

Investigating Soil-Plant-Water Relations

Preliminary Findings & Maintenance Challenges



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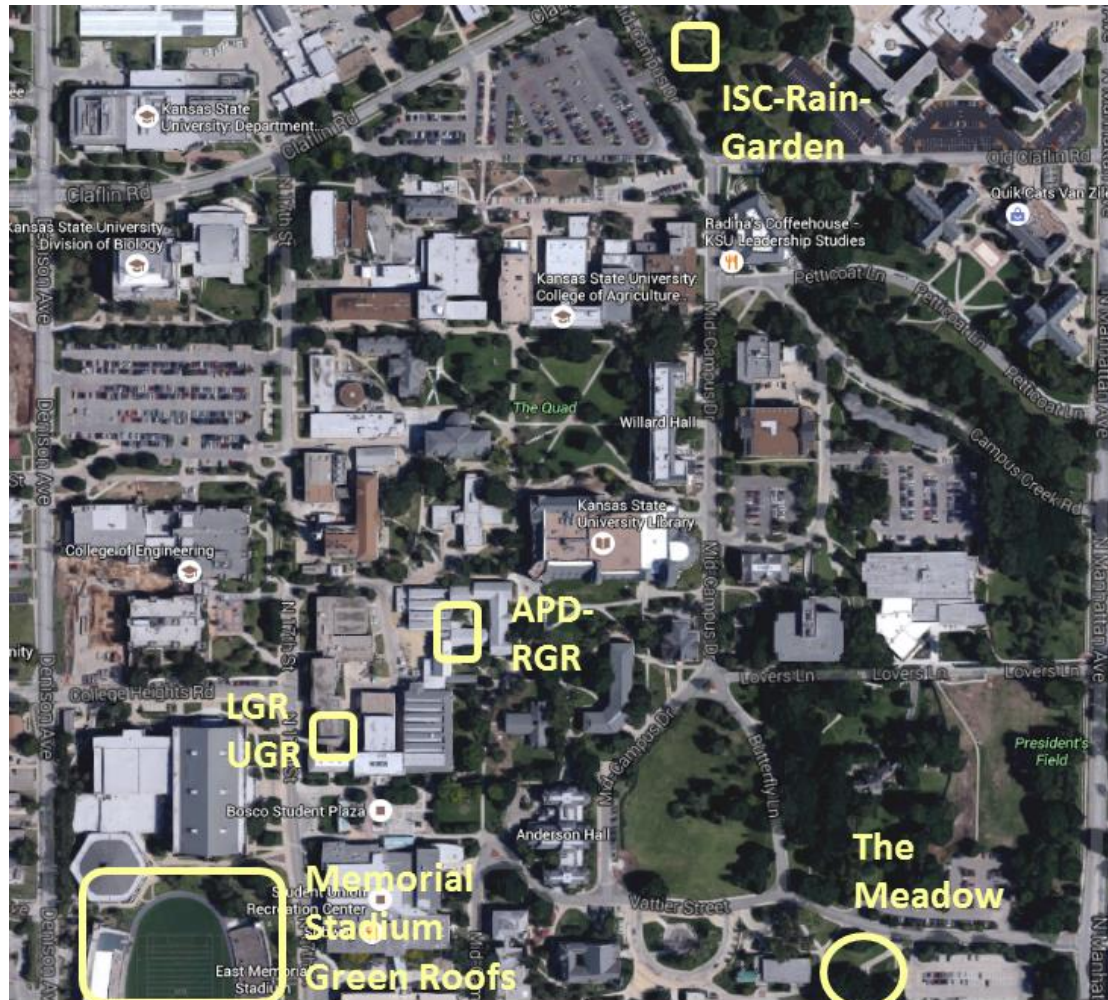
Background Information



