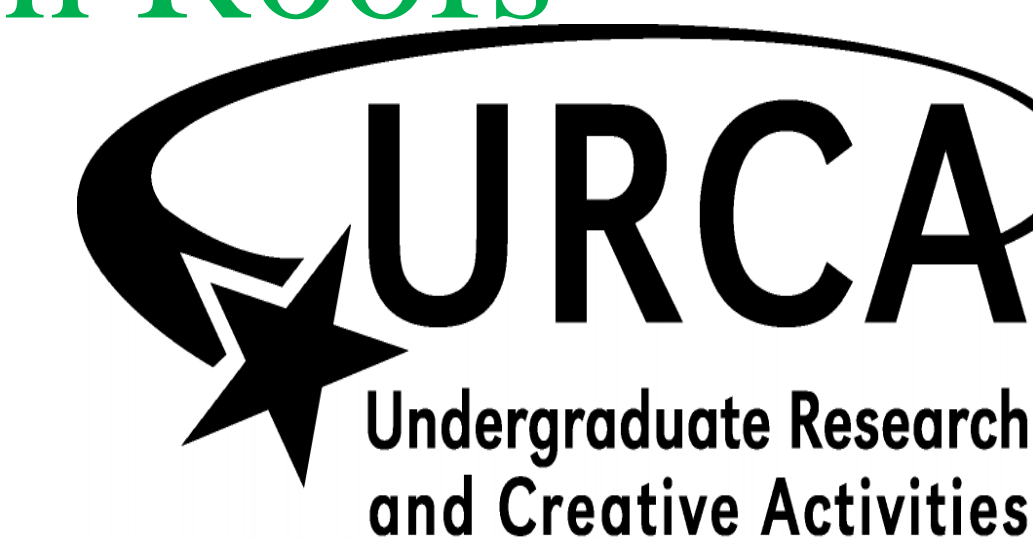


# The Evaluation of *Sedum* cuttings as an Establishment Method on Midwestern Green Roofs



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## Abstract

The majority of research conducted on green roof systems has focused on the reduction in storm water runoff, the mitigation of the heat island effect, and the reduction in energy costs in buildings with vegetative roofs. Now that the ecological importance of green roof systems has been demonstrated, it is important that research be done to help reduce the cost to make green roofs more affordable. My study evaluates the use of *Sedum* cuttings and *Sedum* 406 plugs as viable green roof establishment methods on Midwestern green roofs. The typical green roof establishment method in the Midwest region is the use of either 36 or 72 plugs, but cuttings and 406 plugs are far cheaper. My study is located on the Student Success Center at Southern Illinois University Edwardsville. This green roof uses Green Roof Blocks™ (GRB) and is planted with several *Sedum* species that were established using plugs. I established three replicate test plots, one each in east, west, and center locations on the green roof. Each replicate contains six sections each containing 10 GRB. Each replicate contains an untreated section of 10 GRB. Cuttings were applied to two plot sections of 10 GRB each in each replicate and 406 plugs were applied to two plot sections of 10 GRB each in each replicate. Atlas Soil Lock was applied to one section in each replicate containing cuttings and one section in each replicate containing 406 plugs. Cuttings were added to a new 10 GRB section in each replicate to assess the effect of applying cuttings in the fall rather than in the spring. On March 5<sup>th</sup> 2010, the average vegetative coverage of each GRB on the roof was found to be 35%. I remeasured coverage on May 18<sup>th</sup> 2010, 5 weeks after application, and found that the average coverage on untreated GRB was 60% and the roof coverage in all treatments was greater than the untreated GRB. At the end of the first growing season, I remeasured coverage again on October 29<sup>th</sup> 2010 and found that average coverage on untreated blocks was 70% and the coverage of GRB treated with only cuttings and those treated with 406 plugs and Atlas Soil Lock was greater than the untreated GRBs and all other treatments.

