EFFECT OF BACKFILL AMENDMENT ON GROWTH OF RED MAPLE

by Timothy J. Smalley and Carleton B. Wood[1]

Abstract. Balled-and-burlapped red maple (*Acer rubrum*) trees were planted in holes backfilled with 1) native soil, 2) 50:50 (v/v) aged pine bark: soil, 3) 50:50 (v/v) Mr. Natural Concentrated Landscape Media (CLM): soil, and 4) 100% CLM. The CLM is an improved, proprietary soil amendment composed of top soil, pine humus, granite sand, crushed granite, expanded shale, and composted poultry litter. The CLM: soil treatment increased fibrous root growth within the planting hole after five months but did not increase shoot growth. Aged pine bark induced nitrogen deficiency symptoms and reduced shoot growth during the first year. Shoot growth of the treatments did not differ after two years. The data support use of native soil in backfilling planting holes.

Many studies have demonstrated that amending backfill soil of a planting hole with organic matter does not increase survival percentages and growth of woody plants (1,2,4). However, amending the backfill soil is still recommended by garden centers and still practiced by some landscape firms and the Georgia Department of Transportation.

Since the late 1980s, after most of the current backfill research had been completed, new regional soil amendment products such as Nature's Helper (Smith Trucking Company, Cumming, Ga.) and Mr. Natural™ Concentrated Landscape Media (CLM) (Mr. Natural, Dahlonega, Ga.) were developed. Supplier and industry anecdotes supported the use of these products, but no studies comparing these new products had been conducted. The purpose of this study was to determine the effect of Nature's Helper, Mr. Natural CLM, and native soil on the root and shoot growth of red maple (*Acer rubrum*).

Materials and Methods

Balled-and-burlapped clonal *Acer rubrum* trees [3 cm (1.2 in) caliper, 30 cm (1 ft) ball] were planted on 6 & 8 April 1992 into 60 cm diameter (2 ft) by 30 cm deep (1 ft) holes. The clonal trees had been tissue cultured from an *A. rubrum* 'Autumn Flame' seedling. The Cecil sandy loam (63.4% sand, 21.5% clay, 15.1% silt) planting-site soil was compacted before planting with a tractor to a bulk density of 1.72 g/cc. The soil is typical of that found at landscape sites in the piedmont area of the Southeast. Planting holes were dug with a tractor-powered auger, and the sides of the holes were scored by shovels to promote root growth out of the hole. The backfill area between the rootball and sides of the hole was filled with 1) native soil, 2) native soil and Nature's Helper (50:50, v/v), 3) native soil and Mr. Natural CLM (50:50, v/v) and 4) 100% CLM. On 25 August 92, the pH (H_2O) of the treatments were 1) 5.0, 2) 4.9, 3) 5.2 and 4) 5.4, respectively.

Nature's Helper, an aged pine bark locally sold in Georgia, had a 95 C:1 N ratio at planting as determined by a CR-12 combustion system (Leco, St. Joseph, Mich.) and a modified Kjeldahl N analysis. Mr. Natural CLM is a locally produced, proprietary, fabricated soil amendment composed of pine humus, granite sand, crushed granite, expanded shale, and composted poultry litter. Unlike a typical organic amendment like pine bark, CLM contains a nitrogen source, composted poultry litter, and components that will not decompose over time: granite sand, crushed granite, and expanded shale.

The backfill mixtures were homogenized in a cement mixer before placing around the root balls. Two trees were planted per treatment in each of eight reps in a randomized complete block design. Trees were planted in east-west rows, 2 m (6 ft) spacing in the row and 3.1 m (10 ft) spacing

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between rows. Planting holes were mulched with 10 cm (4 in) of pine needles, and the trees were provided 2.5 cm (1 in) of irrigation water per week during the first year after planting as needed. Trees were not fertilized.

Calipers of all trees at 15 cm (6 in) above the ground were measured on 19 August 1992 and 1 Dec. 1993. The lengths of the three and five longest current season's shoots in the upper third of the crown were measured on 25 August 92 and 1 Dec. 93, respectively. On 25 August 1992, trees in three reps were excavated and the diameter of the root system from the longest root in the eastern quadrant to the longest root in the western quadrant was determined. New root growth in the east and west quadrant outside the planting hole was excavated by hand and smaller roots were recovered from the soil by sieving. Roots were dried after separation into ≤2 mm (0.1 in) and > 2 mm size classes. Roots in the planting hole and outside the original root ball were sorted and dried similarly.

Results and Discussion

For all treatments, most of the root-system growth out of the hole was along the surface soil: mulch interface because of soil compaction. Roots that penetrated the sides of the planting hole were below the compacted upper layer, which was 5 to 7 cm (2 to 3 in) deep.This observed surface rooting supported the recommendation for disturbing as large an area as possible to promote root growth.

The root-system width of the bark-amended treatment was greater than that of the other treatments, but only significantly greater than the width of the native soil treatment (Table 1). Root length has been shown to increase as nitrogen levels decrease (3), and the plants in the bark treatment exhibited nitrogen deficiency symptoms. Microbial competition for soil nitrogen caused the nitrogen deficiency symptoms, as the microbes utilized nitrogen in degrading cellulose in bark wood fragments. The pine bark had been aged, but was not fully composted. Wood et al. (8) observed similar nitrogen deficiency symptoms and increased root diameter results in *Viburnum plicatum* var. *tomentosum* 'Mariesii' planted in bark-amended soil.

