EFFECTS OF SOIL AMENDMENTS AND FERTILIZER LEVELS ON THE ESTABLISHMENT OF SILVER MAPLE [1]

by Joseph R. Schulte and Carl E. Whitcomb

In developing a landscape, establishment of woody ornamentals is a major concern. Most recommendations suggest the use of some form of soil amendment (4, 17). Others go so far as to recommend digging the planting hole a year in advance and filling it with leaves and organic matter to form a composted planting media (3). However, their recommendations are seldom referenced by research findings.

The same is true for the addition of fertilizers. Some authors maintain fertilizer should not be applied to newly planted landscape material the first year. They state that it takes year for new feeder roots to develop (4, 5, 8). Other advocate the use of diluted solutions of soluble fertilizers, but fail to mention rate and frequency of application (6, 10, 17).

Allison and Anderson (1), using sawdust for soil improvements, observed harmful effects on crop yields when sawdust was applied alone. It depleted nitrogen in the form of ammonia and nitrates. Rigby (8) used ground pine bark as a growing medium for container nursery stock. His results showed the newly planted material required additional nitrogen fertilizer for the first few months. Gartner, et. al., (11) worked with several species of plant material and various mixes of hardwood bark, soil and perlite. The decomposition of the bark in the mix caused a severe nitrogen deficiency that was not corrected by normal fertilization practices. Later studies by Gartner, Meyer and Saupe (12) demonstrated that a slow release fertilizer incorporated in bark-amended mixes prevented nitrogen deficiencies.

Allison and Murphy (2) and Matkin (15) found that hardwoods decomposed at a faster rate than softwoods (40-50% in 60 days) and the hardwoods were attacked more readily by the microorganisms and consequently required more immediate nitrogen. In further studies with wood by-products, Viljoen and Fred (22) and Lunt (14) reported that there was no toxic effects on plants due to sawdust and woodchips. Joiner and Conover (13) found that shredded pine bark proved to be an accessible, inexpensive substitute for peat as the organic component of soil mixtures with sand for container-grown pittosporum.

Salter and Williams (19) studied the moisture characteristics and crop yields from sandy loam soils amended with farmyard manure and peat. Yield differences between the peat and control plots were small and inconsistent. Feustal and Byers (9) studied the moisture absorbing and retaining capacities of peat-soil mixtures. They stated that moisture retention properties alone should not be the basis for incorporating peat with soil. They did not recommend it as a soil amendment.

Pellet (16) found that the addition of peat, vermiculite or sawdust to the soils of central Minnesota resulted in no better growth of landscape plants than unamended soil. In agreement with Pellet, Townsend (21) used a 50% sandy loam soil and 50% peat mixture and tested the effects of soil amendments on the growth and productivity of highbush blueberries. The unamended control plot yielded larger plants and better fruit over a five year period than the peat amended soils. Smalley, Pritchett and Hammond (20) found similar results in experiments with bermudagrass putting greens. However, they found that the addition of vermiculite to a loamy fine sand putting-green soil increased yield significantly. It was not advantageous to

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use more than 10% vermiculite in the mixture except during drought periods when 20% proved to be more beneficial.

Chadwick (7) applied an inorganic 12-6-4, and organic 6-6-4 to Moline elm trees of one inch caliper. After one year, all trees receiving fertilizer treatments were larger than control trees.

Materials and Methods

This experiment was set up to study the effects of 9 soil amendment treatments and 3 fertilizer rates in factorial combination on the establishment of 216 Silver Maple trees in the landscape. One hundred and eight trees were planted in a good, clay loam soil with a pH of 5.8, and 108 trees in a nutrient deficient silt loam subsoil with a pH of 7.1 in a housing addition. Amendment treatments used were: 1) check, 2) 20% bark, 3) 40% bark, 4) 20% peat moss, 5) 40% peat moss, 6) 20% sand, 7) 40% sand, 8) 20% vermiculite, and 9) 40% vermiculite. Fertilizer levels were: 1) 0, 2) 20 lbs. 10-20-10/1000 sq. ft./mo., and 3) 40 lbs. 10-20-10/1000 sq. ft./mo. The experimental design was a randomized block with 4 replications at each location.