## Introduction

The study of the use of green roofs as a method of increasing the energy efficiency of buildings is a growing area of interest as the cost of energy rises and the impact of urban development on the environment becomes more apparent. Green roofs are known to reduce storm water runoff, mitigate the heat island effect, and keep buildings cooler during the summer (Emilsson *et al.*, 2005). The positive environmental effects of green roof systems cannot be fully realized unless they become more common. To make them more accessible and affordable, it is necessary to decrease the cost. A conventional roofing system in the Midwest has a lifespan of 15-20 years; however, it is estimated that if a green roof system is added, protecting it from the elements, the lifespan of the conventional roof below can be as much as 60 years (Luckett 2009). In Europe, green roofs have been found to more than double the lifespan of a conventional roof (Carter *et al.* 2008). Though the benefits to the environment that green roofs offer are difficult to quantify, these factors should also be considered when doing a cost-benefit analysis of installing a green roof system. One way to reduce the cost is to decrease the amount of time it takes to establish a green roof system. The more quickly extensive roof coverage is achieved the more quickly the initial cost of the green roof can be recovered. There are three main methods of establishment for green roof plants: prefabricated vegetation mats, inserting plug plants, and placing cuttings. In Europe, the most common method is the use of prefabricated vegetation mats because the plants are allowed to grow for months before being placed on the roof and there is little wait time for extensive coverage. However, this is the most expensive. The most commonly used method on Midwestern green roofs is plug plants because they already have developed root systems and can anchor the substrate. Cuttings are portions of plant material taken from an already mature plant and placed on top of the growing media. Several *Sedum* species are known to produce root systems from cuttings after coming into contact with soil or substrate. Because cuttings can be harvested from plants already growing on the roof, this is the cheapest option. My study evaluated four methods to determine if they could be used to more rapidly increase the coverage of a Midwestern green roof.



Figure 1: Vic Jost of Jost Greenhouses and undergraduate, Roxane Krutsinger, applying *Sedum* cuttings.



Figure 2: *Sedum* cutting showing some root growth.

## Methods

A 16,000 ft<sup>2</sup> green roof was planted in April 2009 in Green Roof Blocks™ (GRB) with five *Sedum* species – *Sedum sexangulare*, *Sedum reflexum*, *Sedum kamtschaticum*, *Sedum album*, *Sedum spurium* – and installed on the Student Success Center at Southern Illinois University Edwardsville in August 2009. Three replicate test plots were identified in different locations on the roof – an east edge plot, a west edge plot, and a center plot. Each plot consists of six sections of ten GRB each. The sections of each plot are delineated with capped irrigation tubes colored with spray paint placed in all four corners of each section of the test plot. The section with blue markers was treated with a mixture of *Sedum* cuttings and the section with black markers was treated with *Sedum* cuttings and Atlas Soil Lock. The section marked in purple was treated with 406 plugs and the section with silver markers was treated with 406 plugs and Atlas Soil Lock. All cuttings and plugs were applied by hand at an approximate rate of 25 lbs/1000 ft<sup>2</sup>. The spring cuttings and 406 plugs in the blue, black, silver, and purple sections were applied on April 15<sup>th</sup>, 2010. Atlas Soil Lock was added to the black and silver sections on May 5<sup>th</sup>, 2010. A fifth, unmarked section was added to each plot on September 17<sup>th</sup>, 2010 that consisted of *Sedum* cuttings. Each plot also has an untreated, control section marked in white. On September 14<sup>th</sup>, 2010 the number of 406 plugs and cuttings that survived in each section were counted. Control roof coverage was taken in March 2010 and coverage measurements of treated sections were taken in May and October 2010. The data was analyzed using a one way ANOVA for a completely randomized design.

