Mills Scholarship Report – '09

Bhavana Viswanathan

Soil respiration and soil analysis under American Sweetgum (*Liquidambar styraciflua)* trees as affected by pavement types

Our study researched the prospective application of pervious concrete for paved areas with the objective to potentially reduce surface water runoff and improve soil water availability. We expected that improved soil water availability would provide a better belowground environment for trees to grow.

During the past one and half years we have collected data on soil CO_2 efflux, soil CO_2 and O_2 concentrations, soil water availability, soil temperature, tree diameter growth, root production and soil chemistry. Data collection was as follows:

Data collected	**Instrument used**	**No of days in the year spent on this data collection**	**Start and end date of data collection**
Soil CO_2 efflux	LiCOR 6400 – 09	15 (once every month)	Feb '08 – Apr '09
Soil temperature	LiCOR 6400 – 09	15 (once every month)	Feb '08 – Apr '09
Soil water content	TDR probe	16 (once every month)	May '08 – present
Soil O_2 concentration	Servomex gas analyzer	14 (once every month)	July '08 – present
Root production	Minirhizotron	30 (twice every month)	June '08 - present
Tree diameter	Dendrometer & diameter tape	30 (twice every month)	June '08 - present
Soil chemistry		20	February '09 – March '09
Soil CO_2 concentration		2	August '09

We found that, during the active growing season, soil CO_2 efflux rates were much higher in the paved plots than in the control (unpaved) plots. Within the paved plots, soil CO_2 efflux rates were higher in the standard concrete plots compared to the pervious concrete plots. The values of CO_2 efflux from the standard concrete were extremely high going upto 140 μmoles m^{-2} $s^{-1}$for the month of June '08. We hypothesize that the standard concrete acts like a lid on top of the soil. Due to the presence of the concrete, CO_2 respired by soil microorganisms and roots cannot escape from the soil and this causes extreme buildup of CO_2 under the pavements. Actual measurements of soil CO_2 concentration, as compared to flux, showed that soil CO_2 concentrations under paved soils are twice as high as in soil without pavement. Interestingly, soil CO_2 concentrations

under the pervious pavement were still much higher than in the unpaved treatment, suggesting that the increased porosity compared to standard concrete is not enough to allow free gas exchange at the soil-air surface.

Our soil water content data did not show any significant differences between the different treatments. Soil oxygen concentrations were lowest under the standard concrete. There was a negative relationship between soil water content and soil oxygen - soil oxygen decreased with increasing soil water content. This relationship was much steeper for the standard concrete treatment than the pervious and control treatment. The data showed that for the same soil water content the amount of soil oxygen under the standard concrete was much lower than under the pervious or the control treatments, particularly at higher volumetric water contents above 20%.

The funds from TWRI were spent on buying JMP statistical software, four oxygen probes (Apogee Instruments Inc., Logan UT), and for registration at the ASHS conference at St. Louis in July '09.

Abstracts/Presentations (during funding period):

Viswanathan, B., Volder, A., Watson, W.T. and Peterson, J.A. (2009) Soil respiration and soil analysis under American sweetgum (*Liquidamber styraciflua*) as affected by pavement type. Hortscience 44: 1080-1081.

Publications:

Volder A., Watson W.T. and Viswanathan B. 2009. Potential use of pervious concrete for maintaining existing mature trees during and after urban development. Urban Forestry and Urban Greening 8: xx – xx (In press).
