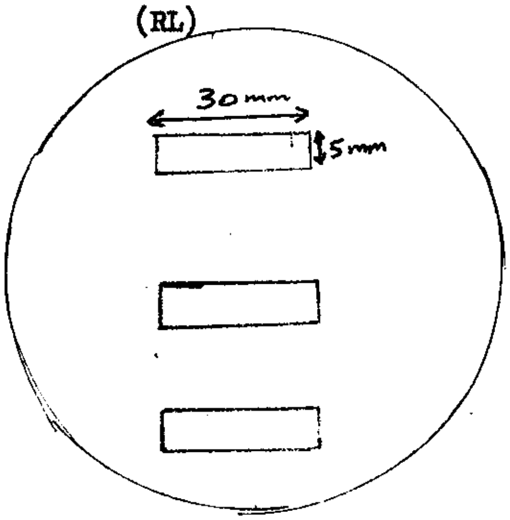
Unsterile soil is the best test substrate since it contains a community of deteriogens similar to that one encountered in nature. It is an accelerated method of testing for natural decay reistance and wood preservatives since conditions in the field are reproduced in the laboratory while maintaining the natural unsterile soil as the test substrate.

The conventional methods utilise sterile agar or steale soil as the test substrates in the laboratory. "Graveyard" test commonly known as field test is the only other best which utilises unsterile soil as a test substrate. But this takes about ten years to produce results while the present method takes only eight weeks.

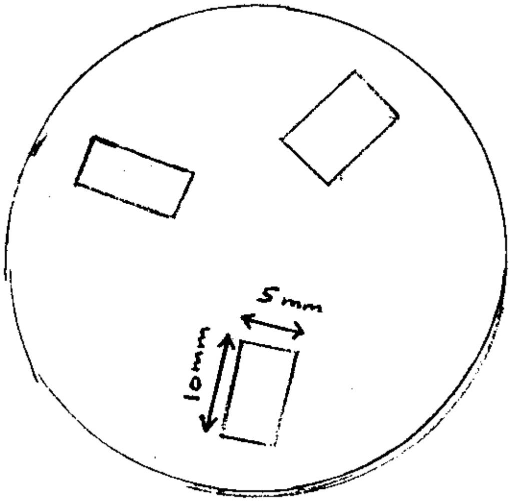
Determination of the role orientation plays in this experiment has brought scientists uses to standardisation of the accelerated methods of testing wood using unsterile soil.

Figure 1.2: The layout of the wood blocks in soilbeds

(a) Radial longitudinal
(RL)



(b) Transverse (T)



(c) Tangential longitudinal (TL)

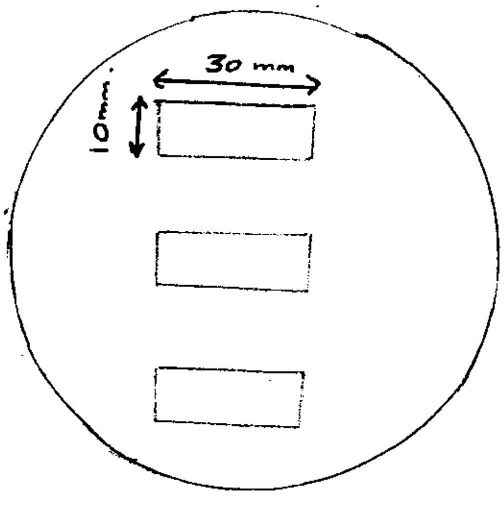


TABLE 1: MEAN WEIGHT LOSSES IN ORIENTATED WOODBLOCKS

	Cupressus lusitanica		*Pinus patula*	
Orientation	Mean % Wt. loss	Standard error	Mean % Wt. loss	Standard error
(a) Radial longitudinal	31.7 (26 - 38)*	1.6	16.0 (15 - 22)	0.9
(b) Transverse	30.3 (24 - 33)	1.7	18.0 (16 - 22)	1.0
(c) Tangential longitudinal	30.9 (23 - 37)	1.5	18.3 (14 - 22)	1.2

* = Range

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