Yard Waste Compost as a Landscape Soil Amendment for Azaleas[1]

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Abstract

Azaleas, *Rhododendron indicum* L. 'G.G. Gerbing', were transplanted into landscape beds amended with yard waste compost at rates of 0, 5.1, 7.6, or 10.2 cm (0, 2, 3, or 4 in) incorporated into the top 18 cm (7 in) of a sandy soil. Plants were irrigated on alternate days (high irrigation rate) or on every third day (low irrigation rate), and shoot and root growth measurements were recorded at 0, 4, 8, 12, and 18 months after transplanting. Differences among compost treatments for plant quality and root elongation were observed after 8 months. By 18 months, incorporation of 7.6 or 10.2 cm (3 or 4 in) of compost resulted in plants with larger shoots, greater root elongation, and larger root masses compared to the 0 and 5.1 cm (2 in) compost treatments. The larger azalea shoots and roots achieved with high rates of compost occurred under both irrigation regimes. Incorporating 7.6 or 10.2 cm (3 or 4 in) of compost increased root elongation, mostly between 4 and 8 months, and increased root mass after 12 months. Compost incorporation affected the quality of plants under high irrigation, with 10.2 cm (4 in) of compost producing the highest-quality plants.

Index words: azalea, compost, yard waste, soil amendment, landscape establishment, irrigation.

Species used in this study: 'G. G. Gerbing' azalea (*Rhododendron indicum* L. 'G.G. Gerbing').

Significance to the Nursery Industry

Plant growth, plant quality, and root system development of transplanted azaleas were improved when landscape beds were amended with7.6 or 10.2 cm (3 or 4 in) of yard waste compost to an 18 cm (7 in) depth prior to transplanting. Improvement of plant quality, measured as an increase in canopy density, was observed by 8 months after transplanting, before differences in shoot size were observed. High rates of compost amendments also accelerated root elongation into the backfill compared to azaleas growing in unamended soil. Eighteen months after transplanting, incorporation of 7.6 or 10.2 cm (3 or 4 in) of compost resulted in greater canopy size and root growth, compared to 5.1 cm (2 in) and no-compost treatments. Improved shoot and root growth observed with higher rates of compost occurred regardless of the frequency of irrigation. These results indicate that azaleas transplanted into sandy soils amended with at least 7.6 cm (3 in) of yard waste compost and irrigated every third day had greater shoot and root growth than azaleas in unamended soil that are irrigated more frequently. Thus, soil amendment appears to be more critical to azalea establishment in landscapes than irrigation frequency.

Introduction

Conflicting ideas exist regarding use of soil amendments for landscape installation. Garden centers and many landscapers insist soil amendments are essential for landscape establishment. Cited benefits of soil amendments include pH adjustment, increased biological activity, improved drainage and air space in clay soils, and improved water and nutrient holding capability in sandy soils (4). Despite these perceived benefits, use of soil amendments is not well-supported by research. Various additions to backfill soils have been explored, including container substrates (6, 11), peat moss (6, 10, 16), vermiculite (16), sand (16), pine bark (6, 16), fired montmorillonite clay (10), topsoil (14), polymer gels (10), and various composts (15). These soil amendments generally had no effect, or were detrimental to landscape establishment and growth.

Transplanted trees can produce root growth of 0.6 to 1.9 m (3 to 6 ft) per year after transplanting (3, 8, 9). Shrub root growth, however, is much less vigorous. Red tip photinia (*Photinia* x *fraseri* Dress) transplanted from #3 containers generated only 27 cm (11 in) of root elongation a year after transplanting into sandy soils (2). The comparatively limited root growth of shrubs suggests that the addition of soil amendments to transplant beds may be beneficial for shrub establishment and growth. In addition, rapid root growth when container-grown shrubs are upcanned to larger containers indicates potential for accelerated root growth in porous soils.

