

Does combining moss and sedum improve functional performance of green roofs in the Pacific Northwest?

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Overview

- The problem and how green roofs can help
 - Green roof basics & vegetation selection
- Why a moss & sedum combination?
- Hypothesis & experimental design
- Set up & methods
- Results & discussion

The Problem



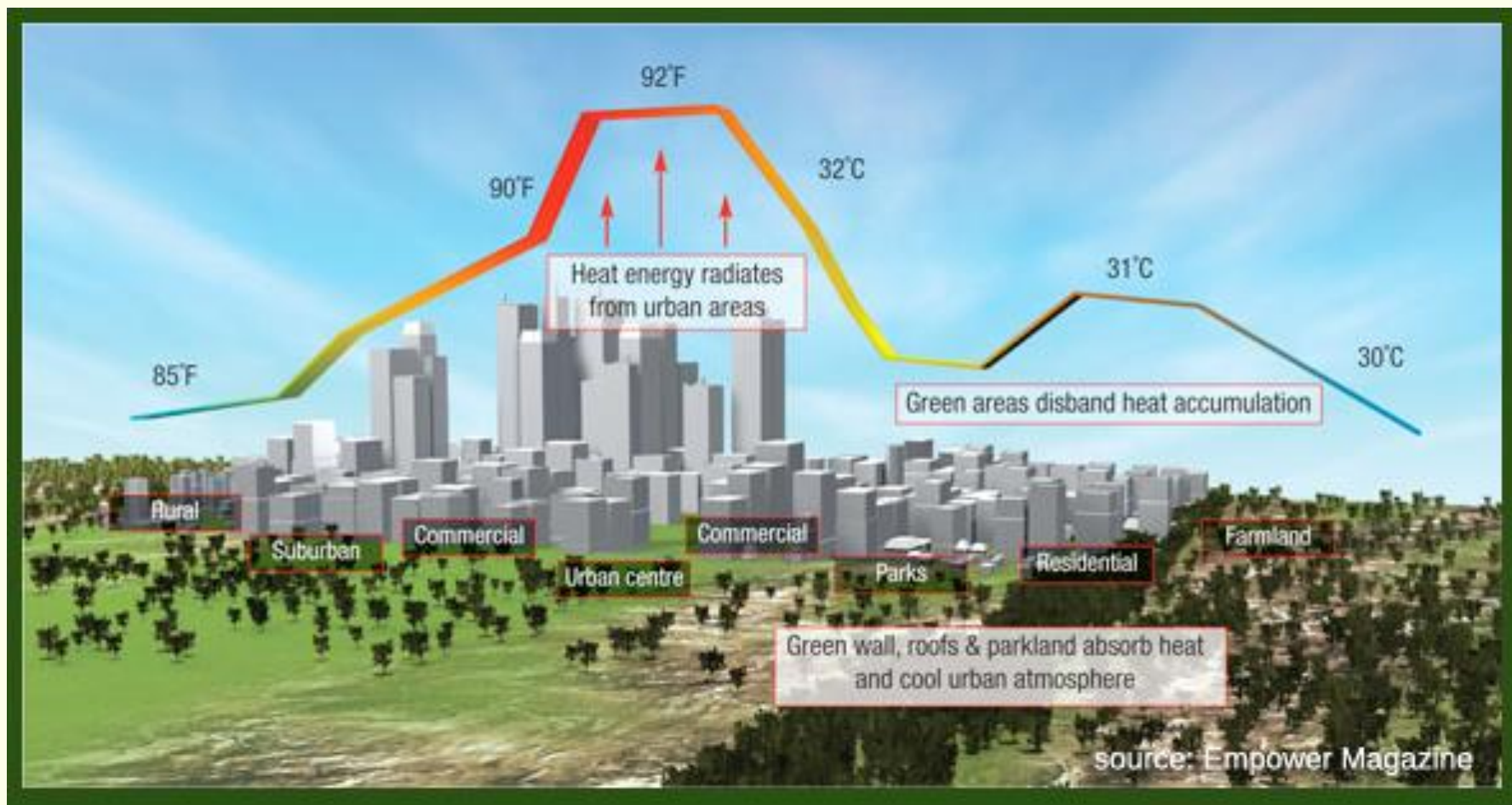
Urban Expansion Leads to:

- Decreased permeable surfaces
- Increased Pollution Concentration
- Urban Heat Island Effect

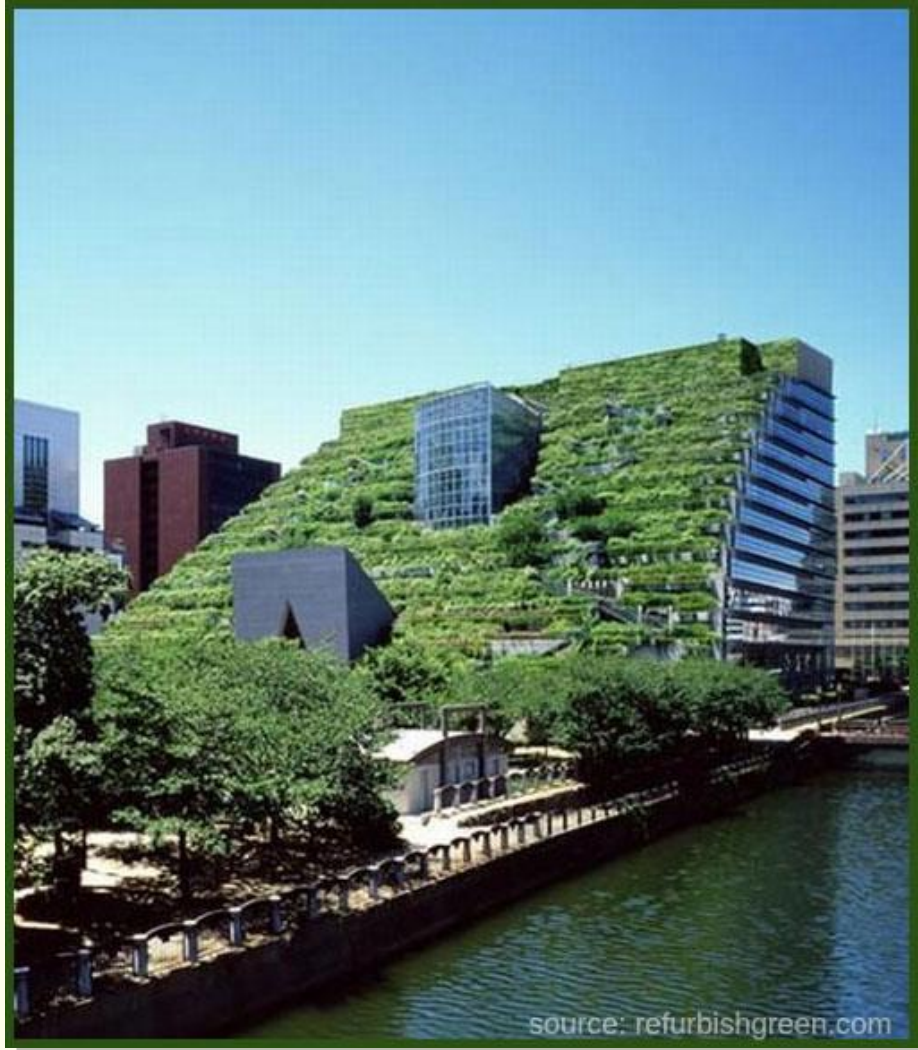
Population growth
leads to urban
expansion



Urban Heat Island Effect



Why Green Roofs?



