Douglas fir bark: properties and management

Dr. James Altland
A good container media must:

• Provide anchorage for the plant

• Provide a reservoir for water

• Allow oxygen/gas exchange for roots

• Retain nutrients for uptake
Introduction

• Douglas fir bark
  – Primary container component

• Fresh and aged bark are used

• Aged bark
  – Large piles sit undisturbed for several months.
  – Not composted.
Particle distribution of raw bark

![Graph showing the particle distribution of raw bark](graph.png)
Physical properties of raw bark

- **Fresh 1**: 21 Solids, 32 Water, 46 Air
- **Aged 1**: 18 Solids, 42 Water, 41 Air
- **Fresh 2**: 22 Solids, 38 Water, 40 Air
- **Aged 2**: 18 Solids, 40 Water, 42 Air
- **Recom. range**: 25 Solids, 55 Water, 20 Air
Changes in physical properties

• Source 1:
  – Starts as a larger particle size – 7/8” screen
  – Aging reduces AS and increased WHC is evident

• Source 2:
  – Starts as a smaller particle size – 3/8” screen
  – Changes in porosity from aging not as evident
• “Making media is similar to making soup.”

• “Learn to shift your thinking from ingredients and components to properties and parameters.”

– William Fonteno
Ideal ranges for container crops

- Total porosity
  - 50-85%

- Air space
  - 10-30%

- Water holding capacity
  - 45-65%

These are listed as ideal ranges for containers in the southeast U.S.

Should Oregon follow the same recommendations?

Some Oregon nursery producers believe our substrates should have more Air space and less WHC to allow for winter drainage.
Substrate mixes

• How does pumice and peat affect container physical properties?

• How does bark particle size affect physical properties?
Two popular Oregon mixes

- 50% bark  30% peat  20% pumice
- 75% bark  10% peat  15% pumice

- Which has greater porosity?
- Which has greater water holding capacity?
Physical properties of 2 substrates

- **50 bark: 30 peat: 20 pumice**
  - Solid: 23
  - WHC: 62
  - Air: 15

- **75 bark: 10 peat: 15 pumice**
  - Solid: 21
  - WHC: 63
  - Air: 16
Pumice

• Raw volcanic material
  – Mined
  – Graded to size

• Contains vesicles
  – Light weight (when dry)
  – Porous
Bulk density of bark + pumice
Medium bark + pumice

----Sifted pumice (%)----  ---Unsifted pumice (%)---

0  1  02  03  0  0  1  02  03  0

Solid
WCH
Air space
Pumice

• Adding pumice to Douglas fir bark
  – Increases bulk density
    • Stability
    • Increased weight
  – Has little or no impact on container physical properties (AS, WHC, P)
  – Does it reduce compaction over time?
Peat moss

- Peat – organic residues of plants, incompletely decomposed due to lack of oxygen

- Peat used in Oregon is primarily *Sphagnum* peat moss
  - Other types not used
    - Hypnum peat, reed peat, sedge peat
• Sphagnum peat moss
  – Derived from peat bogs, composed of >60% mosses in the genus *Sphagnum*
  
  – Considered the highest quality type of peat moss for horticulture
Sphagnum peat moss

- pH: 3.6 to 4.6
- Weed content: 0
- Bulk density: 0.07 to 0.09 g/cc
Bark + peat

Bulk density

<table>
<thead>
<tr>
<th>Percentage of Peat</th>
<th>BD (g/cc)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>0.17</td>
</tr>
<tr>
<td>10%</td>
<td>0.16</td>
</tr>
<tr>
<td>20%</td>
<td>0.15</td>
</tr>
<tr>
<td>30%</td>
<td>0.14</td>
</tr>
<tr>
<td>100%</td>
<td>0.08</td>
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</table>
Peat moss

- Spongy, fibrous material capable of storing large amounts of available water.
- Increases WHC of Douglas fir bark
  - Decreases air space
- Decreases bulk density
Summary

• Physical properties of Oregon substrates are not well documented

• Future work
  – Further investigate interaction of primary substrate components
  – Develop better guidelines for Oregon nursery growers in selecting substrates.
Questions

• Before we move to chemical properties.
Ideal, all nutrients are in relative balance. One or more nutrients is deficient, so growth is limited. Excess of one nutrient will not result in increased growth, may cause deficiency in another nutrient.
The Nutrition Triangle

- Fertilizer
- Substrate
- Irrigation
Important point

• Plants do not absorb nutrients from soil particles.