In the early 1990s many states, including Florida, passed laws limiting or prohibiting organic yard waste (grass clipping, woody pruning, etc.) from landfills. In Florida, several companies formed to convert these organic yard wastes to compost. One market avenue proposed for this material was an amendment for landscape soils. However, prior to 1993, research on landscape soil amendments had not included yard waste compost. The objectives of this research were to determine: 1) if amending landscape soils with commercially produced yard waste compost benefitted plant establishment and growth, 2) whether there was an optimum rate of compost incorporation, and 3) if this amendment could substitute for higher irrigation frequencies during plant establishment.

Material and Methods

In late February 1993, four landscape beds 1.5 m (5 ft) wide and 82 m (270 ft) long were constructed using 0 (control), 5.1, 7.6, or 10.2 cm (0, 2, 3, or 4 in) of commercially available yard waste compost (Enviro-Comp, Inc., Jacksonville, FL). Two meters (6 ft) were left between beds to allow

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for root excavation. Compost was mature and consisted of particles passed through a 19 mm (3/4 in) screen. Climatic conditions in Florida are favorable for rapid decomposition; this relatively large particle size was chosen to insure that the compost would persist for the duration of the experiment. The compost had a pH of 7.2. No other chemical analyses were obtained. The landscape site was in full sun and consisted of a Myakka fine sand, which is classified as a sandy, siliceous hypertermic Aeric Haplaquods with bulk densities of 1.45 and 1.6 g/cm^2, available water capacity of 0.02 to 0.15 in/in and 2 to 5% clay content (13). Myakka fine sand soils are characterized by a dark upper layer about 20 cm (8 in) deep of fine sand mixed with fine organic components and a nearly impervious hard pan 45 to 60 cm (18 to 24 in) below the soil surface. Beds were constructed with an east-west orientation by rototilling a bed area to 18 cm (7 in), then applying the amount of compost to the surface and rototilling to a depth of 18 cm (7 in). No efforts were expended to adjust soil pH, nor was it measured after compost amendment. One half of each bed was randomly chosen to receive alternating-day irrigation (high regime; 2.5 cm (1.0 in)), and the other half was irrigated every third day (low regime; 3.8 cm (1.5 in)). Irrigation was applied across the entire width of a bed using single piece spray jets with a 0.04-in orifice and 40E deflector cap (Maxijet, Inc., Dundee, FL), elevated 1.2 m (4 ft) above the soil. Beds were irrigated independent of rainfall or climatic conditions.

'G. G. Gerbing' azaleas (*Rhododendron indicum* L.) in 10.2-liter (#3) containers were obtained from a local commercial nursery and transplanted into the beds on 1.5 m (5 ft) spacings in early March 1993. Twenty-five plant replicates were planted in each bed. At transplanting, a representative subset of six plants were harvested to determine initial leaf surface area, leaf dry mass, and shoot dry mass. All plants were fertilized on August 12, 1993, with 100 g of Osmocote 18–6–12 (Scotts Co., Marysville, OH) per plant, and again at the same rate on July 13, 1994.

In mid-July 1993, three plant replicates from each irrigation regime and compost treatment were randomly selected for a 4-month harvest. Twenty-five percent of the root system of each plant was excavated, as a 90-degree arc, centered on the trunk and along a north-south axis, from both the north and south sides of the root ball (2). This orientation was perpendicular to the rows, resulting in minimum disturbance to remaining plants, and allowed sampling of soil areas in both sun and shade. Excavations were as deep as the deepest root and extended under a transplanted root ball to its center. Longest root lengths from the original root ball were measured, and excavated roots were washed and collected for root dry mass.

Shoot height and canopy spread (widest width and width perpendicular to the widest width) were measured on excavated plants. These dimensions were multiplied to determine growth index (GI; m^3), an estimate of canopy volume. Afterwards, shoots were removed at ground level for dry mass determination. Leaf surface areas of each plant were calculated from the leaf area: dry weight ratio of a subset of leaves (approximately one-eighth of the total canopy) and total leaf dry weight. Shoot dry weights were the total of leaf and stem dry weights. Similar excavations occurred in November 1993 (8 months after transplanting), March 1994 (12 months after transplanting), and September 1994 (18 months after transplanting).

