Thermal Performance of Biowalls

B. Retzlaff[1], D. Gerstenecker[1], L. Richter[1], and M. Woolbright[2]

Southern Illinois University Edwardsville[1], Green Wall Ventures[2]

ABSTRACT

Eighteen circular (7-foot diameter) green walls (donated by Hercules Manufacturing of St. Louis) have been located on the SIUE campus. The project is designed to evaluate the plant growth and performance of five Sedum species and one unplanted wall on north, south, east, and west wall aspects. In addition, the temperature of the wall, growing medium, and plant surfaces have been monitored on the same north, south, east, and west wall aspects. One of the Sedum species ('*Bertrum Anderson*') did not survive the first year of the study and we have replaced this species with mixed Sedum plugs. Walls planted with *Sedum spurium* and *Sedum phedimus* have approximately 75% growth media coverage after one year. Further, plant surface temperatures are less than wall block surface temperatures while the growing medium (Ameren Bottom Ash) has the greatest surface temperature. North and east wall aspects have the lowest afternoon surface temperatures - more than 25 degrees F lower than west and south aspects. Our data indicates that living wall systems have the potential to reduce the urban heat flux and that species selection may impact the thermal benefit.

INTRODUCTION

Green (living) walls may be used to help cool cities and reduce the Urban Heat Island Effect. When the plants of a green wall grow to maximum coverage, their shade and evaporation should help to reduce the amount of heat that would have been absorbed by the wall material. Evaluation of the biowalls planted at SIUE is needed to determine which plant species provide the greatest thermal benefits. This study evaluated the surface temperatures of 4 different *Sedum* species walls, a mixed *Sedum* species wall, and a control wall with no plant species. Our hypothesis was that planted walls would have lower surface temperatures than unplanted walls.

SIUE PROJECT MATERIALS AND METHODS

Green Wall Setup – 3 replicates of 6 Green Walls each planted with one of four Sedum species, one with no plants (the control wall), and one with mixed *Sedum* plug in a completely randomized design. (Fig. 1)
Green Wall Species - *Sedum immergrunchen, Sedum kamshaticum, Sedum phedimus, and Sedum spurium*
The mixed Sedum species wall included *S. spurium, S. sexangulare, S. cauticola, S. kamshaticum, and S. album*
Green Wall Medium - Bottom Ash mixed with composted pinebark donated by Ameren UE (Retzlaff et al., 2008)
Green Wall Blocks - Donated by Hercules Manufacturing of St. Louis (Retzlaff et al., 2008)
Project monitoring – wall surface temperatures on the north, south, east, and west aspects were taken monthly for 8 months. We began in September of 2008 and concluded in April 2009. An infrared thermometer was used to collect temperatures at the same time each afternoon. A one way ANOVA for a completely randomized design was used to test for differences between treatments. A Tukey's post-hoc test was then used to rank differences at an alpha level of 0.05 (Proc GLM, SAS version 9.1)

DISCUSSION

Significantly different temperatures for the control walls and species planted walls are a desirable outcome for living wall systems. The plant and medium can act together as a thermal unit that provide a cooling layer to building material (Sidwell et al., 2008). The study of these thermal environments are to determine how great the benefits in temperature reduction are per plant species throughout changing atmospheric temperatures. This study helps to promote the idea that green walls can reduce the effects of the Urban heat Island caused by development. The coverage of a plant has a direct correlation with the temperature of the medium and block it is placed in. The greater the coverage of the species the lower the temperatures the medium and block should be. The dark surface of the medium heats up, but with maximum growth, the plant should provide shade and reduce the amount of heat absorbed. The coverage and maximum growth can influence the temperature, and help provide optimal thermal benefits (Koehler et al., 2006). The ability of the living wall to collect rainwater and the process of evaporation are also factors that may lead to cooling of the building material (Koehler et al.,2006). More studies are needed to determine how great an influence biowalls can have on the surrounding thermal environment.

