# NOTE ON ROOT-WOOD STRENGTH DETERIORATION IN NOTHOFAGUS FUSCA AND N. TRUNCATA AFTER CLEARFELLING

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## INTRODUCTION

Shallow landsliding on recently clearfelled slopes in North Westland has been attributed partly to the deterioration of tree root networks after tree cutting (O'Loughlin & Pearce 1976). As part of a larger study of the slope stability conditions on intact beech/podocarp/mixed-hardwood forest slopes and clearfelled slopes in the Forest Research Institute's experimental catchments in Tawhai State Forest near Reefton, an investigation of root-wood tensile strength decline rates in red beech (*Nothofagus fusca* Hook. f.) and hard beech (*N. truncata* Col.) was undertaken. Details of the climate, slope environments, and vegetation of the study area are provided by O'Loughlin *et al.* (1978).

## METHODS

Roots were sampled from living red and hard beech trees and from stumps cut 18, 31, and 44 months prior to sampling. The sample trees and stumps were located on steep well-drained slopes underlain by shallow podzolised yellow-brown earths (Blackball Hill Soils) usually with a well-developed humus horizon. No attempt was made to distinguish red beech stumps from hard beech stumps although, on the sites sampled, it is likely that most of the roots were taken from hard beech stumps. Roots were carefully excavated from soil 10 to 100 cm below the surface, cut, and sealed in plastic bags. Sampled roots ranged in diameter from approximately 1 mm to 15 mm.

The sampled roots were transferred to the laboratory where straight sections of roots were cut from the samples, trimmed to a length of approximately 28 cm, and tested in tension on a Floor Model 1195 Instron Universal Testing Machine equipped with a 5-kN maximum capacity, reversible-load cell. The details of the testing equipment, test speeds, and technique have been outlined by O'Loughlin (1974) and O'Loughlin & Watson (1979). A total of 369 successful tensile strength tests were completed.

## RESULTS AND DISCUSSION

The root-wood tensile strength test results are shown in Table 1 and Fig. 1. The mean tensile strength of living roots (32 571 kPa) declined rapidly until, 44 months after tree felling, the mean root-wood tensile strength was only 12 208 kPa. This represents a mean strength-decline rate of approximately 460 kPa per month, which is very similar to the strength-decline rate of about 500 kPa per month measured for *Pinus radiata* D. Don at Ashley State Forest (O'Loughlin & Watson 1979). However, the mean living root-wood strength of red and hard beech was almost double the mean root-wood strength of living roots of *P. radiata*. The decline of beech root-wood strength can be approximated by a negative exponential curve.

TABLE 1—Root-wood tensile strength (TS) and diameter (D) of **Nothofagus** spp. sampled from Tawhai State Forest

| Root class (No. tested) | Mean | | Maximum | | Minimum | | Standard dev. | |
|---|---|---|---|---|---|---|---|---|
| | TS (kPa) | D (mm) | TS (kPa) | D (mm) | TS (kPa) | D (mm) | TS (kPa) | D (mm) |
| Living trees (97) | 32 571 | 3.8 | 82 873 | 8.4 | 8370 | 1.1 | 15 921 | 1.7 |
| Cut 18 mths (109) | 21 471 | 3.8 | 60 877 | 6.6 | 4329 | 1.6 | 10 677 | 1.4 |
| Cut 31 mths (107) | 18 539 | 4.2 | 48 690 | 9.0 | 2829 | 1.5 | 10 519 | 1.5 |
| Cut 44 mths (56) | 12 205 | 5.7 | 37 033 | 14.5 | 363 | 1.9 | 8 987 | 2.6 |

$$TS_t = TS_o e^{-bt} \quad (1)$$

where $TS_o$ = tensile strength of root wood from living trees

$TS_t$ = tensile strength of root wood from stumps cut t months previously

b = probability of decay.

As the term $e^{-b}$ is an expression of the strength decay rate, it follows that the time taken for root strength to decline to half the living root tensile strength (half strength period is:

$$t_{0.5} = \log 0.5/\log(e^{-b}) \quad (2)$$

For beech root-wood the strength-decline curve is:

$$TS_t = 32\,722\ e^{-0.021t} \ (r^2 = 0.975)$$

and $t_{0.5} = 33.01$ months.

This time to half strength for beech roots is considerably longer than that for *P. radiata* roots where $t_{0.5} = 15$ months.

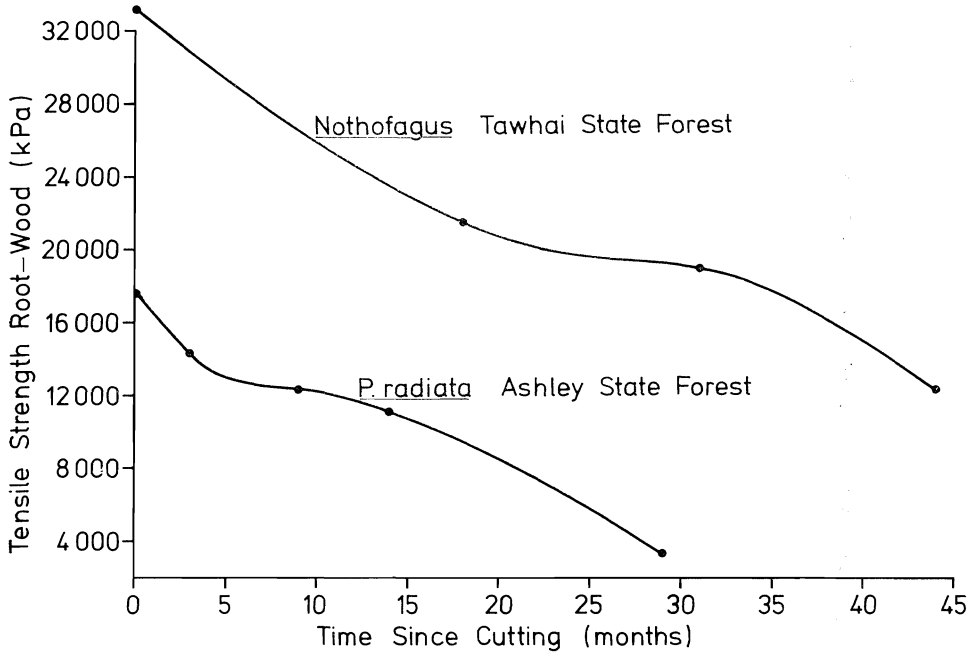


FIG. 1—Curves of mean tensile strength **v.** time elapsed since tree cutting, for root wood of **P. radiata** and **Nothofagus** spp.

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