Root data were analyzed initially as a 2 × 4 × 2 factorial design, with 2 irrigation regimes, 4 levels of compost amendment and 2 excavation sides (north or south). Data were analyzed individually for each excavation date (12). Each of the 3 plants excavated at each sampling period for each compost × irrigation treatment served as a single plant block (Littel, pers. comm.). Root data was re-analyzed as a 2 × 4 factorial, with excavation orientation combined, using the same main effects. Canopy variables were analyzed with the same 2 × 4 factorial design. Each plant was treated as a single plant block, with each sampling period analyzed independently. Where significant differences ($P < 0.05$) occurred, means were separated using Fisher's Protected LSD at the 5% level.

Results and Discussion

Canopy measurements. There were no significant differences ($P < 0.05$) among compost treatments nor irrigation regimes in canopy variables measured 4 months after transplant nor was the interaction significant. Canopy size (height and GI) was still statistically indistinguishable ($P > 0.05$) between irrigation regimes and among compost treatments 8 months after transplant, with means comparable to those calculated initially and 4 months after transplant. While shoot growth variables were unchanged 8 months after transplant, plant quality measurements (leaf surface area and leaf dry mass) were significantly ($P < 0.05$) different among compost treatments. Azaleas transplanted into soil amended with 10.2 cm (4 in) had greater leaf surface area (2.30 m^3) and leaf dry mass (243.85 g) compared to plants in soil containing 5.1 cm (2 in) of compost (leaf area = 1.74 m^3; leaf dry mass = 178.98). Other comparisons among compost treatments were not statistically significant ($P > 0.05$).

Canopy measurements taken at the 12-month harvest were affected by leaf senescence that normally occurs with this cultivar during the winter in this area. No differences in leaf surface area or leaf dry mass were found among compost or between irrigation treatments at this time, contrasting the differences between compost treatments observed at the 8 month sampling. The interaction of compost depth and irrigation regime was significant ($P < 0.05$) for canopy volume (GI) at 12 months. Plants receiving alternate day irrigation (high irrigation regime) had larger shoots when growing in

Table 1. Effect of irrigation regime and depth of yard waste compost amendment on leaf surface area and leaf dry mass of 'G.G. Gerbing' azaleas, measured at 18 months after transplanting. Means are representative of 3 plant replicates.

Irrigation[z]	Depth of compost (cm)	Leaf area (m^2)	Leaf dry mass (g)
Low	0	3.01abc[y]	310.16abc
	5.1	2.75abc	276.52abc
	7.6	3.28ab	317.78ab
	10.2	2.98abc	297.96abc
High	0	2.34bc	253.61bc
	5.1	1.68c	178.90c
	7.6	4.00a	385.17ab
	10.2	4.19a	401.35a

[z]Irrigation regime, where low was 3.8 cm (1.5 in) applied every third day and high was 2.5 cm (1.0 in) applied on alternate days.

[y]Means with the same letter are not significantly different ($P > 0.05$) within a column as separated by Fisher's Protected LSD.

Table 2. Effect of depth of yard waste compost amendment on growth index (GI) and shoot dry mass of 'G.G. Gerbing' azaleas, measured at 18 months after transplanting. Means are representative of 6 plant replicates.

Depth of compost (cm)	GI (m^3)[z]	Shoot dry mass (g)
0	0.82b[y]	926.02ab
5.1	0.81b	802.66b
7.6	1.11a	1110.67a
10.2	0.95ab	1094.30a

[z]Growth index (GI) = height × width × width.

[y]Means with the same letter are not significantly different ($P > 0.05$) within a column as separated by Fisher's Protected LSD.

7.6 cm (3 in) compost-amended soil (0.81 m^3), compared to 5.1 cm (2 in) compost-amended soil (0.59 m^3) and unamended soil (0.57 m^3). Comparisons of GI means among the other compost treatments and irrigation combinations were not significantly different ($P > 0.05$).

