Impact of Forest Management on Wood Stake Decomposition in Mineral Soil: Index for Soil Productivity

A.H. Collins¹, M.F. Jurgensen², D.S. Page-Dumroese¹, D.D. Reed² and P.E. Laks²

1-USDA Rocky Mountain Research Station, Forest Sciences Laboratory, 1221 S. Main, Moscow, ID 83843, USA.
2-School of Forestry Resources and Environmental Science, Michigan Technological University, 1400 Townsend Dr., Houghton, MI 49931, USA.

Photo by Anne H. Collins
Forest management practices impact soil organic matter decomposition rates, which can change soil nutrient availability and carbon sequestration.

Productivity of an area is determined by the soil's capacity to support plant growth and is reflected by site index and biomass accumulation (Powers, 1991).

It has been shown that organic matter decomposition rates and site productivity are directly related (Kurka and Starr, 1997).
Many decomposition studies of organic matter have been conducted using leaf litter as the substrate in forest soils, on the forest floor and throughout the soil column (Berg et al., 1996).

Little has been done to explore the physical properties of soils (mineral soil) that influence root growth and nutrient uptake (Dyck et al., 1991).

There is currently no definitive measure of soil quality that is directly related to site productivity (Fox 2000).
Literature has indicated that most soil decomposition studies have been on the surface using litter bags.

Therefore, a study observing the decomposition of woodstakes in the mineral soil, would be a beneficial measurement.
The objectives of this study are:

- Estimate the effects of surface organic matter removal and soil compaction on wood decomposition in the mineral soil.

- Determine the effects of soil moisture and temperature on decomposition rates and the microbial decay patterns.
Twenty-five sites have been established in North America since 1998.
Priest River Experimental Forest
- 715 m in Elevation (Lat. 48°21’ N, Long. 116°50’ W)
- *Abies grandis/Clintonia uniflora* complex
- Silt loam, medial, frigid Orchreptic Fragixeralf soil

Long Term Soil Productivity Site (LTSP)
The Priest River is shown with various plots and subplots labeled with different treatments:

- **C₀OM₀**: no compaction, no organic removal
- **C₂OM₀**: heavy compaction, no organic removal
- **C₀OM₂**: no compaction, heavy organic removal
- **C₂OM₂**: heavy compaction, heavy organic removal
- **UnC**: uncut (woods)

The images below the diagram correspond to the different treatment types:
Two Standard wood stakes were used

- Southern yellow pine (softwood)
- Trembling Aspen (hardwood)

- Uniform or defined organic material (not from study site)
- Removes OM quality as a decomposition factor
- Measures effect of abiotic soil factors water, temperature, pH, nutrients, etc.
- Comparison among different sites in the Large Stake Study
Two Insertion Date Established

▲ October 1997

▲ April 1998

Mother Stake

2.5 cm x 2.5 cm x 91.44 cm (fall)
2.5 cm x 2.5 cm x 76.2 cm (spring)

<table>
<thead>
<tr>
<th>Daughter Stake-1</th>
<th>Control</th>
<th>Daughter Stake-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.5 cm x 2.5 cm x 33.0 cm</td>
<td>2.5 cm x 2.5 cm x 25.4 cm (f)</td>
<td>2.5 cm x 2.5 cm x 33.0 cm</td>
</tr>
<tr>
<td>2.5 cm x 2.5 cm x 10.1 cm (s)</td>
<td></td>
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500 Stakes inserted in October 1997

500 Stakes inserted in April 1998
Inserted wood stakes
(Size: 2.5 x 2.5 x 33.02cm)
The Stakes were extracted every 6 months from each subplot for 2.5 years

Three Penetrometer Readings were taken 5.1 cm from stake
▲ Depth 1: 2.5 cm - 5.1 cm
▲ Depth 2: 15.2 cm - 17.8 cm
▲ Depth 3: 27.9 cm - 30.5 cm
Pine Stake Decomposition
By treatment

% Weight Loss vs. Time (years)

- C0OM0
- C2OM2
- UnCut
Aspen Stake Decomposition

By treatment

% Weight Loss

Time (years)

0.5 years 1.0 years 1.5 years 2.0 years 2.5 years

C0OM0 C2OM2 UnCut
Pine Stake Decomposition at 1.0 years

By depth

% Weigh Loss

Depth

<table>
<thead>
<tr>
<th>Depth</th>
<th>C0OM</th>
<th>C2OM</th>
<th>Uncut</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 cm</td>
<td>16.5 cm</td>
<td>29 cm</td>
<td></td>
</tr>
</tbody>
</table>

Diagram showing decomposition at 1.0 years by depth.
Pine Stake Decomposition at 2.5 years

By depth

% Weight Loss

Depth

4 cm 16.5 cm 29 cm

C0OM0 C2OM2 UnCut

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

4 cm 16.5 cm 29 cm
Pine Stake Decomposition

By insertion time

% Weight Loss

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Time (years)

0.5 years 1.0 years 1.5 years 2.0 years 2.5 years

C0OM0-Fall  C0OM0-Spring
Pine Stake Decomposition

By insertion time

% Weight Loss

Time (years)

0.5 years 1.0 years 1.5 years 2.0 years 2.5 years

C2OM2-Fall C2OM2-Spring
Pine Stake Decomposition

By insertion time

% Weight Loss

Time (years)

0.5 years
1.0 years
1.5 years
2.0 years
2.5 years

UnCut-Fall
UnCut-Spring
Summary

» Compaction played an important role in the amount of wood stake decomposition.

» Surprisingly, there was no depth effect of decomposition by treatment or time. The UnCut showed some effect initially, but later measurements did not show it.

» There was a definite seasonal effect
References


Thank You