Greenroof Benefits:

- Mitigation of urban heat island effect
- Help to offset greenhouse gasses and other pollutants
- Stormwater management and filtration abilities
- Decreased building heat flux
- Aesthetic value

Typical Green Roof Construction



Vegetation Selection

Ideal Plants:

Suited for environment

Drought tolerant

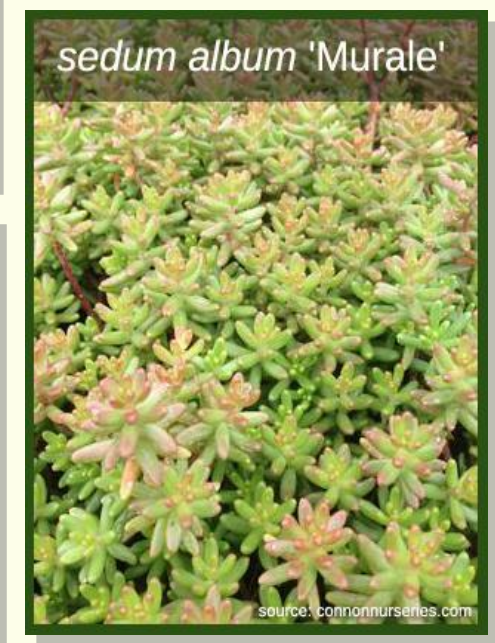
Shallow rooted

Low growing



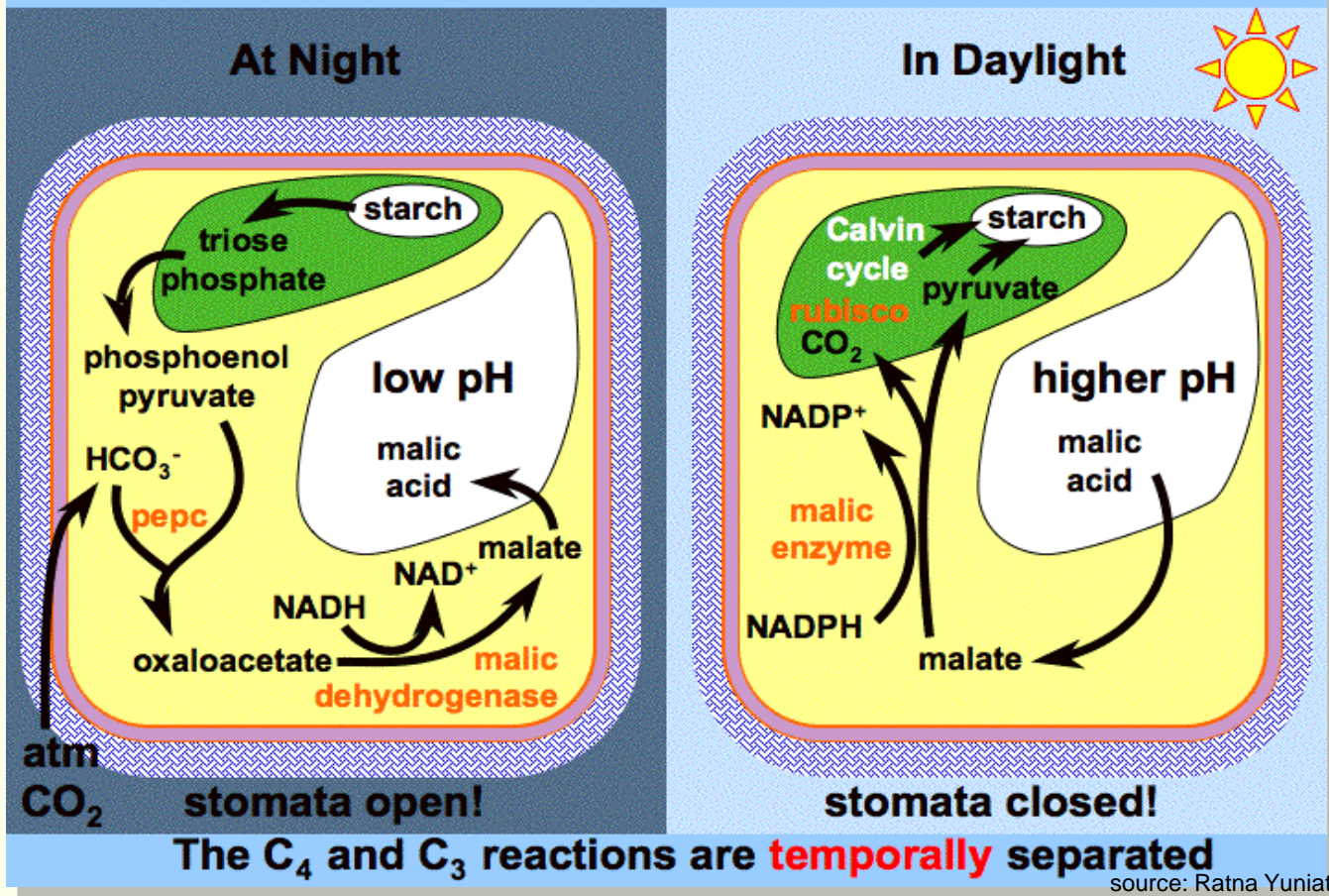
Sedum (Crassulaceae)

- 600 species
- Grow in nearly all environments
- Drought tolerant
- Perform CAM photosynthesis



CAM Photosynthesis

CAM Photosynthesis: Crassulacean Acid Metabolism



Advantages:

- Decreased water loss (drought tolerance)
- Decreased photorespiration

Disadvantages:

- Decreased photosynthetic rates (decreased transpiration)

Moss

- non-vascular plant
- incredible absorbency and water holding capacity
- no control of water loss
- may provide added insulation
- are poikilohydric



Hypothesis

The moss and sedum combination will be more effective vegetation, than either sedum or moss alone, for a green roof in the Pacific Northwest

- Decreased heat flux within medium
- Increased water holding capacity
- Increased/decreased water dissipation abilities

Experimental Design Overview

- Build experimental green roof sections
 - Using 4 treatments (control, moss, sedum, & moss and sedum)
- Subject experimental green roof sections to simulated environments
 - Two simulated environments, winter and summer
- Continual measurement of response
 - Surface and soil temperature, water holding and dissipating ability

Creating Experimental Green Roof Sections

Materials:

17"x 17"x 4" plant trays

Weed barrier

3" well drained media

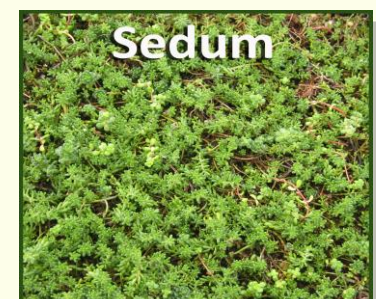
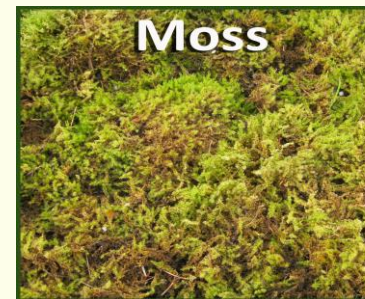
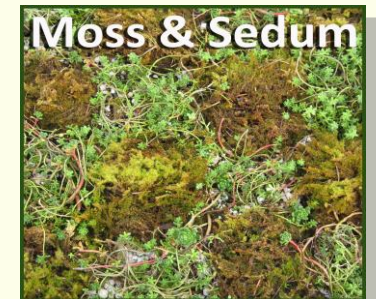
Selected treatment

Media:

1 part soil-less media

1 part Perlite

Treatments:



