Practical soil sampling in planted forests – soil profile

WHY KNOW YOUR SOIL PROFILE?

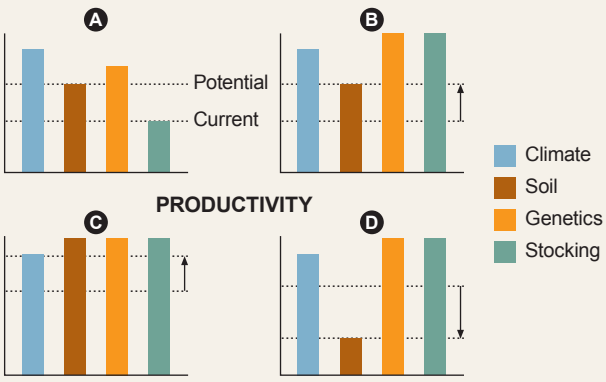
- **General understanding of soil profile properties and their impact on productivity** – topsoil depth, soil structure, rooting depth, hard pans, erosion risk, soil texture, water holding capacity, nutrient supply, growth promotion
- **Identifying the mineral soil surface** – for soil sampling purposes
- **Observation of topsoil depth** – key indicator of soil quality

2015 International Year of Soils

SOIL AND FOREST PRODUCTIVITY

Understanding your soil and soil profile can help unlock the potential of your forest and support long-term sustainable productivity.

The productivity of a forest site is largely determined by climate, soil, genetics and stocking. The relationship between current and potential productivity may be constrained by any one of those factors (see figure).



A) An understocked stand is performing at less than potential as limited by the natural properties of the soil; **B**) Improvements in genetics and stocking increase productivity to the level constrained by the soil; **C**) Soil amelioration (fertiliser use, drainage) raises productivity to a new potential set by local climate; **D**) Both current and potential productivity are reduced through soil degradation (Powers, 1999).

IDENTIFYING MINERAL SOIL SURFACE

A very important step in sampling mineral soil is identifying the mineral soil surface under the forest floor horizon, or LHF. Inclusion of LHF material in mineral soil samples will bias analytical results.

The LFH common to forest soils is formed from dead biomass (leaves, cones, branches and stem):

- **L** (fresh litter <10cm diameter),
- **F** (partly fragment litter with still recognizable plant remains), and
- **H** (decomposed humic litter) horizons.

L, **F** and **H** organic horizons from a pine forest. Arrows indicate base of horizons. *(Photo, John Adams)*.

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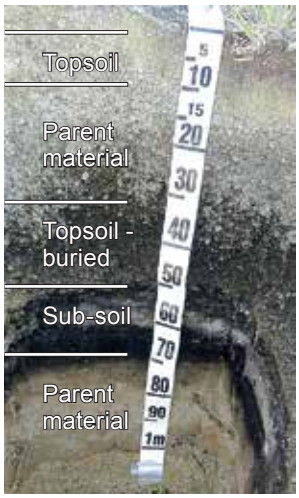
IDENTIFYING THE TOPSOIL

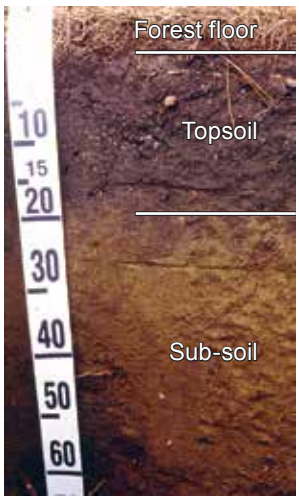
The topsoil contains much of the organic matter, nutrients for plant growth and microorganisms involved in nutrient cycling. Typical in most forest soils, but it can be absent in weakly developed soils, e.g. coastal sands.

Soil organic matter is an extremely important component of the soil. It improves nearly all soil properties, e.g. moisture retention, soil structure, drainage, nutrient storage, and therefore plays a vital role in many functions of soil.

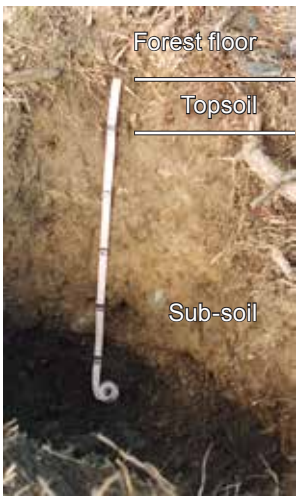


Kaingaroa Forest – Recent Soil

Riverhead Forest – Ultic Soil



Southland Forest – Brown Soil



Karioi Forest – Allophanic Soil

SOIL CLASSIFICATION

Soil classification can tell much about soil chemical and physical properties. New Zealand has a diverse range of soils with 15 main soil orders mapped using the NZ soil classification system (Hewitt, 1998). The main forest soils in New Zealand are listed below.

A national soil classification map is freely available at http://data.linz.govt.nz

TABLE OF NZ FOREST SOIL ORDERS (DAVIS ET AL., 2010)

Soil order NZ Soil Classification (% of NZ area)	% of NZ forest estate	Main diagnostic features (Distribution)
Allophanic (5)	2	Soils dominated by allophane minerals (Central NI, small areas in SI high country)
Brown (43)	33	Aerobic soils with brown colours due to iron oxide coatings (Widespread)
Pallic (12)	7	Soils with pale coloured subsoils with high density (Seasonally dry eastern areas in both islands and Manawatu)
Podzol (13)	7	Strongly leached acid soils with bleached E (eluviated) horizons beneath topsoil, underlain by dark, organic rich horizon (Northland, high country of both islands, West Coast of SI)
Pumice (7)	32	Soils dominated by pumice or pumice sand with a high content of natural glass (Central NI, mainly Volcanic Plateau)
Recent (6)	9	Weakly developed soils showing minimum horizon development, but with distinct topsoil (Throughout in young landscapes)
Ultic (3)	4	Strongly weathered soils with clay enriched subsoils (Northern NI, Wellington, Marlborough, Nelson)

References:
Davis, M., Xue, J., Clinton, P. (2010). *Plantation Forest Nutrition*. New Zealand Forest Research Ltd.
Hewitt, A. E. (1998). *New Zealand Soil Classification. Landcare Research Science Series No. 1*. Lincoln: Manaaki Whenua Press.
Powers R.F. (1999). On the sustainable productivity of planted forests. *New Forests*, **17**: 263-306.