Beyond Skogholm Cotoneaster: Performance of Hydrangea, Azalea, Juniper and Spirea in a Clay Amended Substrate

James S. Owen, Jr. , Stuart L. Warren[2]
Ted E. Bilderback[2] and Joseph P. Albano[3]
North Willamette Res. Ext. Ctr., Oregon State Univ., Aurora, OR 97002-9543
[2]NC State Univ., Dept. of Hort. Sci., Raleigh, NC 27695-7609
[3]USDA-ARS, U.S. Hort. Res. Lab., Fort Pierce, FL 34945
jim.owen@oregonstate.edu

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Significance to the Industry: Georgiana industrial mineral aggregates (clay) can be used to amend pine-bark based soilless substrate in the southeastern US to reduce phosphorus (P) leaching, provide nutrients, and increase substrate water buffering capacity. However, the effect on plant growth is species specific. Hydrangea, a high water use plant, had increased growth in a clay amended substrate, whereas the ericaceous crop, azalea showed reduced growth. Substrate amendments did not affect the growth of spirea or juniper. Therefore, benefits of a given substrate amendment must be weighed with current crop selections, cultural practices, and management practices.

Nature of Work: Pine bark amended with Georgiana mineral aggregates has been shown to dramatically decrease P leaching (5, 7), increase plant nutrient content (6), decrease water usage (5), and increase substrate water buffering capacity (5), while maintaining maximum plant growth. However, this research was conducted on a limited amount of species. Research conducted by Owen et al. (5, 6) used Skogholm cotoneaster as an indicator of substrate water and nutrient availability. Research conducted by Ruter (7, 8) assessed clay amended substrates for P leaching with fallow containers, however Ruter (7) reported growth of *Loropetulum chinense* var. 'Blush' was unaffected if grown in either a sand or clay amended substrate. In 2004, Ruter (8) suggested further research was needed to evaluate the affect of calcined clay amended substrate on a number of ornamental species. Few additional woody ornamental species have been investigated to date.

Carlile and Bedford (1) studied the use of a 20%, 35% or 50% (by vol.) calcined clay in a peat based substrate and reported that plant growth increased with increasing substrate clay content, except for ericaceous plants which had a negative response to higher rates of clay. The increased growth with increasing rate of clay over a wide range of plant species was attributed to the increased air-filled porosity in amended substrates.

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Laiche and Nash (2) conducted research using “Arkalite”, a lightweight clay aggregate, or sand as the inorganic substrate component. Water extractable nutrients were compared from substrates consisting of pine bark and screened,

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crushed or blended "Arkillite" at a 4 organic : 1 inorganic (by vol). Using sand as the inorganic substrate component instead of "Arkallite" resulted in a 19% decrease in fresh weight of *Rhododendron indicum* L. 'Formosa' from 313 g to 264 g using 9 $kg \cdot m^{-3}$ (15 $lb \cdot yd^{-3}$) of CRF. However, the inverse was observed by Laiche and Nash (2) at a lower rate of fertility [5 $kg \cdot m^{-3}$ CRF (8 $lb \cdot yd^{-3}$ CRF]. *Rhododendron* 'Formosa' fresh weight increased 32% (95 g) when grown with sand versus "Arkalite".

Warren and Bilderback (9) compared rates [0, 27, 54, 67, 81 $kg \cdot m^{-3}$ (0, 45, 91, 113, 137 $lb \cdot yd^{-3}$)] of arcillite in pine bark substrate, finding that incorporation resulted in a change in pore size distribution that curvilinearly increased available water and linearly decreased air space, whereas total porosity was unaffected. Plant growth of *Rhododendron* sp. 'Sunglow' increased curvilinearly with increasing arcillite, the optimum rate being 57 $kg \cdot m^{-3}$ (96 $lb \cdot yd^{-3}$). This increased growth was hypothesized to be the result of more P, K, and Mg root absorption and increased available water in the substrate.