N=6

Total= 24 (+ 2) trays

Experimental Setup



Establishment & Data Collection

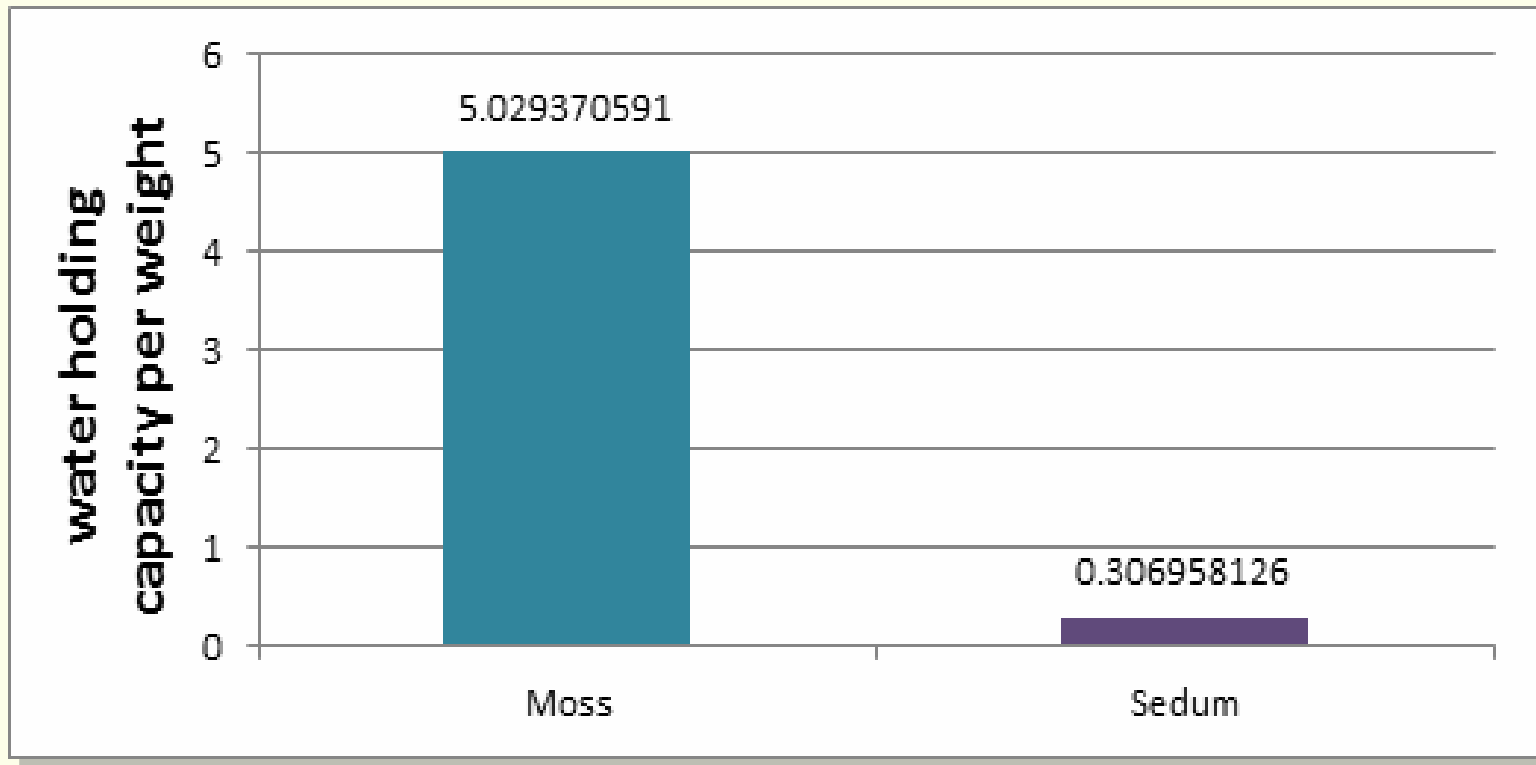
Establishment-

Trays were allowed an establishment and integration period of about 4 months. In 'optimal' growing conditions

Data Collected-

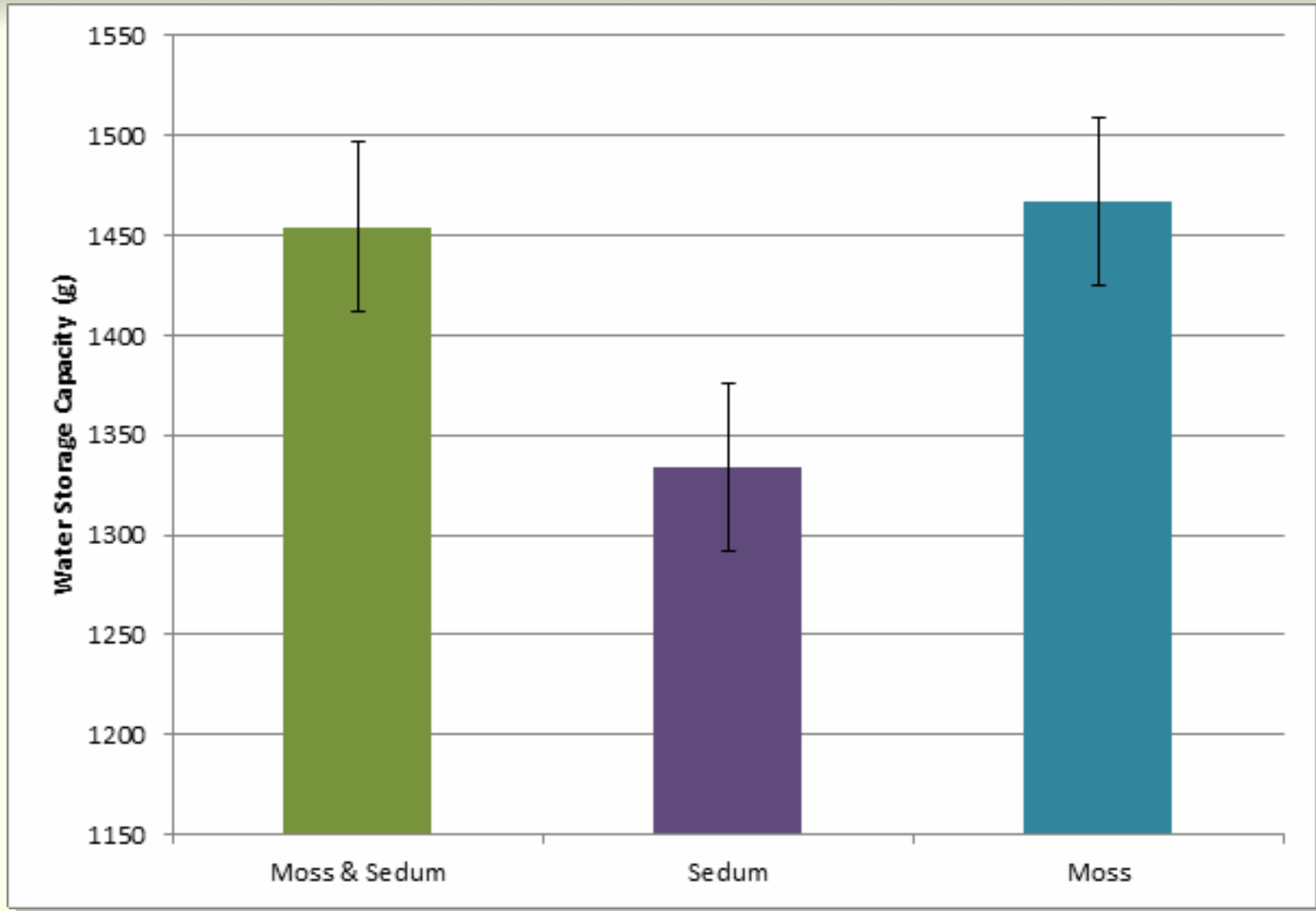
- Absolute water holding capacity
- Water storage capacity
- Percent retention
- Water dissipation and recharge ability
- Temperature flux reduction