Planting holes were dug 12 inches deep using a tractor-mounted auger 24 inches in diameter. Holes were spaced five feet apart with six feet between rows. The soil at the existing site removed by the auger was placed in a five cubic foot cement mixer and combined with the proportionate volume of soil amendment. With check treatments, the existing soil was placed back into the planting hole with no amendments. The seedlings were individually selected for uniform size and quality and planted on May 20. The trees were fertilized June 20, July 20, and August 20.

Tensiometers were installed at both locations to determine when the trees needed watering. All trees were watered during extended dry periods to avoid excessive water stress.

Results

All trees grown in the clay loam soil increased in total new growth as the fertilizer level increased. Forty pounds of 10-20-10 per 1000 square feet per month significantly increased growth compared to no fertilizer. Trees growing in pine bark amended soils grew less than all other treatments at the same level of fertilizer (Figure 1). As the quantity of pine bark in the planting hole increased, the amount of new growth was less, unless fertilizer was added. A similar response was observed in increase in stem caliper (Figure 2).

Available nitrogen at the 0 fertilizer level in bark amended soils was very low (Table 1). An abrupt change in ammonium nitrogen was found when pine bark had been added to the soil. This was apparently due to microorganisms decomposing the pine bark, thus accentuating the nitrogen deficiency. The addition of fertilizer at the 40 pound rate provided sufficient nitrogen for tree growth as well as microbial decomposition of the pine bark. It is of interest to note that the pine bark did not influence the availability of phosphorus or potassium (Table 1). There was no evidence to suggest pine bark was toxic to the trees. This is similar to the findings of other researchers. (15).

Growing conditions in the silt loam subsoil were very poor. Growth differences were not significant for any fertilizer rates or amendment level treatments. Plants grew equally well in the unamended soild as with the addition of soil amendments.

Root observations showed that trees grown in the clay loam soil produced more new growth and stronger and more vigorous root systems than trees grown in the silt loam subsoil. Trees in the unamended clay loam grew well and the roots had a well balanced distribution with roots extending well beyond the limits of the planting hole (Figure 3). Trees planted in soils amended with peat moss had very fibrous roots but they did not develop beyond the amended planting hole.

Poorest roots were observed on trees grown in soils amended with pine bark. Roots extended well out of the amended soil but few secondary and fibrous roots were observed. With the 40% bark treatment, the majority of trees were dead by mid-winter when the trees were dug and evaluated.

There appears to be no substitute for a good soil. The trees in the good clay loam soil grew an average of 69 inches of new growth and with a stem diameter of about 3/4 inch. By contrast, trees in the silt loam subsoil grew an average of 12 inches of new growth with a stem diameter of less than 1/4 inch.

No benefit was derived from the use of soil amendments either with a good clay loam soil or a very poor silt loam subsoil. Pine bark as a soil amendment was detrimental to the growth of young Silver Maple trees in both soils unless fertilizer was applied to off-set the nitrogen tie-up by microorganisms. Trees growing in soils amended with peat moss developed a more fibrous root system than all other treatments. However, the fact that the roots did not develop into the surrounding soil, as was the case with all other treatments, may mean the trees would be more susceptible to drought.

Young trees should be fertilized, at least at a moderate rate, during their first growing season in the landscape. If organic soil amendments are used in the planting hole, it is even more important to fertilize young trees. These data do not support the use of soil amendments in the establishment and growth of newly planted trees. These findings are similar to those reported by Pellett (25), Allison and Anderson (2), Townsend (33), and Smalley, Pritchett and Hammond (32).

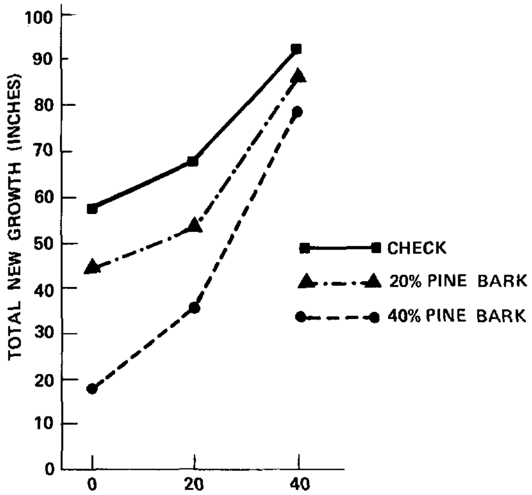

Figure 1. Effects of three fertilizer levels and pine bark treatments on total new growth of *Acer saccharinum* grown from May 20 to November 21 in a clay loam soil.

