Amended vs. Mulched Compost Effects in a Woody Landscape Bed

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Objectives

Assess the short and long-term effects of compost and bark application on soil properties and growth of woody plants in landscape beds.

Compare effects of incorporation of compost vs. compost applied as a mulch.

Methods

Experiment established June 2001.

Site: Puyallup, Washington, in Puget Lowland of western Washington.

Soil: Puyallup fine sandy loam (coarse–loamy over sandy, isotic, mixed, Vitrandic Haploxerolls) 11 g/kg organic C and 30–60 g/kg clay.

Climate: Mild (18°C) dry summers and cool (4°C) wet winters.

Treatments

U: Unamended control.
CS: Compost applied as mulch (8 cm depth).
CI: Compost (8 cm) incorporated to 20 cm depth.
B: Bark mulch (8 cm).
BCS: Compost mulch + bark mulch.
BCI: Compost incorporated + bark mulch.

Design

3x2 factorial arranged in randomized completed block with 4 reps.

Plot size: 6.1 x 5.2 meters.

Amendments (*Table 1*)

Yard debris compost rich in grass clippings.
Douglas fir bark, medium grade.

Plants

Pacific NW native plants
- Alaska cedar, Chamaecyparis nootkatensis
- Pacific madrone, Arbutus menziesii
- Redosier dogwood, Cornus sericea

Non-native plants
- Fringe tree, Chionanthus virginicus
- Rhododendron, 'Henry's Red'
- Strawberry tree, Arbutus unedo

Measurements

Bulk density: Hammer driven core sampler, 2004 and 2007.
Infiltration: Single ring falling head, 2005.
Compaction: Rimik penetrometer, 2002–2006.
Aggregate stability: Wet sieving, 2005.
Soil moisture tension: Tensiometers at 15 and 30 cm depths, 2002–2006.
Soil test nutrients and pH: 2001 and 2006.
Soil nitrate: Fall 2001–2004.
Compost and bark mulch depth: 2001, 2002, 2004 and 2007.
Plant shoot growth index, caliper, width: 2001–2006.

Results

Soil C (*data not shown*). Equivalent 41% C retention in compost incorporated + bark treatment and 26% C retention in compost incorporated without bark 5 years after compost application.

Mulch depth (*Figure 1*). Mean compost depth of mulched compost treatments was 52% of original depth 5+ years after application, and bark depth was 76% of original depth.

Bulk density (*Figure 2*). Significant bulk density reduction by both mulched and incorporated compost 5+ years after application.

Soil compaction (*Figure 3*). Compost significantly reduced soil compaction to a depth of at least 30 cm (statistics not shown). Differences declined with time, but treatment was still significant in 2006.

Infiltration (*Figure 4*). All amendments increased infiltration rate compared with unamended control. Protecting the soil surface with bark or compost mulch was as effective as incorporating compost at improving infiltration.

Aggregate stability. Visual differences in aggregation were apparent, but wet sieving results were not significant.

Soil moisture tension (*Figure 5*). Soil moisture tension data showed unmulched treatments drying several weeks faster than the mulched treatments (2003 data at 15 cm depth shown). Compost incorporation did not appear to improve available water.

Soil test P, K, pH (*Table 2*). Soil test P and K were elevated 5 years after compost application, and pH was similar or slightly lower than in the unamended soil.

Plant growth (*data not shown*). Compost effects on shoot growth index were significant through 2004, an apparent response to N release from the compost.

Soil nitrate N (*Figure 6*). Excessively high levels of soil nitrate N were apparent in the fall of 2001, and differences among treatments were still significant in 2004. The low C:N ratio of the grass rich compost lead to high levels of available N the first year. Subsequent mineralization of compost N raised soil N levels the following years.

Discussion

Incorporated compost had a greater effect than compost mulch on soil properties that are directly related to organic amendment (C, N, and bulk density) (*Table 3*).

There was little difference in the other soil properties between the two methods of compost amendment.