Absolute Water Holding Capacity

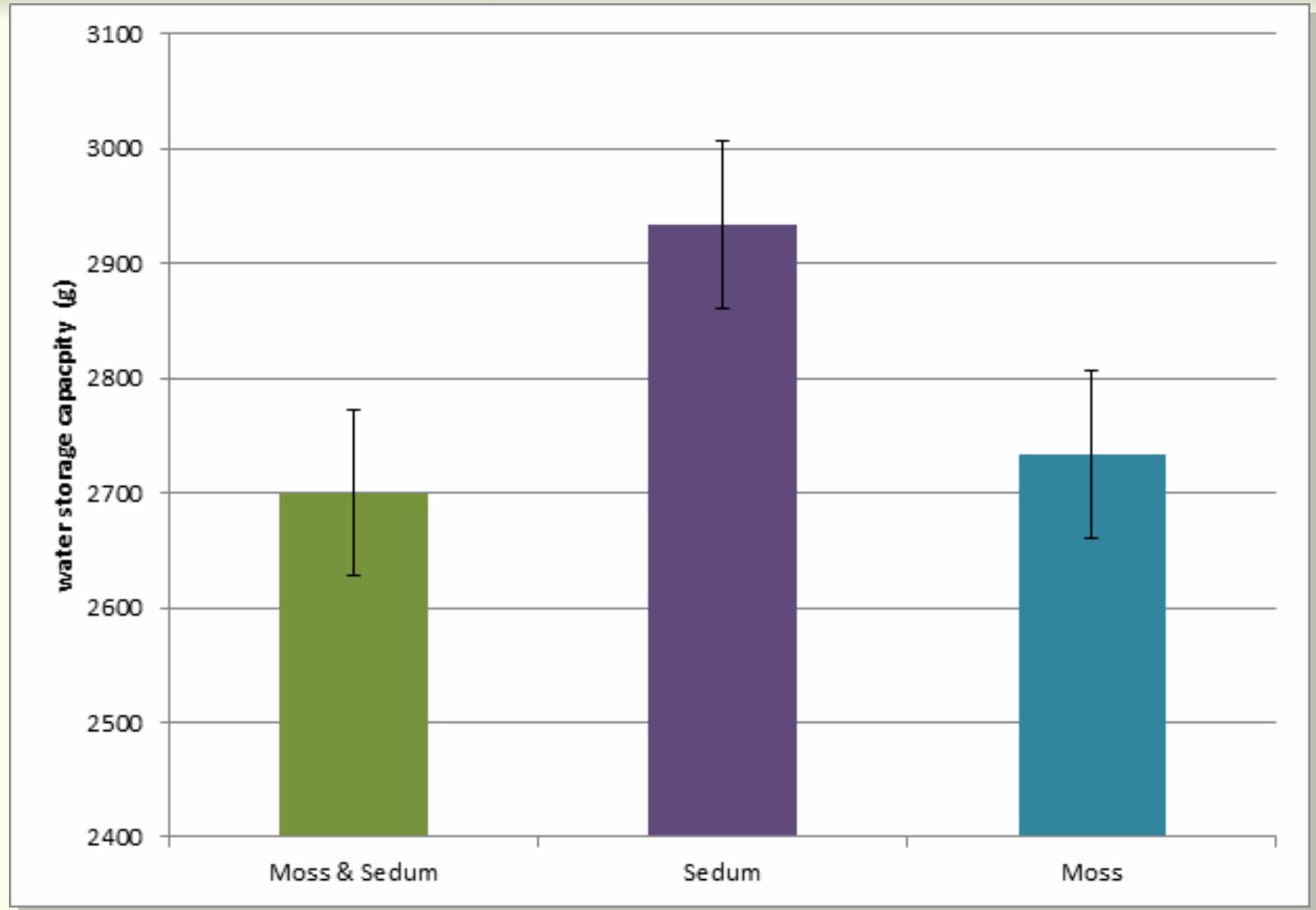


Moss has the ability to hold 16 times the amount of water per weight than sedum

Water Storage Capacity winter conditions

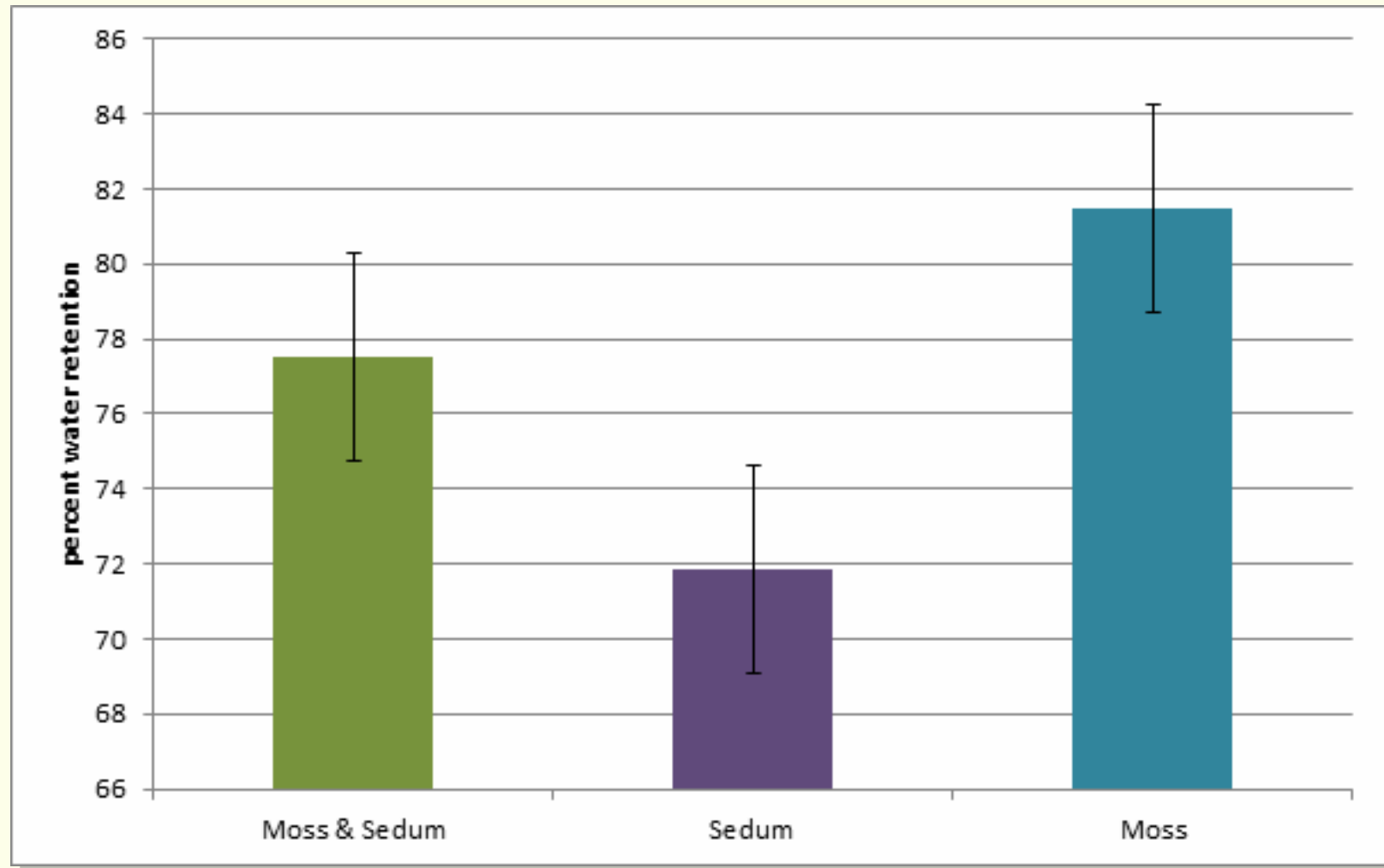


Water Storage Capacity summer conditions



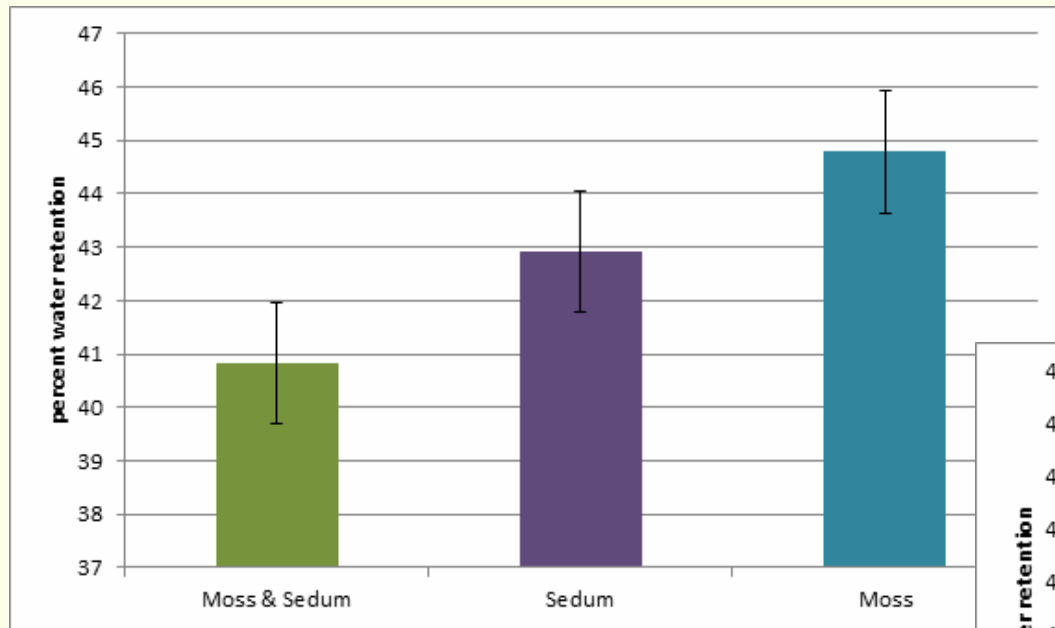
Percent Retention

After 21 day dry period

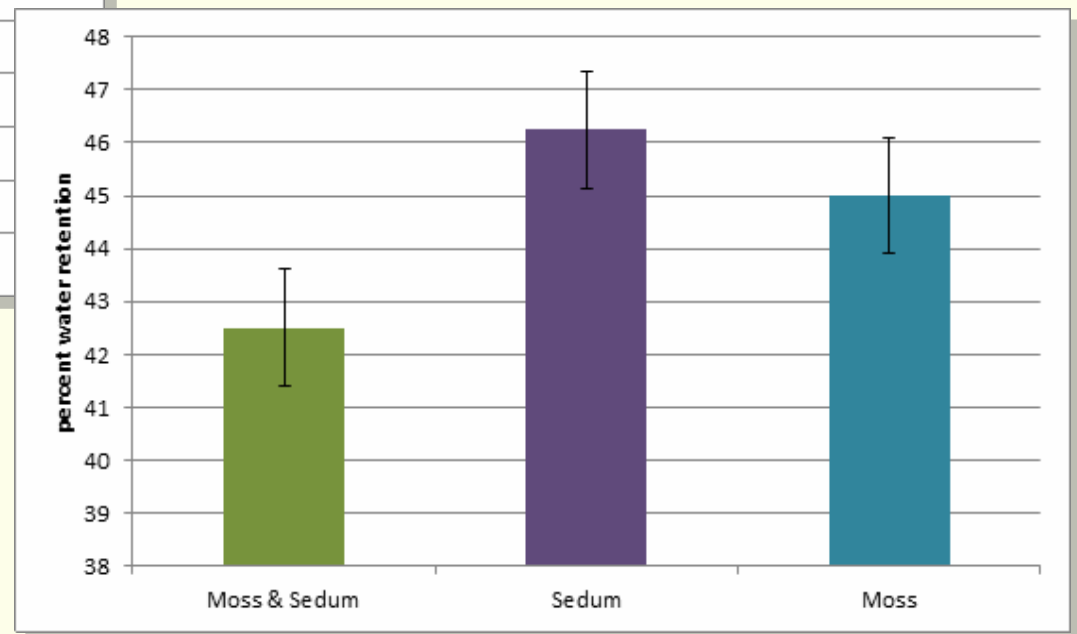


Percent Retention

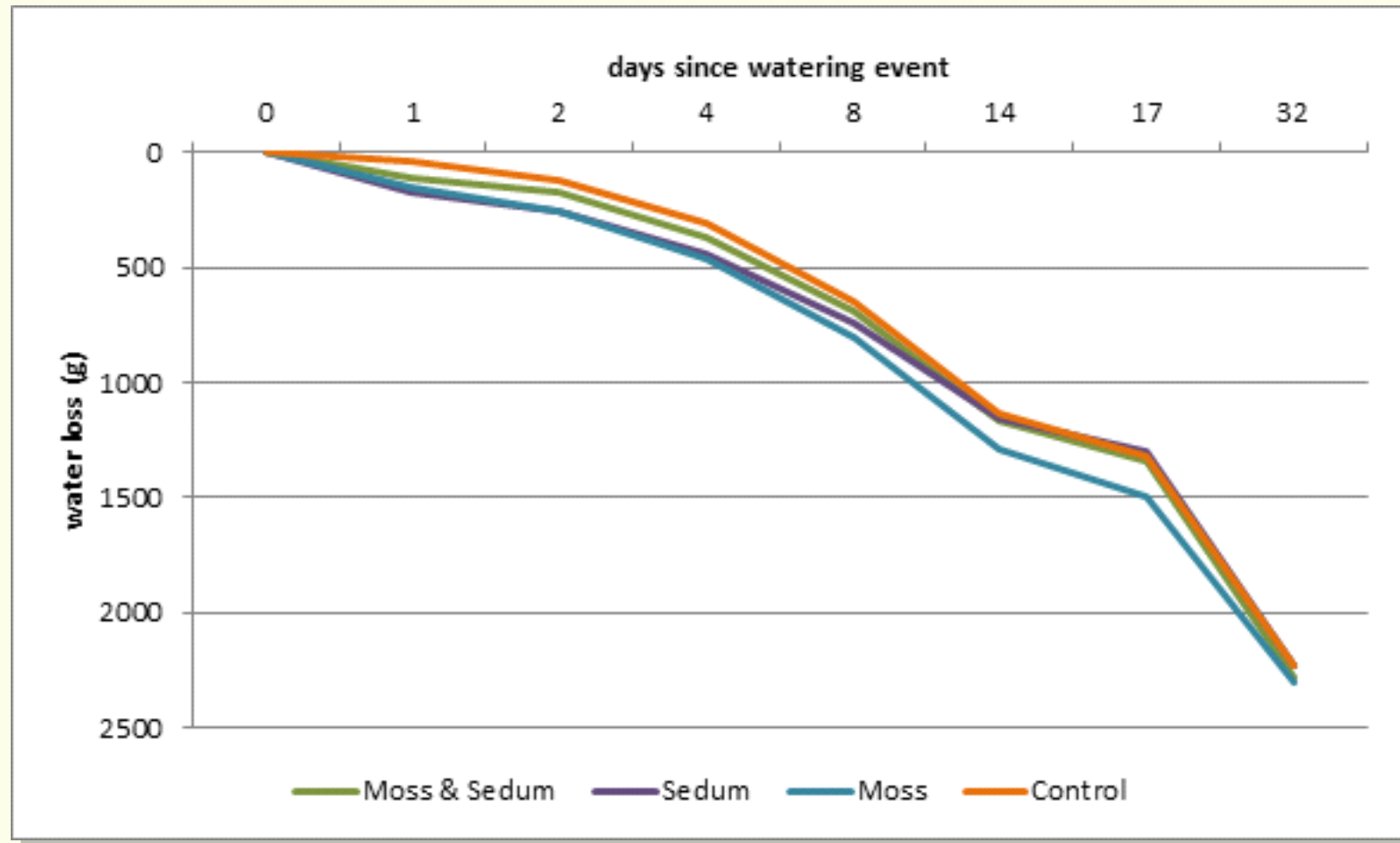
After 4 day dry period



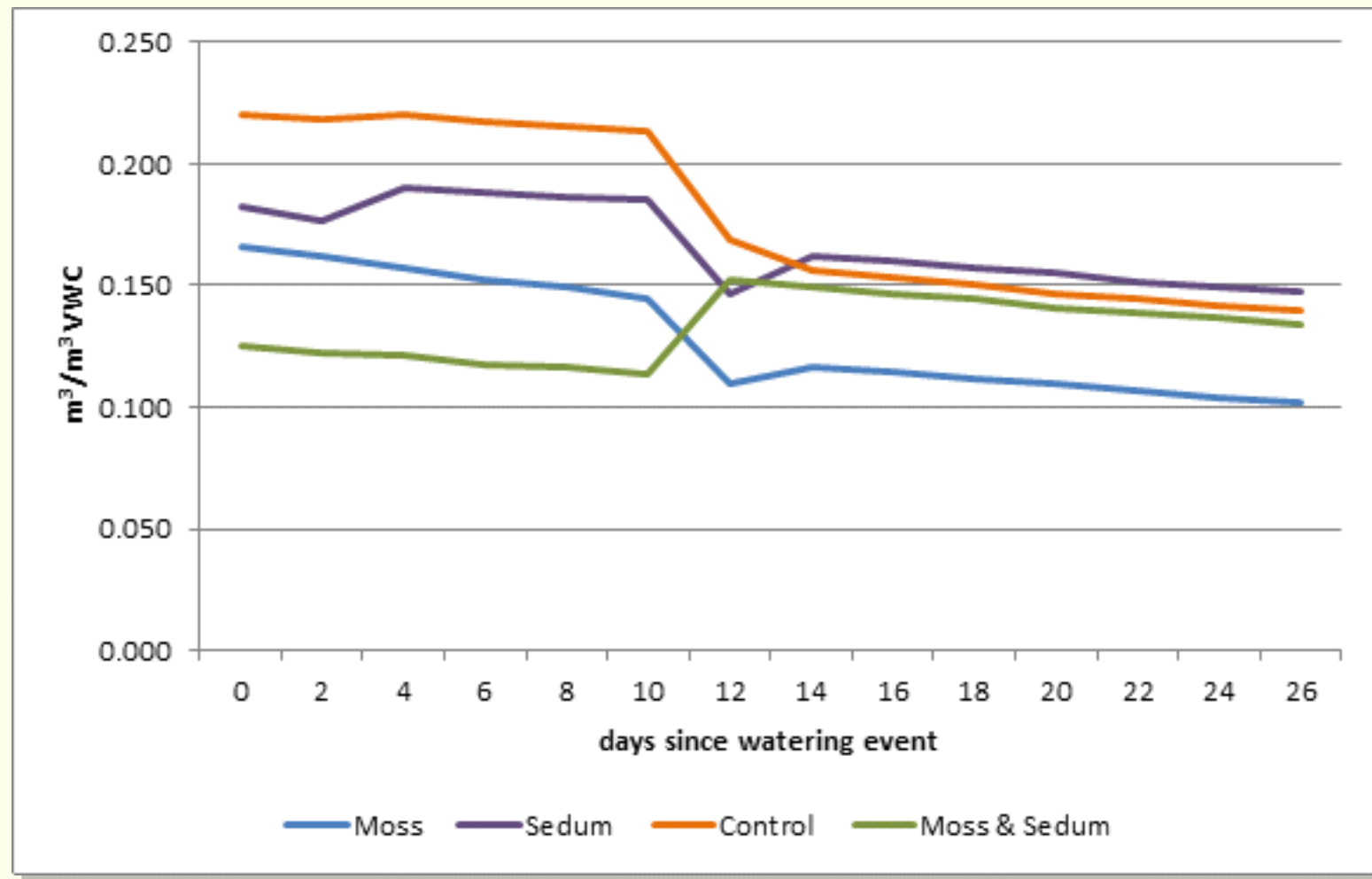
After 9 day dry period