Photo by Allyssa Decker, Spring 2016

Southern Illinois University Edwardsville

Green Roof & Green Infrastructure at K-State



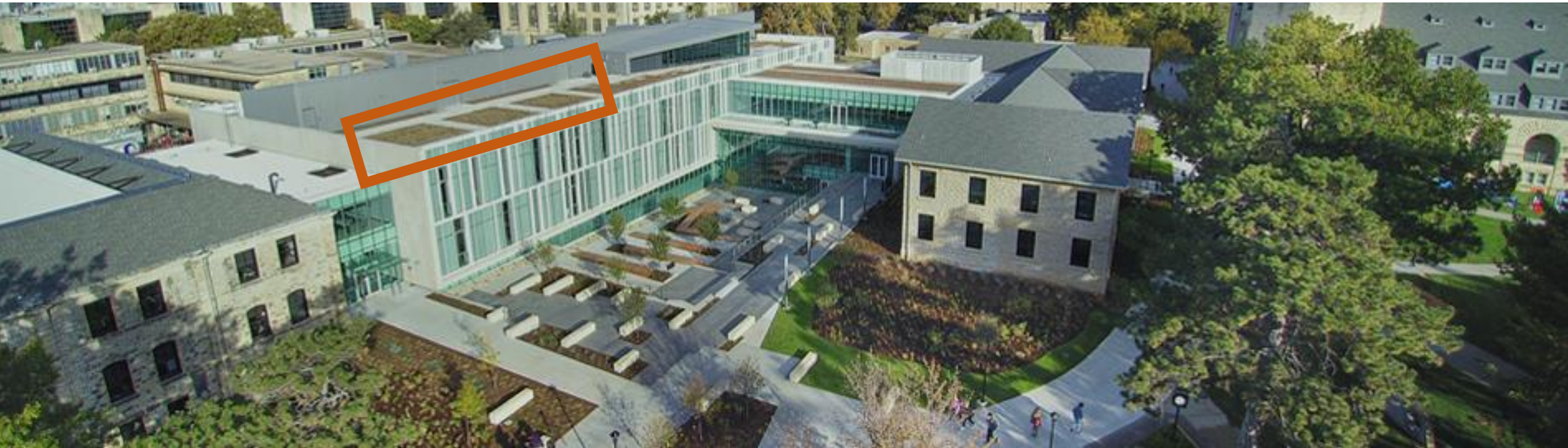
Purposes of KSU Rain Gardens and The Meadow:

- Education
- Stormwater management
- Provision of native vegetation
- Habitat for insects, birds, and small mammals

Green Roof Monitoring:

- Soil/Substrate Moisture Dynamics
- Vegetation & Biomass Coverage
- Plant Species Diversity
- Pollinator & Bird Use
- Irrigation Amounts & Practices
- Maintenance (Fertilizing and Weeding Procedures & Timing)

