Soil Bioremediation of Live Oak Trees at Louisiana State University, Baton Rouge, Louisiana

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The Louisiana State University (LSU) Baton Rouge Complex has more than five thousand trees with a diverse mix of more than sixty species. The main campus of the university encompasses five hundred acres which are dominated by 1,052 large, mature live oak trees (*Quercus virginiana*). In 1995 a survey of the campus live oaks, reported by Thompson (1995) indicated the need for establishing an ongoing cultural program to protect and sustain the campus live oaks. This investigation identified 613 of the 1052 live oaks that were either stressed or were in decline.

Statement of the problem

Soil compaction, resulting from foot traffic from an average of 37,000 people a day crisscrossing the campus, is a major cause of tree stress. Additionally, maintenance vehicles, construction, off-street parking of thousands of cars during athletic events, all which occur throughout the year, contribute to root injury and compaction of the soil.

Since 1998, a plan was implemented based upon best management practice for the protection and sustained health of the campus live oaks (Guidry, 1998).

Mulching as a Best Management Practice

Moving from a crisis to a scheduled tree maintenance program means there are increased needs for money, supplies, equipment and manpower.

Within budget constraints the task is to properly care for the living green infrastructure of the campus. Ameliorating tree problems can be accomplished through a process of best management practice such as using urban tree wood waste as a mulch material. Recycling urban whole tree wood waste as a mulch material not only greatly benefits tree health, but also that of the environment and the community as well. At least eleven benefits of mulch are described by Harris (1992), each of which enhances the physical, chemical and biological properties of the soil beneath a tree.

Recycling urban wood waste as a mulch material simulates what nature does, particularly if leaves, twigs, branches and portions of the trunk are included. A stroll into the forest allows one to experience an ecosystem that is self sustaining. Walking on the forest floor litter creates an awareness of the phenomenon of organic recycling. A good question is, who waters and fertilizes the forest? Throughout time, trees evolved as forest trees. Genetically, trees on urban sites are still forest trees (Shigo, 1991).

Methodology

Twelve live oak trees were randomly identified from a selected area of the campus. Six trees were mulched and six trees were not mulched. The mulched trees were mulched to a depth of six inches eighteen months prior to sampling. The mulch used was whole tree wood waste of multiple species directly from the chipper truck of a utility line clearing crew. Chemical analyses were obtained from three levels of the wood waste mulched material: fresh wood waste, partially decomposed wood waste, and completely decomposed wood waste.

Fresh wood waste was collected from the surface of the mulch layer. Partially decomposed wood waste was collected at a depth of three inches into the mulch layer. This sample represented decomposing mulch material at a stage between fresh and completely decomposed. Completely decomposed wood waste represented material located just above the soil/mulch interface. Chemical analysis of the wood waste mulched material was limited to identifying phosphorus, potassium, calcium, magnesium and sodium. In addition to this information, pH tests were conducted on the soil beneath trees that were not mulched and compared to those trees that were mulched.

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Table 1

Urban tree wood waste chemical analysis

	PPM				
Chemicals	P	K	Ca	Mg	Na
Fresh	162 (0%*)	527 (0%)	5264 (0%)	648 (0%)	69 (0%)
Partially	143 (12%)	407 (23%)	5973 (13%)	528 (19%)	65 (6%)
Completey	105 (36%)	406 (23%)	5170 (2%)	465 (28%)	70 (2%)

* *Percent of plant nutrient contributed to rhizosphere*

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Results

Chemical analyses of mulched urban tree wood waste for fresh, partially, and completely decomposed material indicated that as decomposition progresses, these elements move toward the soil. This study indicated that in the completely decomposed mulch layer, phosphorus increased by 36%, potassium by 23%, calcium by 2%, magnesium by 28%, and sodium by 2% (Table 1). However, calcium showed an interesting trend: 13% was contributed from the partially decomposed mulch layer, compared to only 2% from the completely decomposed layer. Concentrations of calcium were found to be 5264 ppm for fresh mulch, 5973 ppm for partially decomposed mulch, and 5170 ppm for completely decomposed mulch.

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A large, healthy Quercus virginiana *(the Majestic Oak in Savannah) as seen during the Oak Conference Low Country Field Trip.*

Table 2

Comparative chemical analysis for the rhizosphere

	PPM				
Chemicals	P	K	Ca	Mg	Na
No mulch	38	138	806	96	32
Mulched	76	325	2792	303	64
% increase from mulch	100	135	246	215	100

A pH status was established from soil samples taken from beneath unmulched and mulched trees. Unmulched soil was found to have a pH of 5.33 (806ppm), whereas mulched soil was found to have a pH of 6.33 (2792 ppm).

The base status of mulched soil compared to unmulched soil was found to be better than three to one. The unmulched soil had a percent base saturation of 5.28, as compared to 17.56 for mulched soil.

Conclusions

This study indicates the rhizosphere beneath the mulched trees was enhanced through translocation of the five elements identified in this investigation. Chemical analyses showed mulch provides nutrient element enrichment to the soil as the organic mulch material decomposes. Comparing chemical analyses between unmulched to mulched soil, we found that phosphorus increased by 100%, potassium by 135%, calcium by 246%, magnesium by 215% and sodium by 100%. (Table 2). Drought conditions since 1997 caused stress in many of the trees on the campus, and since 1999, Baton Rouge was well below average rainfall. However, trees that were mulched through this period of time exhibited a noticeable difference in vitality. Moisture conservation and nutrient availability have been significant for the mulched trees on the LSU campus.

References

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