Assessing Soil Organic Matter Quality in Response to Silvicultural Manipulations along a Site Quality Gradient in Northern California

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Introduction:
In the late 1980’s, the Garden of Eden Study was established to test the effects of repeated fertilizer applications (F), competing vegetation control via application of herbicide (H), and the combined effects of each type of treatment (HF) on productivity of three ponderosa pine (Pinus ponderosa (Dougl. ex Laws.)) plantations of varying site quality in Northern California. Treatment effects on aboveground biomass are striking (Figure 1). The study provides a unique opportunity to investigate the effects of plantation management on soil C dynamics.

Hypotheses/Expectations
Higher quality SOM tends to be 1) more labile, 2) contain more N, and 3) have lower C:N ratios. In addition, SOM fractions with lower densities tend to be higher quality. Thus, we hypothesize the following:

- Site/treatment combinations that result in higher stand productivity will have higher quality SOM.
- SOM quality will be lower where competing vegetation is absent because shrubs contribute significantly to OM quality.
- Soil with higher quality OM should demonstrate higher rates of C mineralization during laboratory incubation (Figure 2).

II. Soil C quality described by laboratory incubation
We conducted a small-scale mineral soil (0-20 cm depth) incubation for two weeks at 30°C. Treatment effects on aboveground biomass are striking (Figure 1). The study provides a unique opportunity to investigate the effects of plantation management on soil C dynamics.

III. Summary
- The most productive site had the most C, N, and Light fraction, but also the highest C:N ratio and least C mineralization during incubation.
- The least productive site had the lowest C:N ratio and the most C mineralization during incubation.
- Control and Fertilized plots had higher quality SOM than Herbicide treated plots.
- Fertilized plots from two sites had more C mineralized via respiration during incubation, but fertilized plots from all sites had lower C mineralized via DOC than Herbicide treated plots.

IV. What comes next?
- Long-term (6 month) incubation of all treatments with replication.
- Quantification of forest floor, mineral soil, and fine root C pools for each treatment at each site.