College of Architecture, Planning & Design

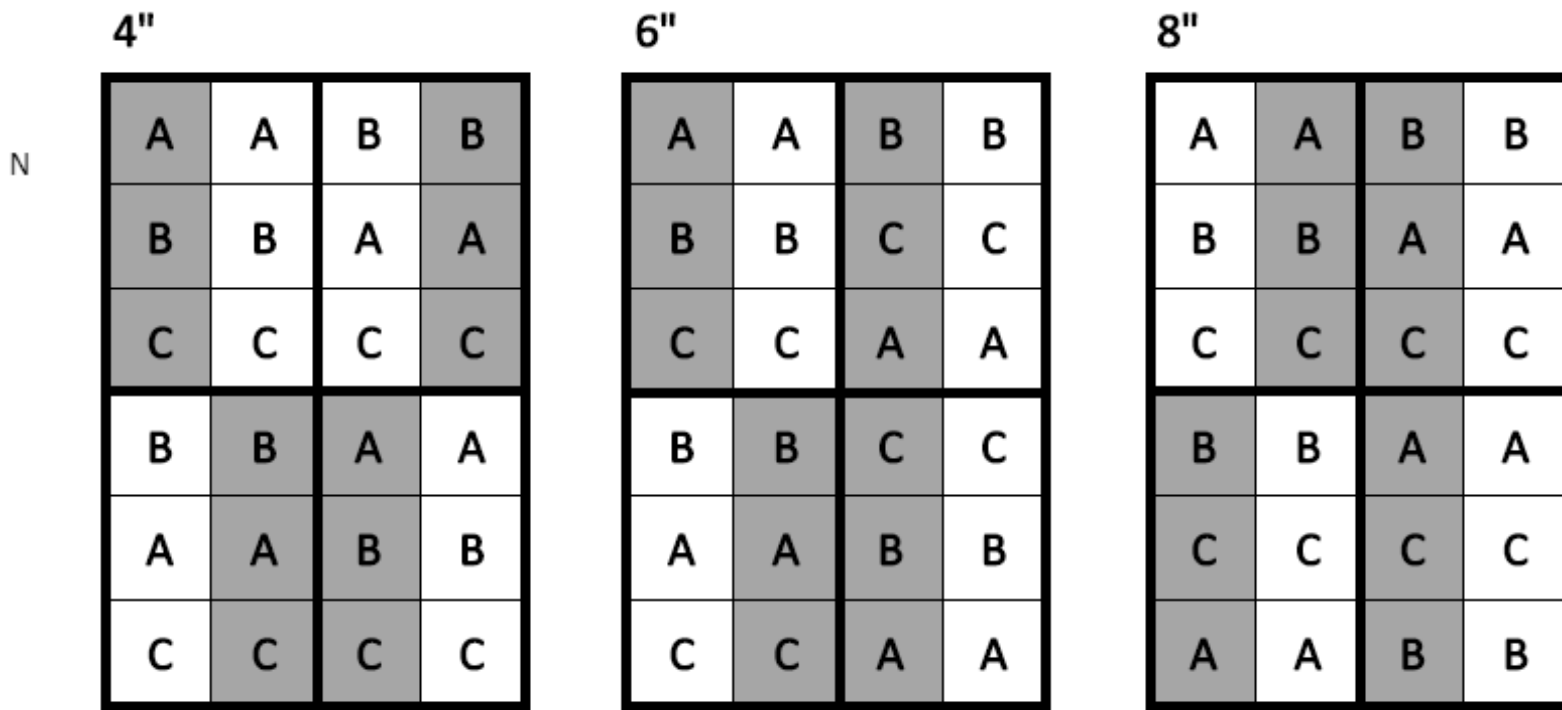




APD Experimental Green Roof

Photo: Allyssa Decker

APD-EGR Experimental Layout



Shaded cells consist of Kansas BuildEx substrate. Non-shaded cells consist of Rooflite Extensive MC substrate.

A, B, and C represent the plant mixes: all *Sedum* (A); *Sedum* & native grasses (B); and grasses and forbs (C).

BuildEx vs Rooflite Substrate Tests

Size (mm)	BuildEx	Rooflite
Clay <0.002	2.9	1.3
Silt 0.002 - 0.063	4.5	5.8
Sand 0.063 - 2.0	67.6	52.4
Gravel > 2.0	25	40.5

Substrate Properties

Property	BuildEx	Rooflite
Bulk Density (g/cm ³)	1.46	0.97
Pore Space (%)	42	58
Organic Matter (%)	1.9	2.2
Water Permeability (mm/hr)	0.2	30.9

APD-EGR Plant Layout

Mix A: All Sedums	Mix B: Sedum and native grasses	Mix C: Native grasses and forbs
<i>Sedum album</i> var. <i>murale</i>	<i>Bouteloua curtipendula</i>	<i>Carex brevior</i>
<i>Sedum ellacombeanum</i>	<i>Bouteloua dactyloides</i>	<i>Dalea purpurea</i>
<i>Sedum hybridum</i>	<i>Bouteloua gracilis</i>	<i>Koeleria pyramidata</i>
<i>Sedum kamtschaticum</i> var. <i>floriferum</i>	<i>Schizachyrium scoparium</i>	<i>Packera obovata</i>
<i>Sedum sexangulare</i>	<i>Sedum reflexum</i>	<i>Schizachyrium scoparium</i>
<i>Sedum spurium</i>	<i>Sedum represtre</i>	<i>Sporobolus heterolepis</i>

1		6		5		4
	4		3		2	
2		1		6		5
	5		4		3	
3		2		1		6

Systematic Plant Layout each APD-EGR cell



Photo: Lee R. Skabelund



Photo: Allyssa Decker

Goals & Purposes

Broad Goal: Improve the design, implementation, and management of green roofs in the Flint Hills Ecoregion.