Surface application of compost could provide significant benefits where incorporation is not feasible.

The data show long-term beneficial effects of compost addition, with substantial changes in soil properties persisting for five years after application and likely to persist for much longer.

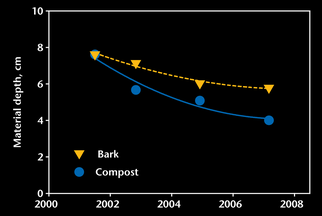

Figure 1. Change in depth of compost and bark layers over time, 2001–2007.

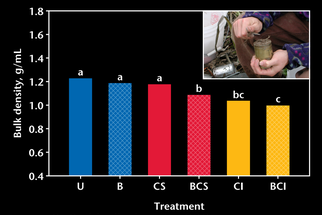

Figure 2. Soil bulk density, 2007.

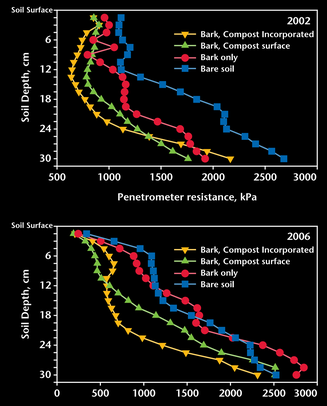

Figure 3. Soil compaction 0–30 cm depth measured by recording penetrometer.

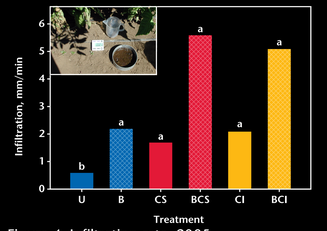

Figure 4. Infiltration rate, 2005.

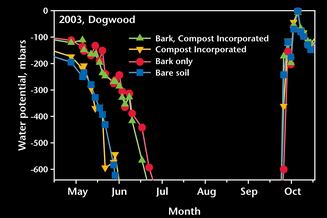

Figure 5. Soil moisture tension, 15 cm depth, 2003.

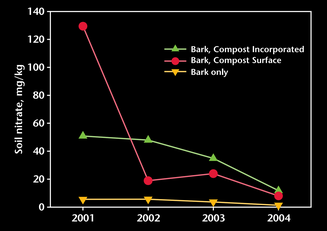

Figure 6. Soil nitrate–N 0–30 cm depth, Fall 2001–2004.

Table 1. Compost and bark chemical analysis.

Material	Total C (g/kg)	Total N (g/kg)	C:N	NH_4–N (mg/kg)	NO_3–N (mg/kg)	Total P (g/kg)	Total K (g/kg)	pH	EC (ds/m)
Compost	220	21	10	593	20	4.2	22	7	3.2
Bark	470	2.5	186	25	8	0.3	2	4	0.8

Table 2. Soil total C and N, pH, P and K, 2006.

Treatment	Total C (g/kg)	Total N (g/kg)	pH	Bray P (mg/kg)	Exch. K (mg/kg)
None	10 d	0.9 d	5.5 a	285 b	276 c
Bark	10 d	0.9 d	5.4 a	299 b	274 c
Compost Surface	11 d	1.0 d	5.4 a	423 a	434 a
Bark + Compost Surface	14 c	1.2 c	5.4 a	413 a	388 b
Compost Incorporated	17 b	1.7 b	5.4 a	395 a	379 b
Bark + Compost Incorporated	21 a	2.0 a	5.2 b	413 a	305 c

Table 3. Summary of mulched and incorporated compost effects on soil properties compared with unamended control.

Property	Compost Mulch	Compost Incorporated
Total C	+	++
Total N	+	++
Bulk density	+	++
Compaction	+	+
Aggregate stability	0	0
Infiltration	+	+
Soil moisture tension	0	0
Nutrients	+	+
Nitrate leaching potential	–	––
Plant growth	0	+/0
Leaf color	+	+

+, ++ represent benefits compared with control.
–, –– represent negative effects.
0 represents little or no effect.

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