Water Dissipation & Recharge gravimetric data winter conditions

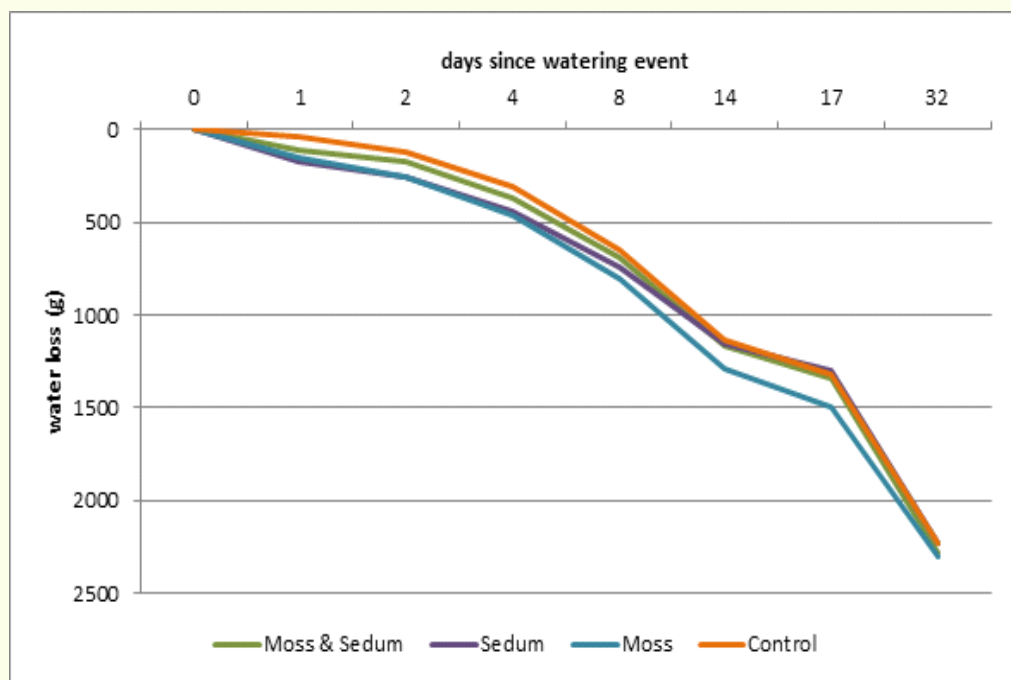


Water Dissipation & Recharge moisture probe data winter conditions

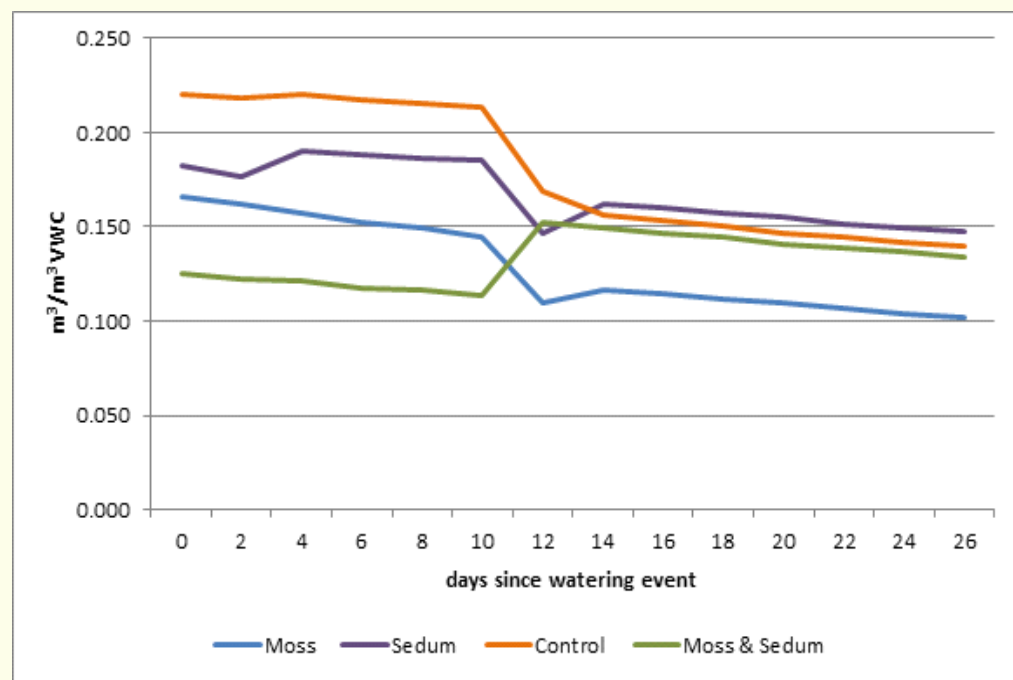


Water Dissipation & Recharge winter conditions

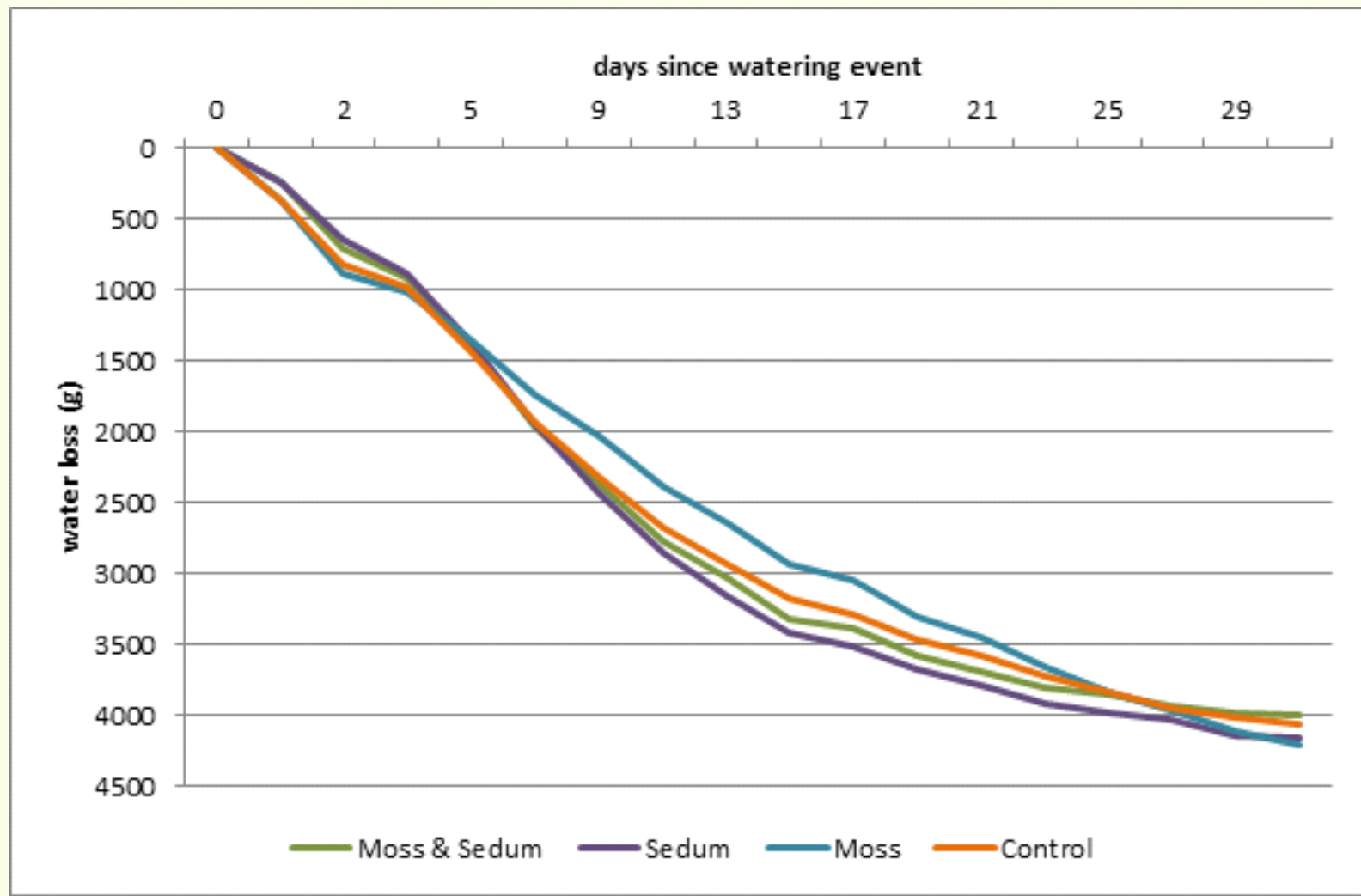
Gravimetric data



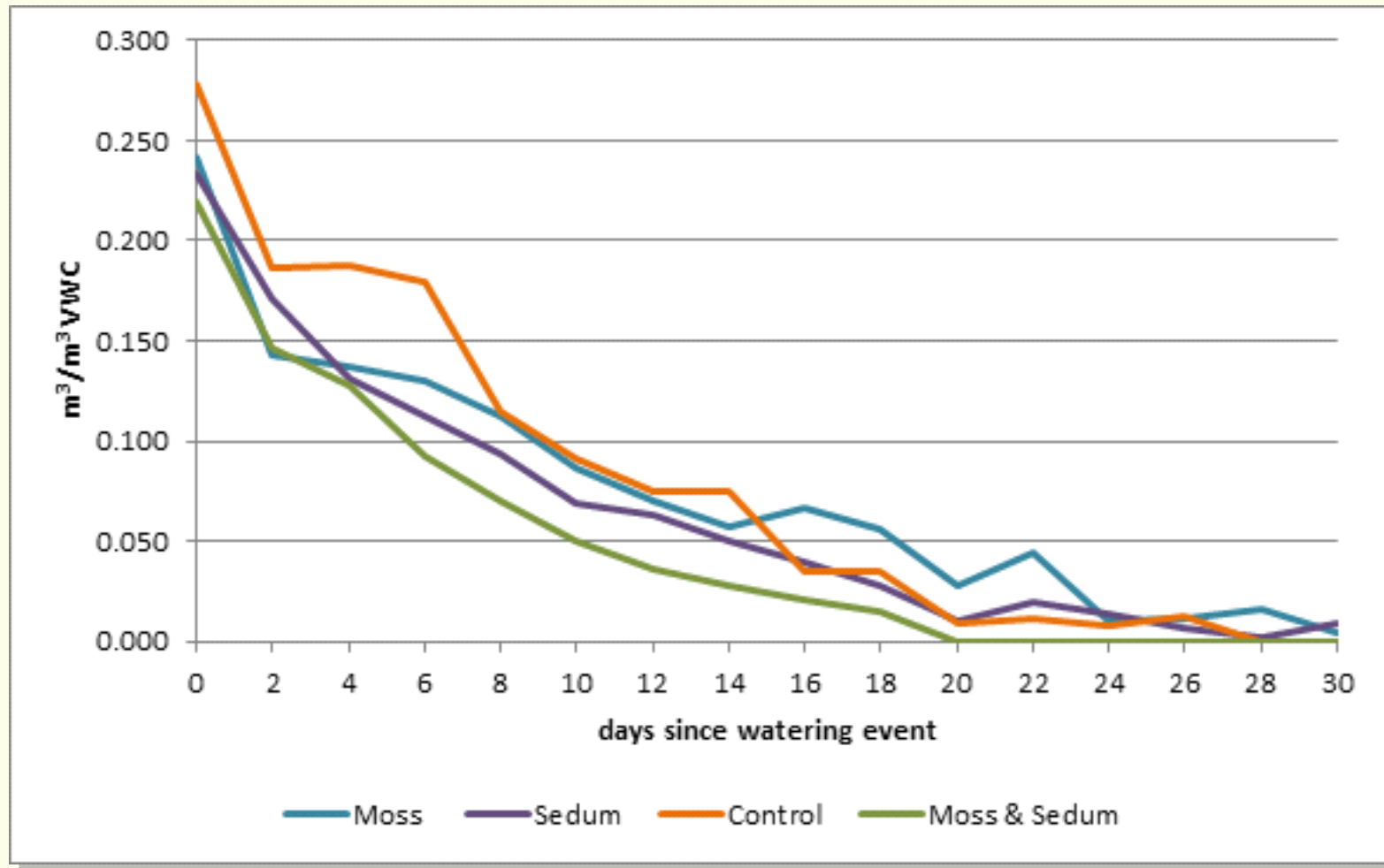
Soil moisture probe data



Water Dissipation & Recharge gravimetric data summer conditions

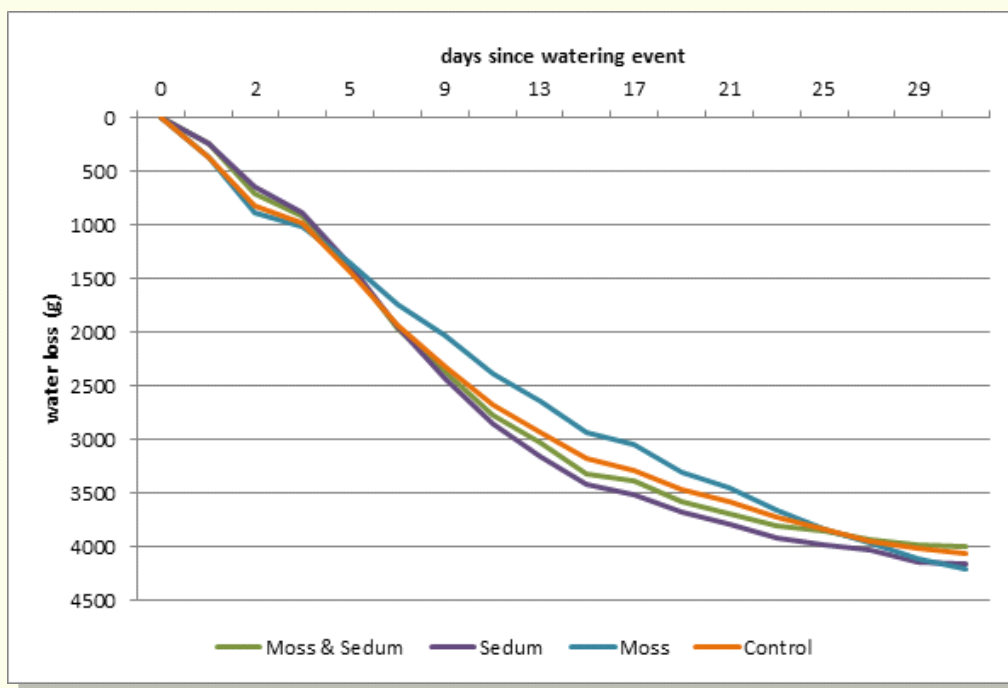


Water Dissipation & Recharge moisture probe data summer conditions

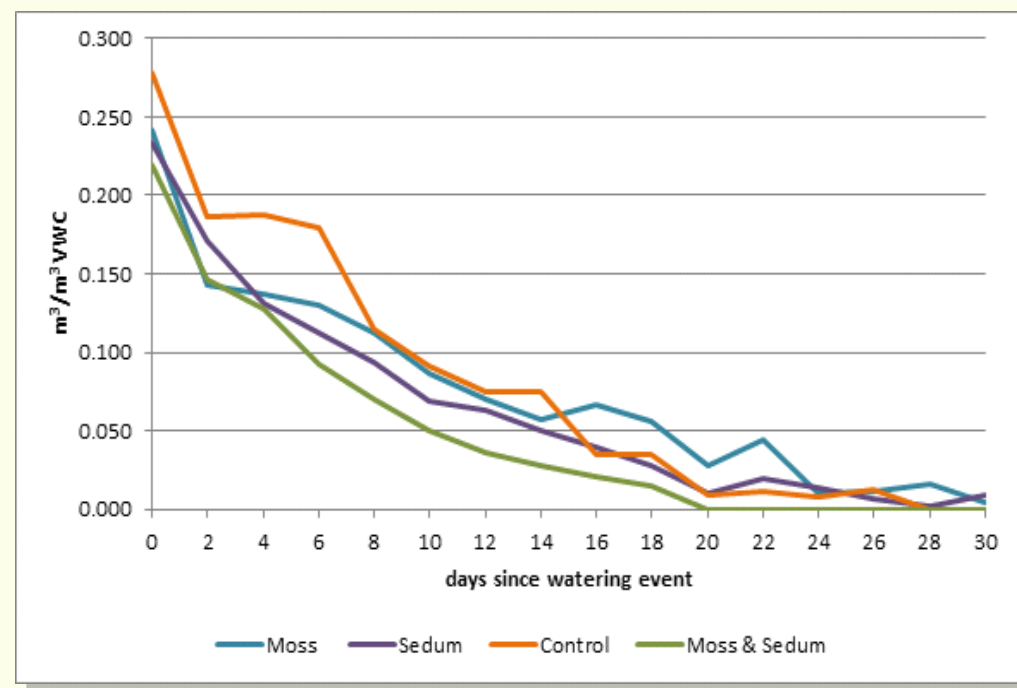