Main Purpose: To monitor the survival & growth of three different plant mixes in two different soil types.



Primary Research Question

How do soil moisture, **substrate type**, and micrometeorological conditions affect **coverage** and species survival of different green roof plant mixes in different depths?



Focused Research Question & Hypothesis

Question

How does the performance of the three plant mixes (A: all Sedums, B: Sedums and native grasses, and C: native grasses and forbs) on the APDesign Research Green Roof differ in each substrate in terms of vegetative coverage?

Hypotheses

Coverage will be greater for the Sedum mix due to Sedum species adaptations to survive extreme stress.

Vegetative Coverage Methods



Take overhead photos every two weeks

Measure coverage in ImageJ (Butler, 2009)

Analyze coverage values in SAS

Photo by Lee R. Skabelund

Overhead Coverage Photos



MIX A – all *Sedum*

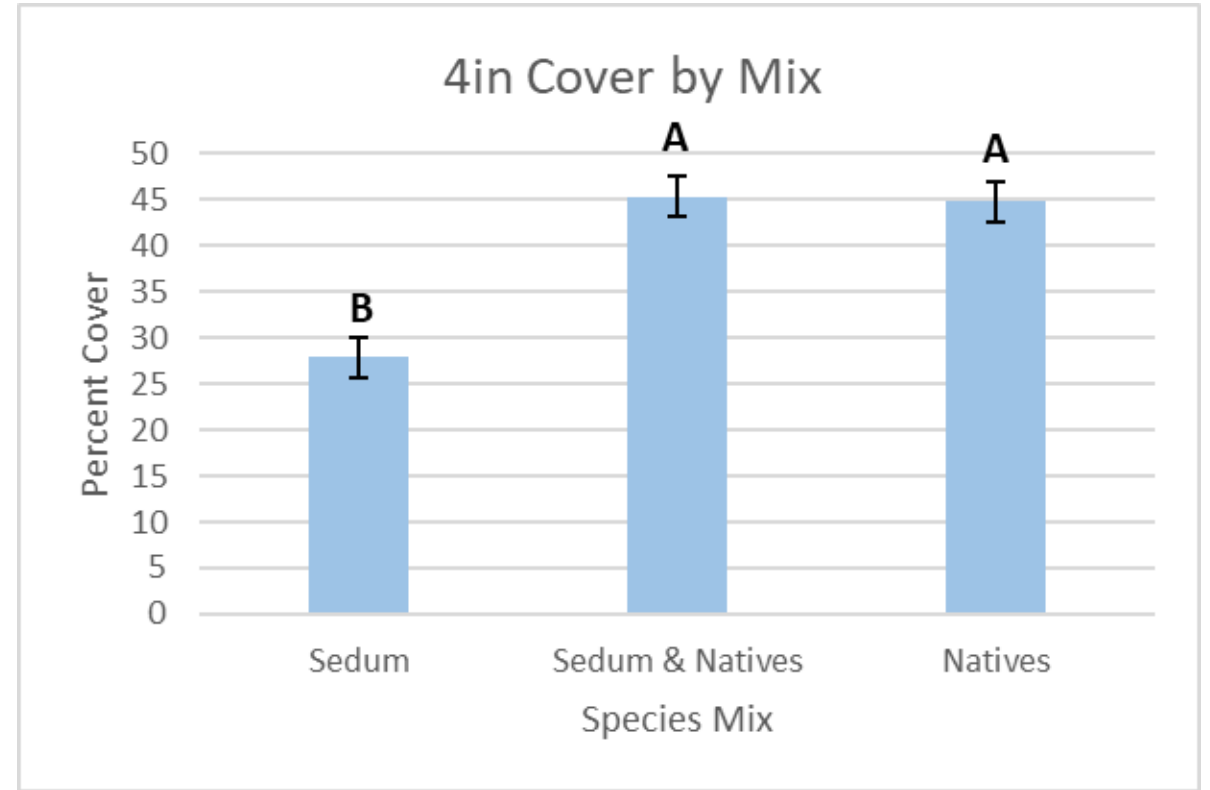
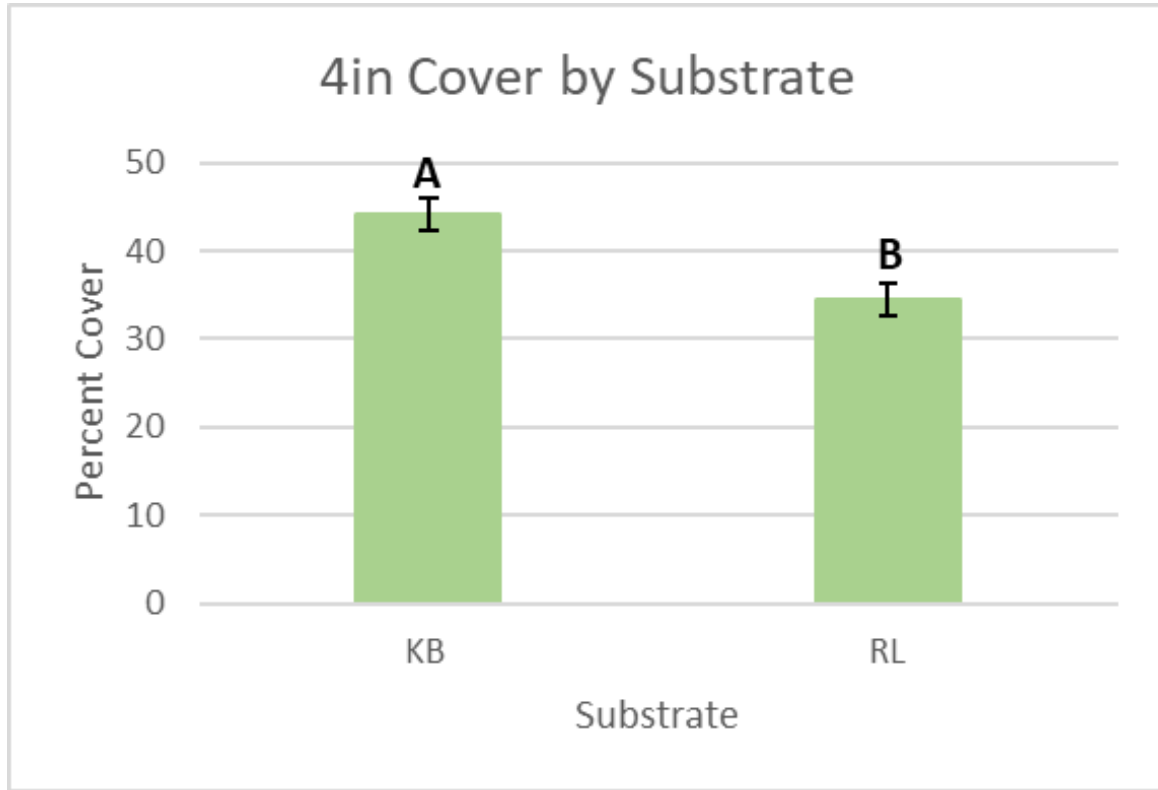