Canopy quality responded to the interaction of compost amendment and irrigation frequency at the final sampling period (18 months; $P < 0.05$). The greatest amount of leaf area and leaf dry mass occurred under the high irrigation regime when plants were transplanted into either 7.6 or 10.2 cm (3 or 4 in) compost-amended soils (Table 1). However, these means were not significantly larger ($P < 0.05$) than those from any compost treatment under the low irrigation regime. Only plants grown under the high irrigation regime in unamended beds or beds amended with 5.1 cm (2 in) of compost had significantly less (P > 0.05) leaf area or leaf mass than the two highest compost treatments irrigated under the same high frequency regime (Table 1).

Canopy volume (GI) and shoot dry mass were significantly ($P < 0.05$) affected by the level of compost amendment, regardless of irrigation regime, at 18 months after transplant (Table 2). Incorporation of 7.6 cm (3 in) of compost resulted in larger GI than 5.1 cm (2 in) or no compost, and greater shoot dry mass than 5.1 cm (2 in) of compost (Table 2). Incorporation of 10.2 cm (4 in) of compost also resulted in greater shoot dry masses than 5.1 cm (2 in) of compost (Table 2). Average shoot dry masses for plants grown with high rates of compost (7.6 or 10.2 cm (3 or 4 in)) were 15% larger than for plants in unamended soil; however, these differences were not statistically significant ($P < 0.05$).

Analysis of the canopy data indicates that incorporation of yard waste compost in the planting bed improves plant quality (measured as leaf area and dry mass) more quickly after transplanting than shoot size. Use of sewage sludge compost as an amendment has been reported to result in a similar increase in quality of azaleas without affecting plant size (1). However, sewage sludge compost reduced plant survival rates at high incorporation rates (1). With the yard waste compost evaluated here, amending the transplant bed with relatively high quantities did not affect survival, but eventually resulted in larger canopy size.

Root growth. The side of the plant from which roots were excavated had no effect of collected root masses nor maximum root elongation. Therefore, root data by orientation were combined and the data re-analyzed using the same design as for canopy variables. When re-analyzed, irrigation regime had no significant effect ($P > 0.05$) on maximum root elongation nor dry mass accumulation for the duration of this experiment.

Four months after transplanting, root elongation into landscape beds was minimal in compost-amended soils (<1.3 cm; 0.5 in), and non-existent in unamended soil. Addition of compost to soil had no significant ($P < 0.05$) effect on root exploration the first 4 months after transplanting.

Most of the measured root elongation occurred between 4 and 8 months after transplant, during the fall months, regardless of compost treatment. Mean maximum root lengths were significantly ($P < 0.05$) affected by the rate of compost amendment beginning at 8 months, and at each excavation thereafter (Fig. 1). When azaleas were transplanted into unamended control soil, root exploration was less than 2 cm (0.8 in) after 8 months, and did not increase during the remainder of the 18-months. By 18 months after transplant, addition of 7.6 or 10.2 cm (3 or 4 in) of compost to the soil resulted in more than 10 cm root elongation, on average, compared to less than 1 cm for control plants. The effect of 5.1 cm (2 in) of compost on root extension was variable, but less than half that measured from 7.6 or 10.2 cm (3 or 4 in) of compost at 12 and 18 months (Fig. 1).

These results contrast with root growth observed for other woody ornamental shrubs. Red tip photinia averaged maximum root elongation length of 27 cm (10.6 in) a year after transplanting (2). Chinese juniper (*Juniperus chinensis* L. 'Sea Green') generated more than 20 cm (7.9 in) of root elongation after 16 months in a loam soil (5). In the best compost amendment and irrigation regime, only 10 cm (4 in) of maximum root elongation was measured.