Fig. 1

RESULTS

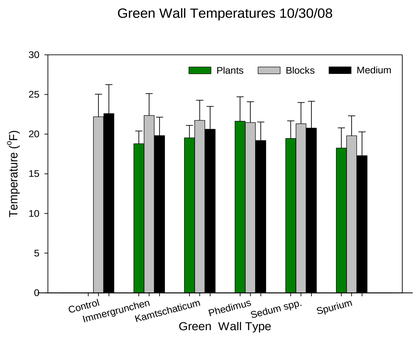

Fig. 2

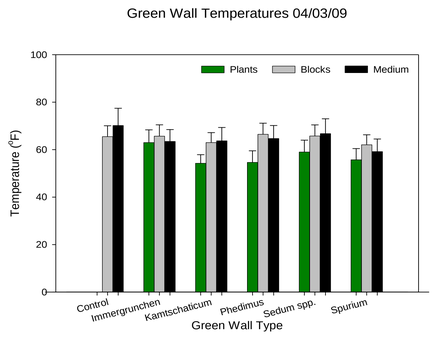

Fig. 3

Mean temperatures of the plants, medium, and blocks per species in the months of October, 2008 and April, 2009).

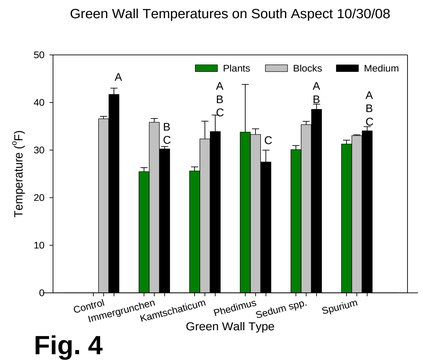

Fig. 4

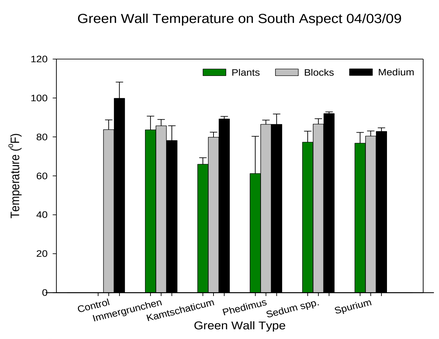

Fig. 5

Mean temperatures of the plant species, growth medium, and blocks per species from the South aspect for the months of October and April.

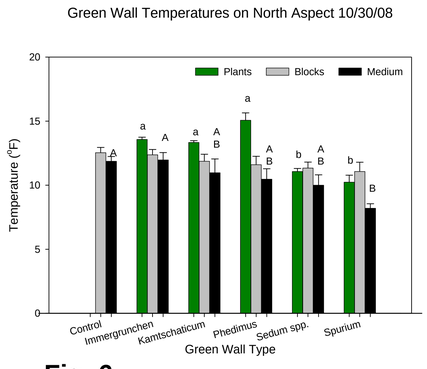

Fig. 6

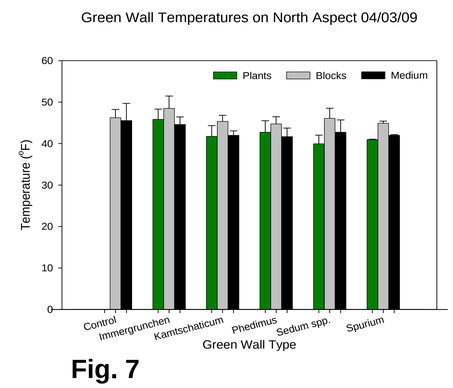

Fig. 7

Mean average temperatures of the plants, medium, and block per species from the North aspect fort he months of October and April. (Medium with different grouping letters are statistically different from one another)

SIUE PROJECT CONCLUSIONS

Average green wall surface temperatures are not statistically different in October or April (Fig. 1, 2).
The North aspect stayed significantly cooler than the South aspect in April and October (Fig. 4,6; Fig. 5,7).
Planted biowalls have a lower growth medium temperature than unplanted walls in October 2008.

REFERENCES:
Sidwell, A., Gibbs-Alley, J., Forrester, K., Jost, V., Luckett, K., Morgan, S., Yan, T., Noble, B., and Retzlaff, W.,2008. Evaluation of the thermal Benefits of Green Roof Systems.
Koehler, Dr. Manfred, 2006. Living Wall Systems- A View Back and Some Visions
Retzlaff, W., J. Middleton, M. Woolbright, V. Jost, S. Morgan, and K. Luckett. 2008. Evaluating the performance of the Ecoworks living wall system. Proceedings Sixth Annual Greening Rooftops for Sustainable Communities Conference, Awards, and Trade Show (available www.greenroofs.org).,Baltimore, MD.