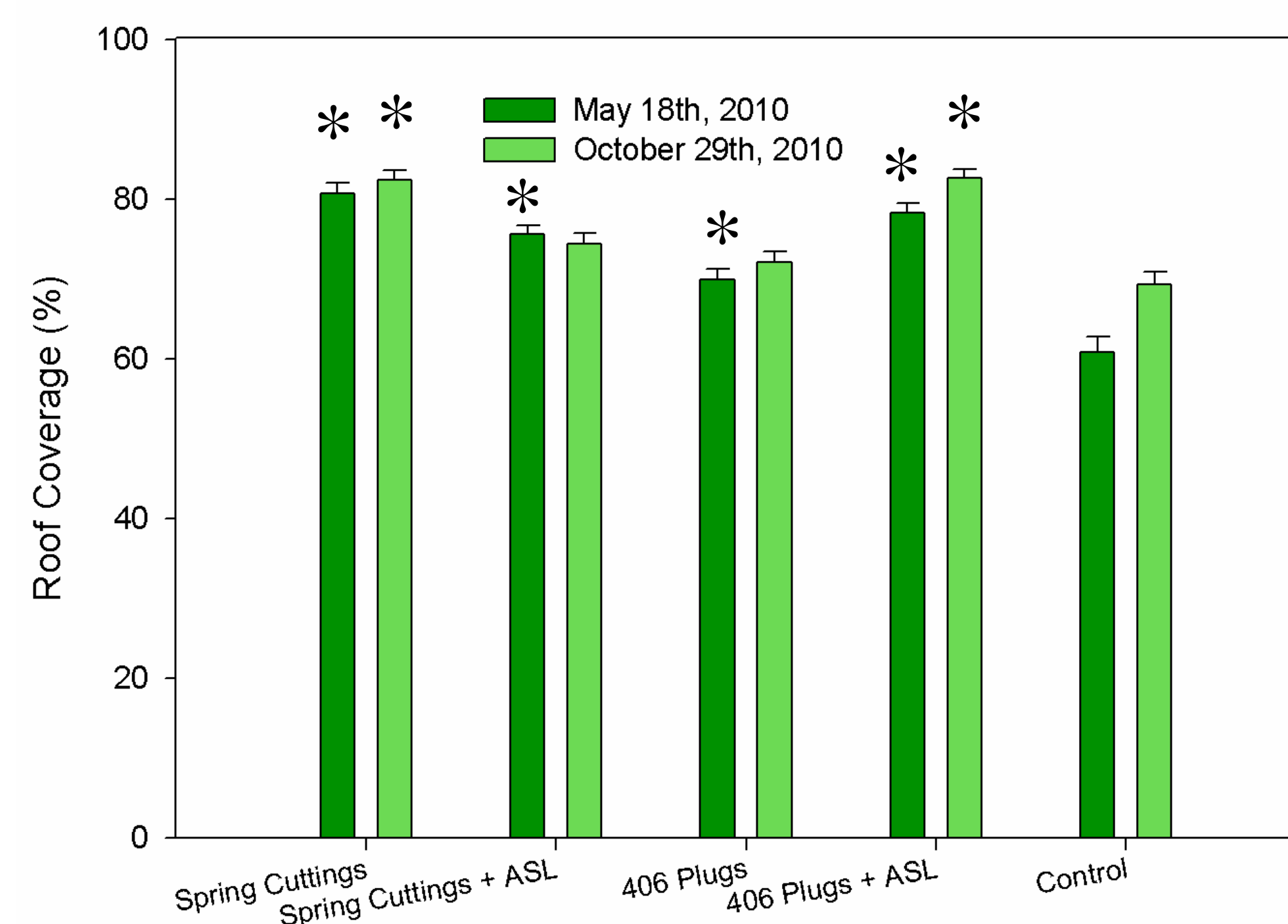


Figure 3: Roof coverage of each treatment on May 18<sup>th</sup>, 2010 and October 29<sup>th</sup>, 2010. In May, all treatments showed greater coverage than the control GRB. In October, GRB treated with Spring Cuttings and GRB treated with 406 plugs and Atlas Soil Lock had greater coverage than any of the other treatments. Bars with an asterisk are significantly greater ( $\alpha > 0.05$ ). Error bars represent + one SE.