Mix B – *Sedum* &
native grasses

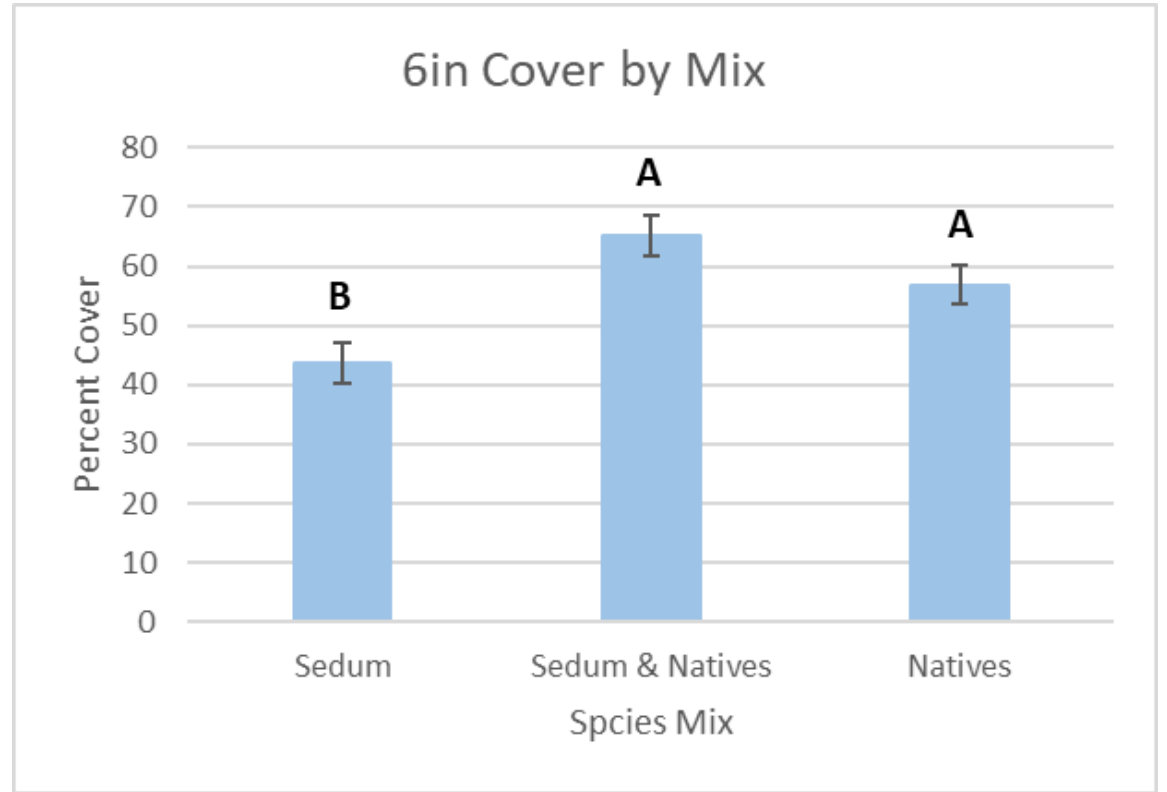


Mix C – all natives

