How Do You Manage Aged Versus Fresh Pine Bark?

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Significance to Industry: 'Skogholm' cotoneaster grown in fresh pine bark was significantly smaller than cotoneaster grown in aged pine bark. The reduction in growth did not appear, however, to be due to a competition for N. Additional N did not increase plant growth in fresh bark. The reduction in growth in fresh bark may have been due to differences in container capacity and available water. Container capacity and available water in aged pine bark were significantly greater than fresh pine bark throughout the study. Growers using fresh pine bark do not need any additional fertilizer but may need to be very diligent in maintaining adequate water within the substrate. This may require applying less water more frequently.

Nature of Work: Pine bark is a common substrate for container-grown plant production in the southeastern United States. Research comparing fresh, aged or composted pine bark is limited. Research conducted in Australia by Handreck and Black (2) reported reduced plant growth with fresh bark due to competition for N. They reported that up to an additional 300 mg N/liter per week may be required to support adequate plant growth in fresh pine bark. Cobb and Keever (1), however, grew dwarf Japanese euonymus (*Euonymus japonica* Thunb. 'Microphylla') and Japanese holly (*Ilex Crenata* Thunb. 'Compacta') in fresh and aged (one year) pine bark with no detrimental effects from using fresh pine bark as a growing substrate. Pokorny (4) also supported the use of fresh pine bark when adequate N was supplied. Adequate N, however, was not defined.

Age of pine bark may also affect physical properties which could affect water availability. Laiche (3) reported lower plant quantity in plants grown in fresh pine bark compared to aged pine bark. He attributed the lower quality to difficulty in maintaining adequate moisture levels, especially during the first two to three months after transplanting.

Growers may need, however, to adjust their fertility and/or water regimes based on whether they are growing in fresh or aged pine bark. What adjustments should be made are currently unknown. The objective of this research was to determine the physical and chemical properties of fresh and aged bark and resultant plant growth.

A 2 x 3 factorial experiment in a randomized complete block design with three replications each containing five plants was conducted at the Horticulture Field Laboratory, North Carolina State University, Raleigh. The main factors consisted of fresh or aged pine bark substrates and three rates of a controlled release fertilizer (low, medium, and high). Rooted stem cuttings of *Cotoneaster dammeri* ‘Skogholm’ were potted May 8, 2003 into 14.2 liter (#5) containers in a pine bark : sand (8:1 by vol) substrate with either fresh or aged pine bark (aged for one year in an unprotected location) amended with 0.9 kg cu m (2 lbs cu yd) dolomitic limestone. Each plant was topdressed at potting with 11.1 g, 22.2 g, or 33.3 g N from a 17N-2.2P-8.2K controlled release fertilizer (17-5-10 with minors, 5 to 6 month, Pursell Technology, Sylacauga, AL). After 160 days, tops were removed and roots were placed over a screen and washed with a high pressure water stream to remove substrate. Shoots and roots were dried at 65 C (150 F) for 5 days and weighed.

Irrigation was applied via pressure compensated spray stakes {Acu-Spray Stick; Wade Mfg. Co., Fresno, CA [200 ml/min (0.3 in/min)]} at 12:00 pm, 3:00 pm, and 6:00 pm. Leachate fraction (leachate volume ÷ irrigation volume) was monitored weekly and irrigation volume was adjusted to maintain a 0.2 leaching fraction within each treatment and replication. Substrate solution samples were collected every three weeks via the pour through extraction method and electrical conductivity (EC) and pH were measured.

All physical property analyses were conducted at the Horticultural Substrates Laboratory N.C. State Univ. on five replicated samples using procedures described by Tyler et al. (5). Root : top ratio (R:S) was calculated as root dry weight ÷ top dry weight. All data were subjected to analysis of variance procedures (ANOVA). Treatments means were separated with Fisher’s Protected least significant difference, $P = 0.05$.

Results and Discussion: Age of pine bark and rate of fertilization affected many of the measured parameters, however, age of pine bark X rate of fertilization interaction was not significant for any measured parameter (data not presented). Therefore, data is presented accordingly. Top dry weight and total plant dry weight of cotoneaster grown in aged pine bark were 12% larger than cotoneaster grown in fresh pine bark (Table 1). Root dry weight and root : top ratio were unaffected by age of bark. The reduction in growth in fresh pine bark may have been due to differences in physical properties. Container capacity and available water in aged pine bark were significantly greater than fresh pine bark throughout the study (Table 2). This was also reflected in the volume of irrigation water required to maintain a 0.2 LF in each bark (Fig. 1). With the increase in available water (AW), aged pine bark required greater volume of water. This difference in AW may have been what Laiche (1974) was referring to when he stated that it was difficult to maintain adequate water in fresh pine bark. Plant growth may have been limited by available water content in fresh pine bark.

The lowest rate of N produced significantly smaller tops and total plant dry weight than the medium and high rates of N. The high rate of N did not produce bigger plants compared to the medium rate of N. Thus, similar to the results reported by Cobb and Keever, (1984) plants grown in fresh pine bark did not appear to need additional N to maximize growth. This is in contrast to Handreck’s (1992) work in Australia. This may be due to differences in pine bark. Bark in the southeastern United States is most often from loblolly pine

(*Pinus taeda*) and longleaf pine (*Pinus palustris*), whereas most bark in Australia is derived from radiata pine (*Pinus radiata*). On most sample dates, EC increased with increasing rate of fertilization, whereas EC was unaffected by age of bark (data not presented). Age of bark and rates of fertilization had little effect on substrate pH with the pH ranging between 6.1 and 6.4 throughout the study (data not presented).

Literature Cited:

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Table 1. Effect of age of bark and rate of fertilization on top, root, and total dry weight and root : top ratio.

Bark	Top (g)	Root (g)	Total (g)	Root : Top[z]
Aged	320 ay	55 a	375 a	0.17 a
Fresh	286 b	51 a	337 b	0.18 a
Fertilizer rate (g N/container)				
11.1	277 c	56 a	333 b	0.20 a
22.2	322 a	55 a	377 a	0.17 b
33.3	310 a	48 b	358 a	0.15 c

[z]Root : top ratio = root dry weight ÷ top dry weight

[y]Means within columns and treatments followed by the same letter are not significantly different as determined by Fisher's protected LSD, P = 0.05.

Table 2. Effect of age of bark on physical properties.

Bark	Total porosity (%)	Air space (%)	Container capacity (%)	Available water (%)	Unavailable water (%)	Bulk density (g/cm^3)
Prior to treatment initiation (pine bark substrate)						
Aged	87.3 a	25.2 b	61.1 a	26.3 a	35.8 b	0.19 a
Fresh	88.3 a	39.3 a	49.0 b	9.8 b	39.2 a	0.17 b
56 days after treatment initiation (8 pine bark : 1 sand substrate)						
Aged	82.8 b	25.9 b	56.9 a	22.7 a	34.3 a	0.32 a
Fresh	85.4 a	36.3 a	49.1 b	15.8 b	33.3 a	0.32 a
336 days after treatment initiation (8 pine bark : 1 sand substrate)						
Aged	74.9 b	17.0 b	57.9 a	30.0 a	27.9 b	0.35 a
Fresh	80.1 a	24.9 a	55.2 b	22.3 b	32.6 a	0.35 a

[z]Means within columns and weeks after treatment initiation followed by the same letter are not significantly different as determined by Fisher's protected LSD, $P = 0.05$.

Fig. 1. Effect of age of bark on irrigation volume required to maintain 0.2 leaching fraction.