Root Growth of Horticultural Crops as Influenced by Pine Bark Age, Wood, and Sand Amendment©

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INTRODUCTION

When plants are produced in containers their roots are restricted to a small volume; consequently the demands made on the substrate for water, air, nutrients, and support are more intense that those made by plants grown in a field production situation where unrestricted root growth can occur (Bunt, 1988). Vigorous root systems are essential for growth and development of healthy plants. A healthy, functioning root system increases the surface area available for the uptake of water and mineral elements. It is also important to appreciate the fact that root system development, mass and architecture also is critical in providing support, storage and anchorage needed by plants (Jackson et al., 2005; Waisel et al., 2002; Wraith and Wright, 1998).

Often excluded from horticultural research, root growth and root system architecture are important factors influencing plant performance and survival (Wright and Wright, 2004). Understanding root growth and development is important to improving plant quality and production success. The capability to observe and measure roots as they grow into a substrate is very useful in determining root growth preference in various substrates. New root measurement techniques have been designed and introduced in recent years which aid in understanding and qualifying root growth of horticultural crops grown in containers (Wright and Wright, 2004; Silva and Beeson, 2011).

Pine bark has been the traditional substrate used for the production of nursery crops grown in containers since the 1970s. Both fresh pine bark and aged pine bark have been utilized by growers and analyzed by researchers to determine the best management practices for growing nursery crops (Cobb and Keever, 1984; Harrelson et al., 2004). It is typical that sand is added as an amendment to pine bark for the purpose of adding weight to the container (helps prevent pots from blowing over). Recently, the use/amendment of pine tree substrates (freshly processed loblolly pine wood; PTS) to pine bark has become a trend for some growers and the focus of several researchers (Jackson et al., 2010; Murphy et al., 2010). The effect that these substrate amendments and pine bark age have on root growth in containers is not well known, understood or documented.

MATERIALS AND METHODS

On 15 May 2012 two ages of pine bark [one week old (fresh) and one year old (aged)] were obtained from a pine bark supplier/distributor in NC. Both the fresh pine bark (FPB) and the aged pine bark (APB) were then amended with 10% sand (v/v) (FPB+S; APB+S), 25% pine wood (FPB+25W; APB+25W), or 25% pine wood plus 10% sand (FPB+25W+S; APB+25W+S). A total of eight substrate treatments were formulated from those combinations. Fresh pine wood was obtained from eight-year-old loblolly pine trees that were harvested at ground level, de-limbed, chipped and then hammer-milled through a 6.35 mm screen [(¼ L x ¼ W x $^{3}/_{16}$ H –inch); C550 – CHP Meadows Mills, North Wilkesboro, North Carolina]. Rooted liners of green giant arborvitae (*Thuja* 'Green Giant') were removed from containers (4.5×4.5×5 in containers) and placed individually in separate Horhizotrons on greenhouse benches. Five Horhizotrons were used to hold the fresh pine bark substrates (four total treatments) and five Horhizotrons were used to hold the aged pine bark substrates (four total treatments) for a total of 10 Horhizotrons. Quadrants were topdressed with 12 lbs/yd^3 Harrells 15-9-12 slow release fertilizer and were hand irrigated with overhead watering as needed. This study was a randomized complete block design (RCBD).

Root length and location in the quadrant profile were measured as newly formed roots

grew out from the root ball and along the face of the glass quadrants. A transparent grid placed on the two glass sides of each quadrant allowed observation and measurement of the four longest roots on each side of the quadrant. Roots were measured 60 and 120 days after planting (DAP).

RESULTS

Root growth at 60 DAP was longest in 100% pine bark (FPB or APB) and with the addition of 10% sand and not positively influenced by the addition of PTS or PTS+S. The addition of sand had no significant influence of root growth compared to pine bark alone, regardless of age (Figs. 1 and 2). At 120 DAP root growth of Green Giant arborvitae was accelerated in FPB when amended with PTS+S (Fig. 1) and root growth was enhanced in APB when amended with PTS and PTS+S (Fig. 2). The enhancement of root growth due to the addition of PTS has been reported by various researchers over the years for both nursery and greenhouse crops. It is thought that PTS improves the aeration (physical environment) of pine bark substrates, which facilitate this root growth. The aged pine bark had a greater enhancement of root growth with PTS compared to fresh pine bark; likely a result of the difference in physical properties between the different aged materials. Aged pine bark likely had less air space (due to decomposition over time) whereas the fresh pine bark likely had more air space. Determining the physical properties of these substrates will be conducted in the future to further understand those influences on root growth of wood plants grown in pine bark or various ages and with various amendments.