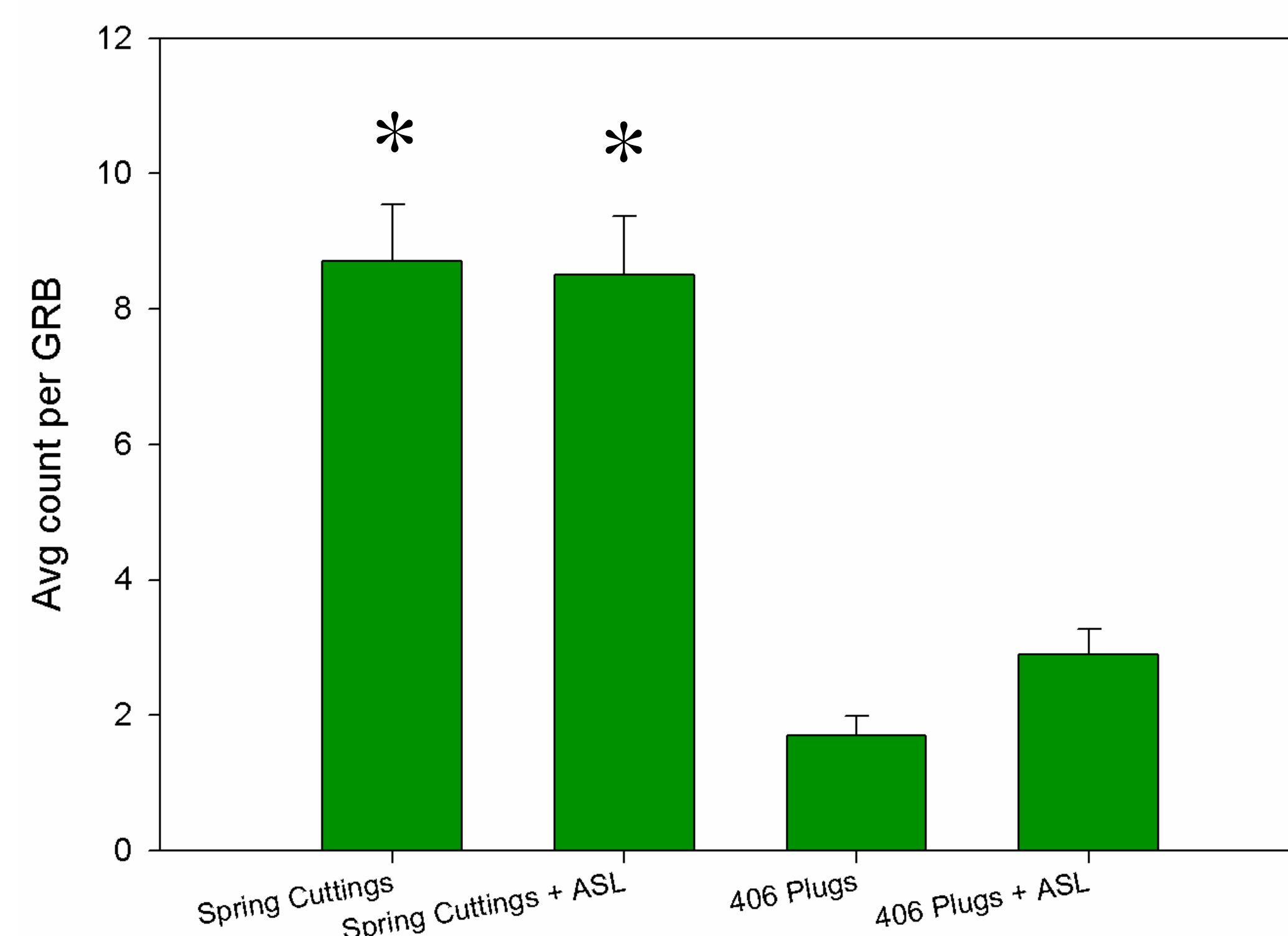


Figure 4: Average count of cuttings or plugs remaining on each GRB in each treatment section in September 2010, five months after initial application. Treatments with Spring Cuttings and Spring Cuttings with Atlas Soil Lock had a greater number of cuttings or 406 plugs remaining than treatments of 406 plugs and 406 plugs with Atlas Soil Lock. Bars with an asterisk are significantly greater ( $\alpha > 0.05$ ). Error bars represent + one SE.

## Results and Discussion

One month after application, all of the treatments were found to have greater coverage than the untreated GRB (Figure 3). Six months after application, only two treatments showed greater coverage than the control group – GRB with cuttings and GRB treated with 406 plugs and Atlas Soil Lock. After one growing season, these two treatments had the same coverage after six months and increased the establishment of the vegetative roof more quickly than untreated GRB. This could be very beneficial for a recently installed green roof because it could decrease the amount of time that the building owner has to wait to see results from the investment. Decreasing the time it takes to see results, such as a decrease in energy bills, means that the building owner would see a return on the investment more quickly. This would be an important step toward making green roofs more common in an urban environment.

Five months after application, sections treated with Spring Cuttings had an average of 8.7 cuttings remaining on each GRB and sections treated with Spring Cuttings and Atlas Soil Lock had an average of 8.5 cuttings remaining on each GRB (Figure 4). Both of these sections had a greater number of cuttings or 406 plugs remaining than sections treated with 406 plugs or 406 plugs and Atlas Soil Lock, which had 1.9 plugs and 1.7 plugs respectively. I was expected that the 406 plugs would be less affected by wind and would remain on the GRB more easily than the cuttings. This prediction was not supported by the results. There may have been fewer 406 plugs applied to each GRB than cuttings because 406 plugs are larger and each GRB may not have accommodated as many.



Figure 5: Green roof on the Student Success Center at Southern Illinois University Edwardsville. Established using plug plants in Green Roof Blocks™.

## Future Research

Data should continue to be collected on this study in order to evaluate the difference in time required for the treated blocks to reach 100% coverage when compared to untreated blocks. It would also be useful to determine if applying different concentrations of cuttings or 406 plugs would make a difference in the time to establishment. Cost of establishment could be decreased even more if it was known the lowest rate of application to achieve the maximum establishment in the lowest amount of time.

## References

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