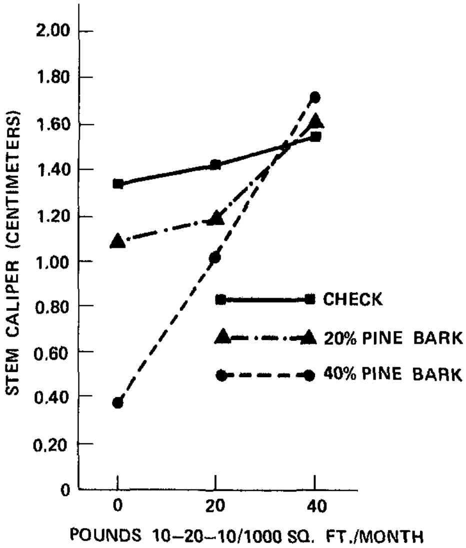

Figure 2. Effects of three fertilizer levels and pine bark treatments on stem caliper of *Acer saccharinum* grown from May 20 to November 21 in a clay loam soil.

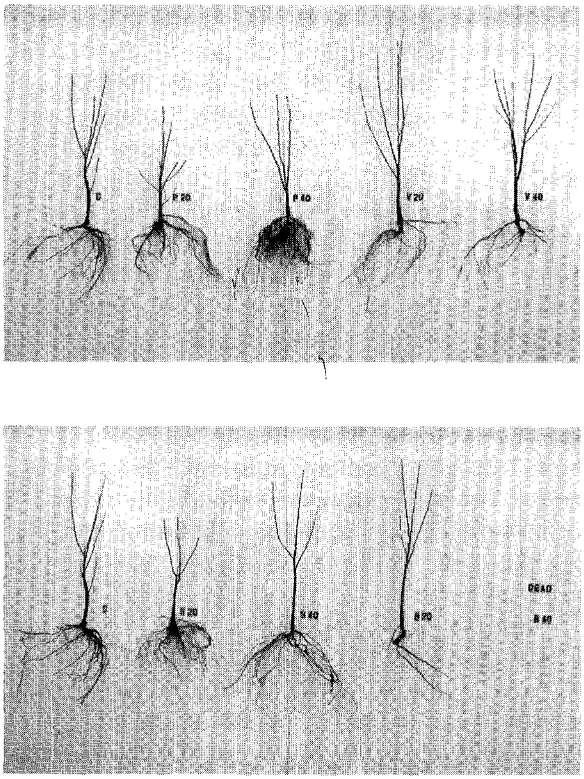

Figure 3. Representative samples of trees and their root development in a clay loam soil. C = check, P20 = 20% peat moss, P40 = 40% peat moss, V20 = 20% vermiculite, V40 = 40% vermiculite, S20 = 20% sand, S40 = 40% sand, B20 = 20% bark, B40 = 40% bark.

Nutrient	Treatment	Fertilizer Rate Lbs 10-20-10/1000 sq. ft./mo. 0	20	40	Mean
	Check	156.0	172.0	214.0	180.6
NH_4-N**	20% Bark	33.0	42.0	72.0	49.0
	40% Bark	33.0	42.0	82.0	52.3
	Mean	74.0	85.3	122.6	
	Check	5.0	6.0	11.0	7.3
NO_3-N***	20% Bark	5.0	9.0	14.0	9.3
	40% Bark	5.0	5.0	18.0	9.3
	Mean	5.0	6.5	14.1	
	Check	4.9	49.7	77.0	43.8
Phosphorus	20% Bark	5.1	33.7	93.7	44.1
	40% Bark	2.3	43.7	87.5	44.5
	Mean	4.1	42.3	86.0	
	Check	220.0	266.0	353.0	279.6
Potassium	20% Bark	211.0	270.0	372.0	284.3
	40% Bark	237.0	295.0	385.0	305.6
	Mean	22.9	277.0	370.4	

* PPM = parts per million
** NH_4-N = ammonium nitrogen
*** NO_3-N = nitrate nitrogen

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Department of Horticulture
Oklahoma State University
Stillwater, Oklahoma