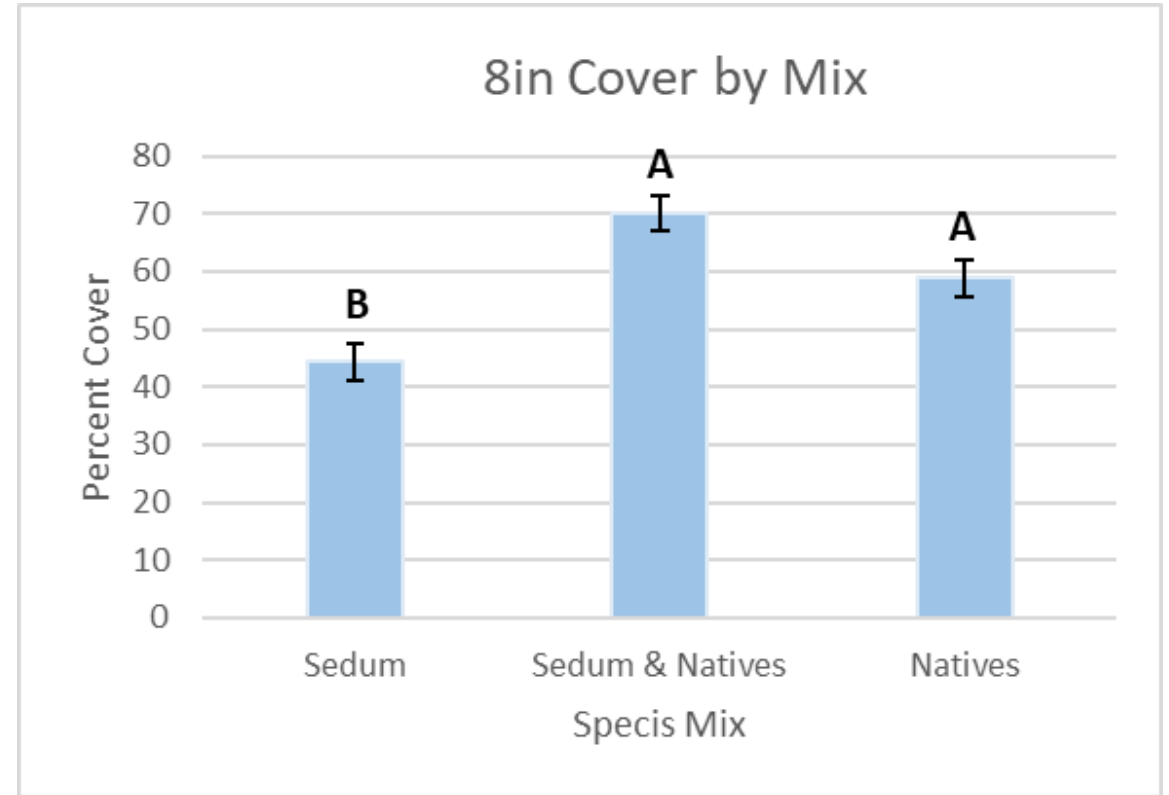
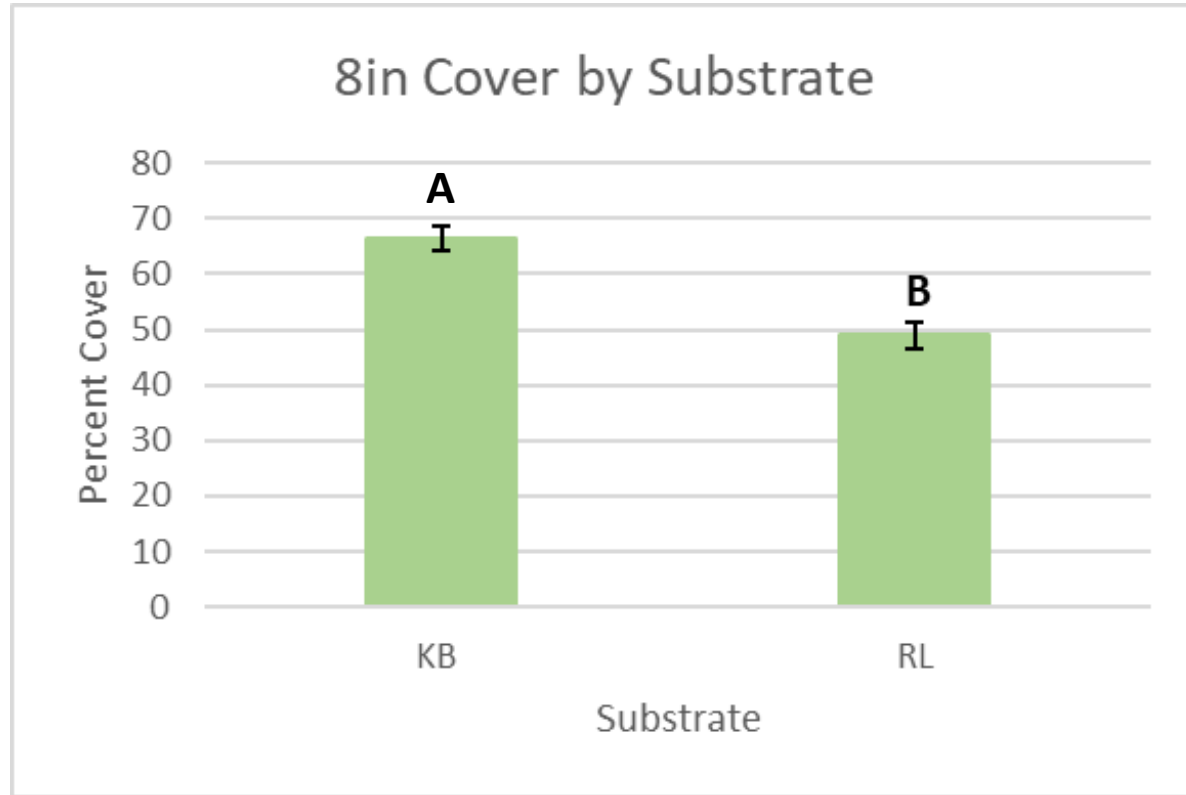
4 Inch Vegetative Coverage Results



