G.R.E.E.N. (Green Roof Environmental Evaluation Network)

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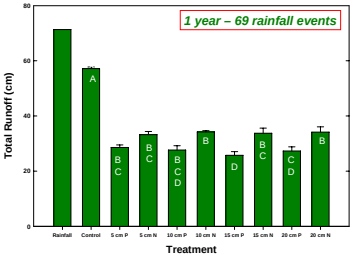
Green Roof Storm Water Retention

To better understand the role of green roofs in storm water management, a study was initiated in September, 2005 to quantify the storm water runoff of green roof systems of varying medium depths (5, 10, 15, and 20 cm). Thirty-two green roof models were constructed utilizing typical built-in-place technologies – ½ were planted with *Sedum immergrauch* and the other ½ were left unplanted. The thirty-two green roof models and four (planted) Green Roof Blocks™ (modules) were fitted with individual flow-through storm water collection systems. Only storm water that falls on the green roof models/modules enters the storm water collection system. The experimental green roof systems were placed in a completely randomized experimental design with four replicates of each medium depth and four control roofs with only EPDM roof surfaces. Storm water runoff was collected and quantified (weighed) after each of 69 rainfall events over the course of the first project year.

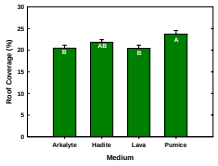


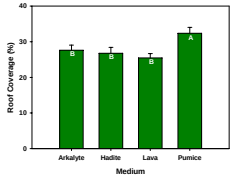
Our results indicate after one year that 15 cm of arkalyte medium (80% aggregate:20% composted pine bark) retains the most storm water (64%). Further, planted green roof systems retain more storm water than aggregate media only.

Our newest field experiment is designed to evaluate the performance of six different aggregate growing mediums. In the first four months, all tested green roof systems retain more storm water than control roofs.

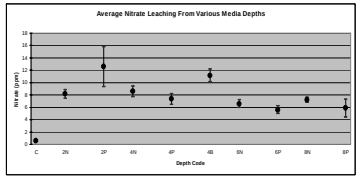
Green Roof Growth Media

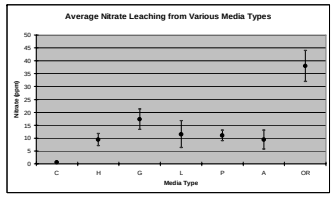
Aggregates used in green roof growth media have varying regional availability and cost. We have several ongoing field, roof, and laboratory studies to evaluate the performance and the interchangeability of these aggregates. Though each of the media formulations support robust plant growth, our initial evaluations have identified plant growth using natural occurring pumice to be greater than that of media using manmade expanded aggregates; clay, slate, and shale. Analysis of water retention characteristics of blended aggregate growth media have identified varying water retention levels and thus varying saturated weights. Additionally, we have begun to monitor post-saturation weights of varying media compositions both with and without plants to identify transpiration rates and thus identify media compositions with greater storm water management potential. We continue to experiment with new aggregates including materials produced from recycled auto glass, recycled polystyrene, and coal byproducts. Developing less expensive and more abundant materials to formulate green roof growth media will help to reduce the overall cost of green roofs.



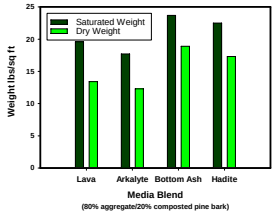


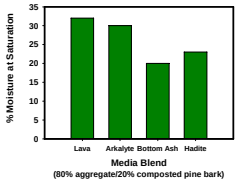
Our experiments with growing media indicate that pumice is initially the best for plant growth and performance. We feel that this is due to the temperature (white media) of the media and may change over time as roof (plant) coverage increases.





Our evaluations of nitrate in storm water runoff indicate large differences between growing medium depth and blend. The greatest nitrate leaching occurs in shallow media depths and unplanted systems. Media of the FLL-type leaches more nitrate than the other aggregate media blends.





Our evaluations of media blends indicate large differences in saturated and dry weights as well as moisture holding capacity at saturation. We have begun blending heavy and light aggregates to evaluate optimal performance and to utilize less expensive, heavier aggregates.

Green Roof Plants

To help the green roof industry gain a better understanding of the factors that effect plant performance, the G.R.E.E.N. research team is conducting monthly plant evaluations in each of our green roof research projects. The diameter (two directions) and height of each plant is measured to establish a growth index. The performance of each plant is subjectively rated on a scale from zero to five to evaluate the health of the plant. Finally, a modified dot-grid is laid over each research green roof to calculate the percentage of roof area covered with plant foliage. While the team has easily identified some factors resulting in plant fatality of certain species (e.g., low fertility and shading), our use of replicated scientific evaluations has also allowed us to identify plant growth rate differences among varying growth media formulations, commercial fertilizer usage, and growth media depths; as well as the roof coverage of various green roof plant species. Our conclusions from our plant evaluation experiments should aid the green roof industry in providing consumers more marketable plant performance.

← Growth measurements

Coverage measurements →

← Evaluating performance

Fertilizer Injury

Shade Intolerance

October 2005

March 2006

Our best species: S. sexangulare, S. spurium, S. sichotense

Our goal is to evaluate the performance of green roof technology and to make the information available to users for development/establishment of green roofs.