The CLM:soil treatment had the greatest amount of small roots (≤ 2 mm), though not significantly different from the CLM or native soil treatment (Table 1). No differences in larger roots (> 2 mm) inside the hole or in both root-size classes outside the hole existed (Table 1).

Schulte and Whitcomb (4) noted fewer secondary and fibrous roots in *Acer saccharinum* trees grown in bark-amended backfill. Similarly, we discovered lower amounts of finer roots in bark-amended plants in this study (Table 1), providing more evidence to support existing research that root length extension is promoted over root branching in nitrogen deficient plants (3).

Results did not support Schulte and Whitcomb's (4) observation that roots were restricted to holes amended with organic matter. Byrnes (reported in 7) observed this restricted root growth phenom-

Table 1. Effect of backfill amendment on root growth of *Acer rubrum*.

Treatment	Root system diam (cm)	Root weight (g) Inside hole ≤2 mm	Inside hole >2 mm	Outside hole ≤2 mm	Outside hole >2 mm
Native soil	120b	57ab	36a	7a	2a
50% bark: 50% soil	149a	46b	32a	21a	9a
50% CLM: 50% soil	135ab	67a	30a	20a	3a
100% CLM	140ab	53ab	26a	13a	3a

Means within columns followed by the same letter or letters are not significantly different at the 5% level using the Duncan's Multiple Range Test (n=6).

Table 2. Effect of backfill amendment on growth of *Acer rubrum*.

	Shoot growth (cm)		Caliper (mm)	
Treatment	8/92	12/93	8/92	12/93
Native soil	34a	46a	37a	44a
50% bark: 50% soil	17b	45a	36a	44a
50% CLM: 50% soil	30a	49a	36a	45a
100% CLM	33a	47a	37a	44a

n=6,10, 6, 10 for the means in each column, respectively
Means within columns followed by the same letter or letters are not significantly different at the 5% level using the Duncan's Multiple Range Test.

enon in sandy soils in Florida. Roots may have remained in the backfill area because the organic matter (peat) increased the plant-available water in the sandy soil. Adding organic matter to the clay soils in our study would not have such an appreciable effect on available water (8).

Increased root growth (roots ≤ 2 mm) of the CLM: soil plants did not prompt an increase in shoot growth after one or two years (Table 2). Reduced shoot growth in the bark treatment was caused by nitrogen deficiency. Whitcomb and Schulte (4) also observed reduced *Acer saccharinum* shoot growth after bark backfill amending. They alleviated the symptoms and offset the growth reduction by adding fertilizer.

Treatment shoot growths did not differ after two seasons. Shoot growth of green ash also was not affected by amendments after two seasons (5).

Poultry compost, a potential source of nitrogen, in the CLM did not promote increased shoot growth of the red maples (Table 2). After amending backfill with leaf compost, Watson et al. (6) observed increased shoot growth in *Cotoneaster apiculata*, but not in *Juniperus chinensis* 'Pfitzeriana Compacta.'

No differences in caliper were observed in both growing seasons.

Conclusion

No advantage was observed in using backfill amendments for transplanting red maples. These results concur with previous similar studies (1,2,4,5). Even a potentially superior backfill such as CLM did not improve plant growth. This study suggested that native soil, even on a compacted clay site, is a satisfactory backfill for *Acer rubrum*.

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Résumé. Des érables rouges (*Acer rubrum*) en motte emballée de jute ont été plantés dans des trous remplis de divers types de matériaux: 1) sol d'origine naturelle; 2) mélange 50-50% (en volume) de sol et d'écorces de pin grossières; 3) mélange 50-50% (en volume) de substrat de culture commercial et de sol; 4) substrat de culture commercial à 100%. Le mélange de sol et de substrat de culture commercial a produit une augmentation du taux de croissance des radicelles dans la fosse de plantation après une période de cinq mois mais n'a pas donné d'augmentation du taux de croissance des pousses. L'écorce de pin grossière a provoqué des symptômes de carence en azote et a réduit le taux de croissance des pousses au cours de la première année. Le taux de croissance des pousses ne différait pas entre les divers types de matériaux de remplissage après deux années. Les données tendent à confirmer la préférence envers l'utilisation du sol d'origine naturelle pour le remplissage de la fosse de plantation.

Zusammenfassung. Ballierte und eingeschlagene Rotahorne wurden in Pflanzlöcher gesetzt, die 1) mit dem Bodenaushub, 2) mit 50:50 (v/v) abgelagerter Nadelholzrinde : Boden, 3) 50:50 (v/v) gewöhnliches Landschaftssubstrat : Boden und 4) mit 100% Landschaftssubstrat verfüllt wurden. Die Anwendung von Landschaftssubstrat und Boden steigerte das Wachstum der Feinwurzeln im Pflanzloch nach fünf Monaten, aber hatte keinen Einfluß auf das Triebwachstum. Die abgelagerte Nadelholzrinde (Rindenmulch) verursachte Stickstoffmangelsymptome und reduzierte das Tribwachstum während des ersten Jahres. Das Wachstum der Triebe veränderte sich auch nach zwei Jahren nicht. Diese Ergebnisse befürworten den Einsatz von Mutterboden beim Verfüllen der Pflanzgruben.