While most root elongation occurred during the second four-month period after transplant, significant ($P < 0.05$) differences in root mass in response to compost amendments did not appear until 18 months after transplant. Root dry mass of plants transplanted into unamended soil was negligible (0.057 g) by the end of the experiment. In contrast, plants growing in soil amended with 7.6 or 10.2 cm (3 or 4 in) of compost averaged significantly greater ($P < 0.05$) root masses

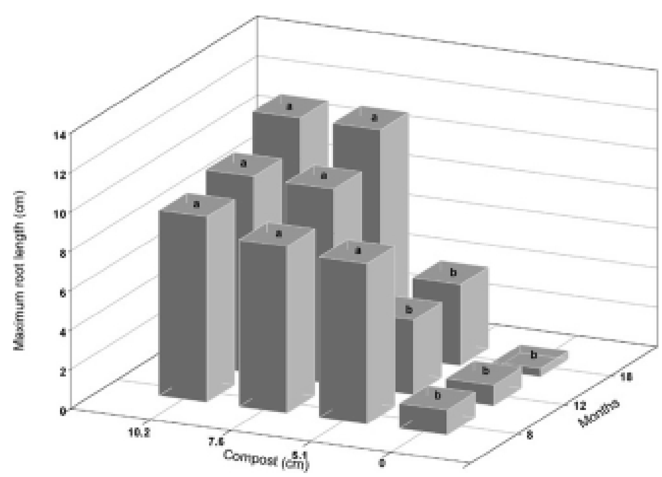

Fig. 1. Maximum root lengths excavated from 'G.G. Gerbing' azaleas transplanted into a Myakka fine sand amended with yard waste compost. Means are the combined effects of the high and low irrigation regimes and represent 6 plant replicates. Months are months after transplanting. Means with the same letter within months are not significantly different at the 5% level based on Fisher's Protected LSD.

(5.56 g and 7.11 g, respectively). The 7.11 g average root mass recovered from the 10.2 cm (4 in) compost amendment was also significantly different ($P < 0.05$) from the 1.10 g average of the 5.1 cm (2 in) compost treatment. Despite the obvious benefit provided by high rates compost, these root masses are less than a third of that recovered from photinia a year after transplanting from a similar size container into unamended soil (2).

Incorporation of 7.6 cm (3 in) of compost into the planting bed produced similar results in terms of plant growth, canopy quality and root system development to 10.2 cm (4 in), and in general, significantly greater results than obtained from 5.1 cm (2 in) of compost. This contrasts the general recommendations for compost amendments of Bilderback and Powell (4), which suggest similar benefits for 5.1 and 7.6 cm (2 and 3 in) of compost. However, this experiment was conducted in a sand soil, whereas the recommendations were more generalized. In this experiment, 5.1 cm (2 in) of compost resulted in azalea root and shoot growth not unlike that of the unamended sandy soil.

Differences in leaf area and dry mass were observed after 8 months, with 10.2 cm (4 in) of compost improving plant quality faster than treatments with 5.1 cm (2 in) or no compost. This improved quality occurred without significant increases in plant dimensions. The greater increase in leaf area and mass probably resulted from more root growth into the amended soils, which was most evident during the 4 to 8 months period after transplanting. In one study, a backfill amendment of leaf compost and sand added to the planting hole resulted in increased shoot growth for *Cotoneaster apiculata*. However, while root density in the amended soil was about twice that of plants in unamended clay soil, variation in the root data did not allow for a correlation between root and shoot growth (15). Similarly, container-grown Chinese juniper transplanted into a loam soil had greater shoot and root growth compared to plants grown in a heavy clay soil (5).

All plants survived with every third day irrigation in full sun, with canopy quality similar to plants receiving alternate day irrigation combined with high levels of compost incorporation. Incorporating 7.6 or 10.2 cm (3 or 4 in) of yard waste compost into the transplant soil produced plants with similar shoot size, quality, and root growth, regardless of the irrigation regime. These results suggest that high levels of compost amendment can allow for a reduction of irrigation frequency for transplanted azaleas without slowing plant growth or establishment.

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