• Plants only absorb nutrients from soil solution.

• Nutrients must be in solution in order to be absorbed!!!
Plant nutrients in DF bark

<table>
<thead>
<tr>
<th></th>
<th>P</th>
<th>K</th>
<th>Ca</th>
<th>Mg</th>
<th>SO4</th>
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<tbody>
<tr>
<td>ppm</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AGED</td>
<td></td>
<td>120</td>
<td>40</td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td>FRESH</td>
<td>10</td>
<td>80</td>
<td>80</td>
<td>60</td>
<td>120</td>
</tr>
</tbody>
</table>

Graph showing the concentration of nutrients (P, K, Ca, Mg, SO4) in DF bark, comparing aged and fresh samples.
Bark survey summary

• Very high P
  – P leaches from containers
  – P is a major pollutant of surface waters.
    • Causes eutrophication
      – Algal blooms, fish kills.
  – P is included in most fertilizers
  – P is often added in pre-mixes for container substrates
  – Too many sources of P considering the levels provided by bark alone
Bark survey summary

• Initial K levels are high
  – K leaches readily
  – K does not cause adverse environmental effects
  – Until research shows otherwise, don’t skimp on K.
    • But don’t overdo it either.

• Deficient Ca, Mg, and S.
  – May be enough in irrigation water (next week).
Plant nutrients in DF bark

- **Fe**
  - AGED: 80 ppm
  - FRESH: 20 ppm

- **Mn**
  - AGED: 5 ppm
  - FRESH: 5 ppm
Bark survey summary

- Sufficient Fe, Mn
- Potentially high Fe:Mn ratio in aged bark.
- Most micronutrient deficiencies are Fe or Mn related.
  - Mostly caused by high pH
  - Often caused by poor fertilizer mgmt.
Plant nutrients in DF bark

- **Cu**: AGED and FRESH
- **B**: AGED and FRESH
- **Zn**: AGED and FRESH
Bark survey summary

- Copper is sufficient.
- B and Zn levels seem low.
  - Low compared to “standards”.
Micronutrients in fresh versus aged bark

Substrate type
- fresh bark
- aged bark

- Micronutrient source
  - Bark only
  - Bark + 10% compost
  - Bark + 1.5 lbs/yd$^3$ Micromax

- *Catharanthus roseus* ’Cooler Peppermint’
Results first trial (6 WAP)

No differences in growth or color
Results second trial (8 WAP)

Differences in growth and color between fresh and aged bark.
Summary

- Douglas fir bark probably provides sufficient micronutrients for crop growth – 2006 trials on woody crops

- Adding a micronutrient package is inexpensive security.

- Consider bark as a major source for Mn and Fe.
N immobilization in fresh versus aged bark

Substrate type
- Fresh bark
- Aged bark

Nitrogen fertilizer rate
- 2nd trial: 100, 200, and 300 ppm N.

_Pelargonium xhortorum_ ‘Maverick Red’
Second trial: Stem biomass and foliar N

![Graph showing stem biomass and foliar N content across different fertilizer N rates for aged and fresh samples.](image)

- Stem biomass (g) increases with higher fertilizer N rates.
- Foliar N (%) also increases with higher fertilizer N rates.

Legend:
- AGED
- FRESH
NDI for fresh and aged bark
Summary

• Differences in geranium growth and foliar N are likely due to greater N availability in aged bark.
  – N is immobilized in fresh bark
  – N immobilization is probably not biological

• Fresh Douglas fir bark requires supplemental N.
  – In geranium studies:
    • 200 ppm N + aged bark = 300 ppm N + fresh bark
Summary

• Douglas fir bark
  – Excellent container substrate
  – Adjust air space and WHC with peat.
  – Adjust BD with pumice
  – Re-evaluate your P program
  – Compensate with extra N for fresh bark, compared to aged bark
Website

• [http://oregonstate.edu/dept/nursery-weeds/](http://oregonstate.edu/dept/nursery-weeds/)