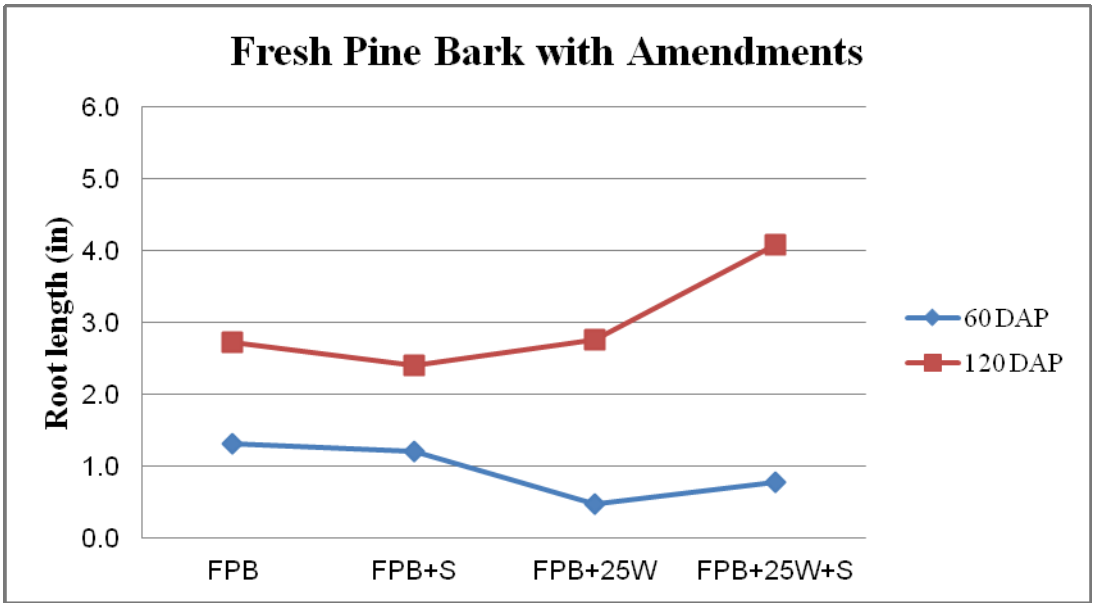

Fig. 1. Root growth of *Thuja* 'Green Giant' grown in either fresh pine bark (FPB), fresh pine bark plus sand (FPB+S), fresh pine bark plus 25% wood (FPB+25W) or fresh pine bark plus 25% wood plus sand (FPB+25W+S) at 60 and 120 days after planting.

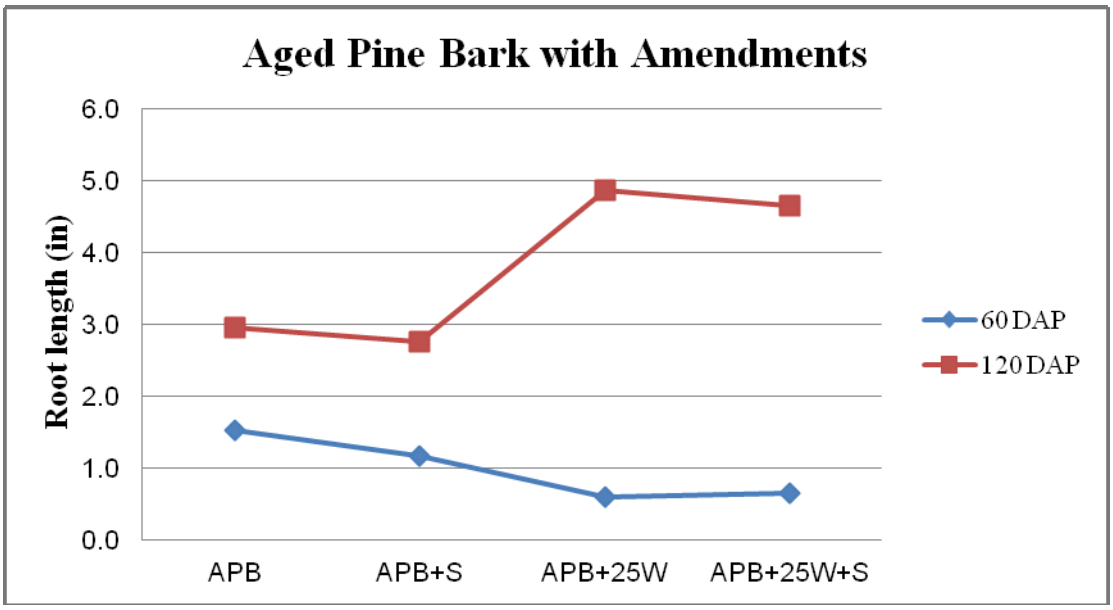

Fig. 2. Root growth of *Thuja* 'Green Giant' grown in either aged pine bark (APB), aged pine bark plus sand (APB+S), aged pine bark plus 25% wood (APB+25W) or aged pine bark plus 25% wood plus sand (APB+25W+S) at 60 and 120 days after planting.

DISCUSSION

Results from this experiment support previous research findings that the addition of fresh pine wood to pine bark (fresh or aged) does enhance/accelerate root growth of plants growing in containers. Currently, the use of PTS in the production of nursery crops has little economic benefit over the use of traditional pine bark based on current pine bark supplies and cost, but the inclusion of 25% PTS could be beneficial in enhancing the root growth and development of crops. It was also shown that root growth was not noticeably different in aged pine bark compared to fresh pine bark for Green Giant arborvitae. The addition of sand had no apparent positive effect on root growth, but its inclusion in pine bark as an amendment can still be justified by some growers as a result of the added weight and resulting decreased blow-over of containers. It is likely that sand is not needed in production systems where container blow-over is not a problem. The reduction in weight by not adding sand could also improve (lighten) shipping costs. It is unknown if different species will have different root growth response to the bark ages and amendments used in this study.

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