6 Inch Vegetative Coverage Results



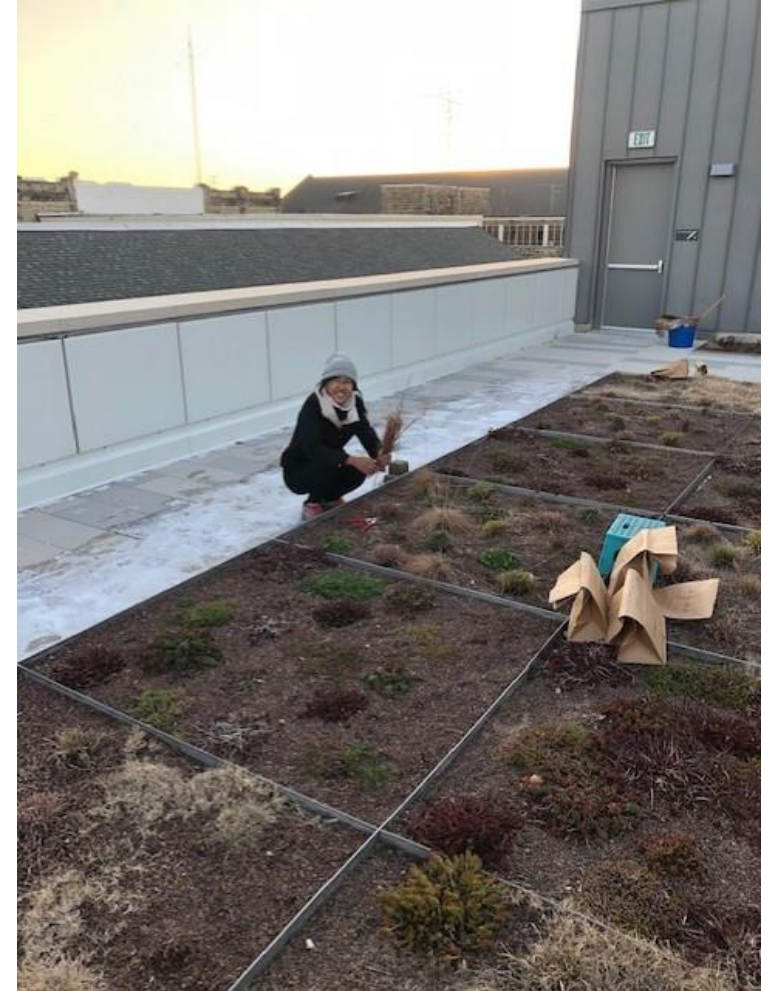
8 Inch Vegetative Coverage Results



Vegetative Coverage Summary

- Substrates yield different coverage, regardless of mix
 - Kansas BuildEx yields greater coverage than Rooflite Extensive MC substrate
- For all depths: mixes yield different coverage, regardless of substrate
 - Mixes B and C have greater coverage than A

Biomass Clipping



Maintenance Challenges

Irrigation – approx. 1 in a week

- What about rain?

Weeding – weed before taking cover photos

- Issues with identifying grass seedlings
- Human Error

Maintenance Challenges – Irrigation

- Inch a week protocol
- Can be time consuming
- Differences in 2018 & 2019



Maintenance Challenges – Irrigation



Weather Station

- Rain Gauge
- VP4 temp/RH/barometric pressure
- Anemometer
- Solar Radiation



Soil Moisture Sensors



Maintenance Challenges – Weeding

- Need to weed before taking cover photos
- A lot of weeds
- Protocol
 - Weed all small grasses
- Human error when weeding



Maintenance Challenges – Weeding



Maintenance Challenges – Weeding



Sedum & Native Grasses - KB



Sedum & Native Grasses - RL

Conclusions

- Starting to see some prominent differences between the plots
- Finding the best protocol is difficult
- Understanding the differences between the substrates is more complex than I thought



THANK YOU



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