We conducted an experiment to evaluate plant growth of four common ornamental species grown in pine bark amended with sand [industry representative substrate 8 pine bark:1 sand (11% by vol)] or Georgiana calcined clay (11% by vol). The experiment was a 2 x 4 (substrate x plant species) factorial in a randomized complete block design with three replications with four plants in each replication. The industrial mineral aggregate was a 0.25 to 0.85 mm (24/48 mesh) calcined (LVM) palygorksite-bentonite mineral from Georgia (Oil-Dri Corporation of America, Chicago, IL) (3). Uniform rooted stem cuttings of *Hydrangea macrophylla* 'Nikko Blue', *Spiraea* x *bumalda* 'Goldflame', *Rhododendron* (Carla hybrid) 'Sunglow', and *Juniperus conferta* 'Blue Pacific' were potted into 14 L containers (#5) containing pine bark : sand or pine bark:clay amended with 0.6 $kg \cdot m^{-3}$ (2 $lb \cdot yd^{-3}$) blend of pulverized and ground dolomitic limestone. Irrigation was applied cyclically daily, with the total volume divided into three equal applications (1100 HR, 1400 HR, and 1700 HR EDT) via pressure compensated spray stakes [Acu-Spray Stick; Wade Mfg. Co., Fresno, CA; (200 $mL \cdot min^{-}$)]. An irrigation volume to maintain a 0.2 leaching fraction (LF = volume leached ÷ volume applied) was applied to each plot based on effluent and irrigation volumes that were monitored weekly. All containers were topdressed with 60 g (2 oz) 17-5-10 6 month controlled-release fertilizer (Harrell's, Lakeland, FL) immediately after potting. After 100 days, tops (aerial tissue) from two randomly chosen containers per plot (total of six plants/ treatment) was removed. Roots of the corresponding plants were placed over a screen and washed with a high pressure water stream to remove substrate. Tops and roots were dried at 65C (150F) for 5 days and weighed. All data was subjected to ANOVA (SAS Institute, Cary, NC) with means separated by Fisher's protected LSD at P = 0.10.

Results and Discussion: Top growth of hydrangea increased 70% when grown in a clay amended substrate versus a sand amended substrate, whereas root

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and top growth of sunglow azalea were reduced 25% when grown in a clay amended substrate versus sand (Table 1). We hypothesized this was a result of decreased air space and increased substrate water holding capacity when pine bark is amended with clay (4). These results are similar to findings by Carlile

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and Bedford (1). Top and root dry mass of juniper and spirea were unaffected by substrate amendment (clay or sand) (Table 1).

Additional growth benefits of the clay amended substrate have been reported when reducing nutrient and water inputs (4, 5). Under these conditions plant growth has remained constant in clay amended substrates, but growth has been shown to decrease in a sand amended substrate (4). The affects of clay amended substrate on water use and mineral nutrient absorption on a variety of ornamental species needs further investigation.

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Table 1. Top and root dry weight of four ornamental species grown in pine bark amended with 11% (by vol.) coarse sand or 0.25 to 0.85 mm Georgiana calcined mineral aggregate.

Substrate Amendment	Plant Part	*Hydrangea macrophylla* 'Nikko Blue'	*Juniperus conferta* 'Blue Pacific'	*Rhododendron* (Carla hybrid) 'Sunglow'	*Spiraea* x *bumalda* 'Goldflame'
Minera aggregate	Top	71.7 ± 7.7[z]	17.6 ± 1.4	20.3 ± 0.7	47.8 ± 6.0
	Root	8.2 ± 1.6	1.8 ± 0.2	2.5 ± 0.1	7.6 ± 2.2
Coarse sand	Top	42.0 ± 7.1	16.0 ± 1.0	27.7 ± 2.1	42.2 ± 0.9
	Root	7.0±1.4	1.8±0.	3.2±0.3	11.4±1.4

[z]mean dry weight (g) ± standard error.

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