Water Dissipation & Recharge summer conditions

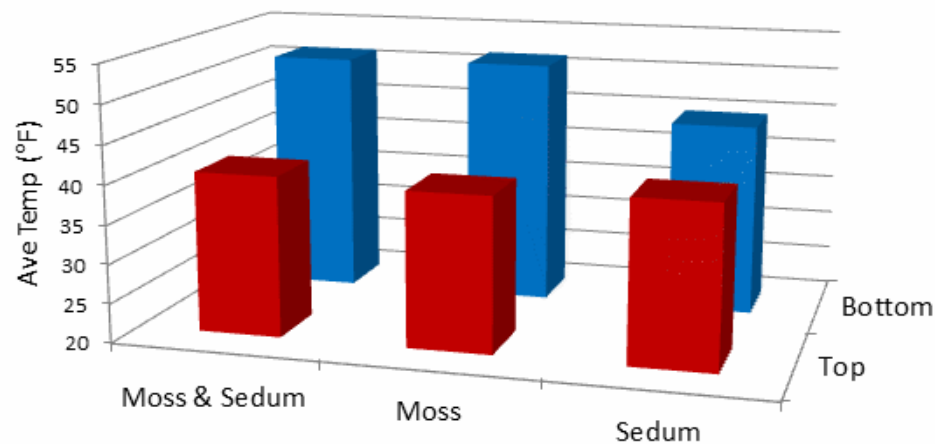
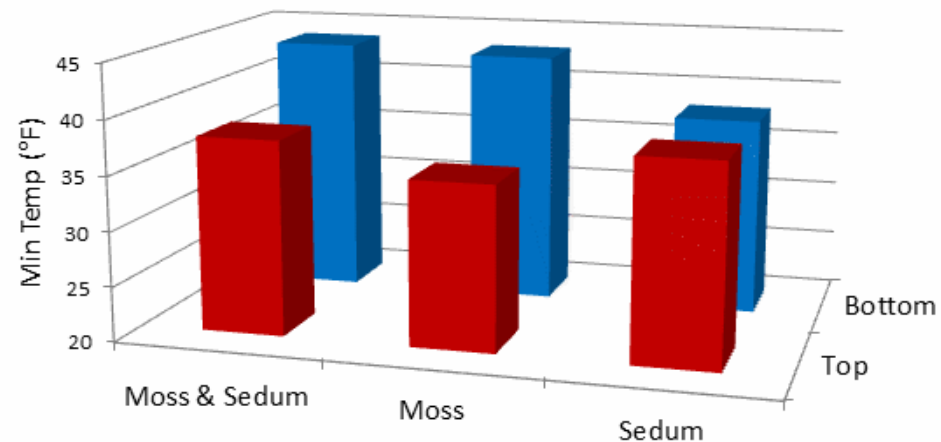
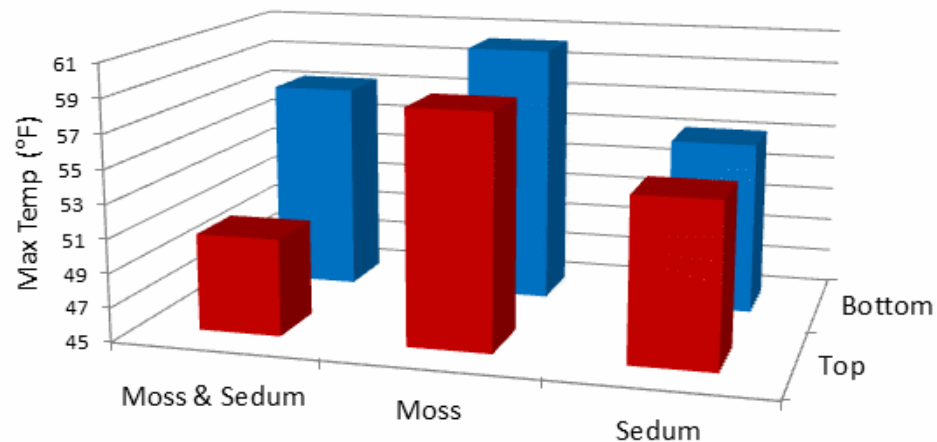
Gravimetric data



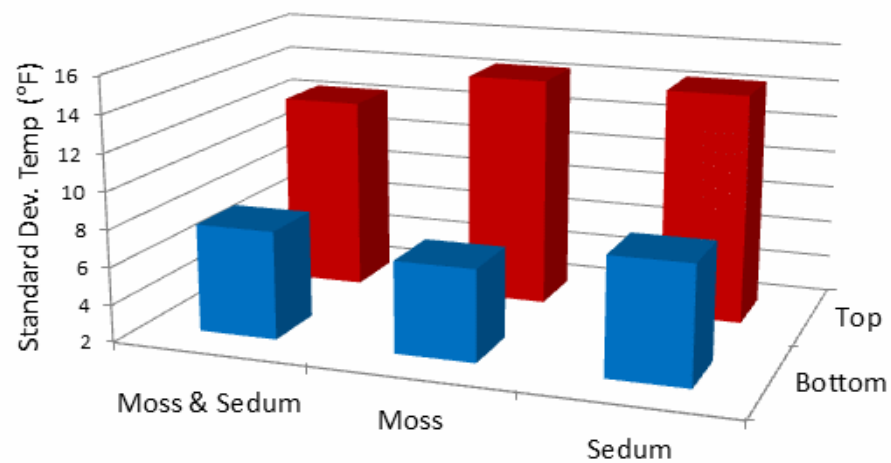
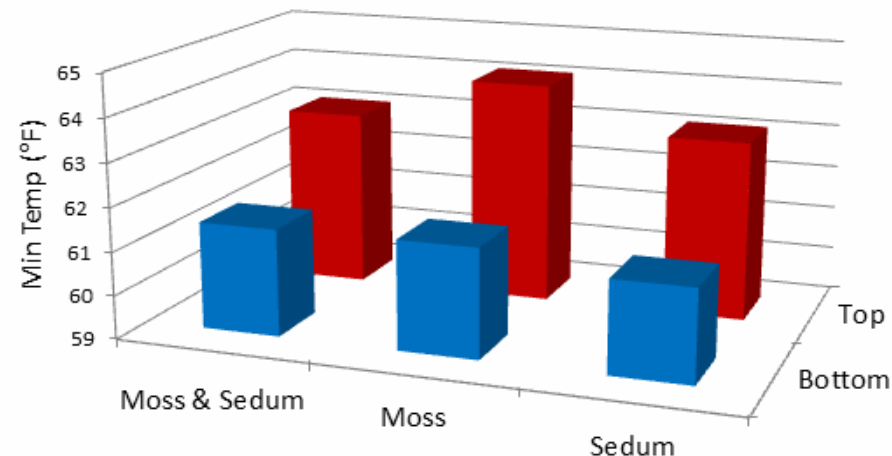
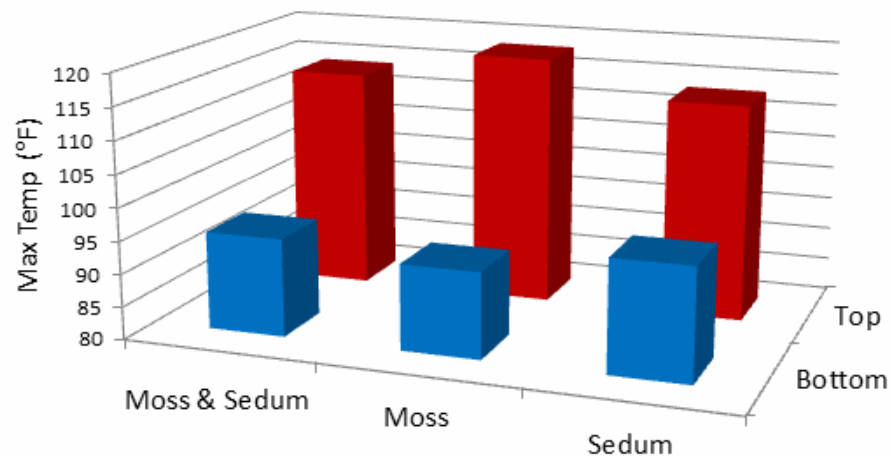
Soil moisture probe data



Temperature Flux Reduction winter conditions



Temperature Flux Reduction summer conditions



Summary

Water Holding Capacity

- Moss has a much greater ability to hold water than sedum

Water Storage Capacity

- winter - the moss improved water storage capacity
- Summer - the sedum improved water storage capacity

Percent Retention (winter conditions)

- Long dry periods - the combination had the highest percent retention
- Intermediate dry periods - sedum only had the highest percent retention
- Short dry periods - the moss only had the highest percent retention

Water Dissipation and Recharge

- Winter - the moss treatment dissipated water at the fastest rate
- Summer - the moss treatment dissipated water the slowest rate

Temperature Flux Reduction

- Winter - the combination constantly kept the temperature within the medium higher than that within the sedum
- Summer - all treatments reduced heat flux and the combination and moss only did so slightly better than the sedum only.

Conclusions

Conclusion

This study found some evidence that suggests a combination of moss and sedum may provide improved functional performance compared to sedum or moss alone as green roof vegetation in the Pacific Northwest

Future Research

A full scale study is needed to provide more data on realized benefits and long term compatibility

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