Physical Evaluation of Wheat Straw Decomposition under Different Fertilizer Treatments and Rates

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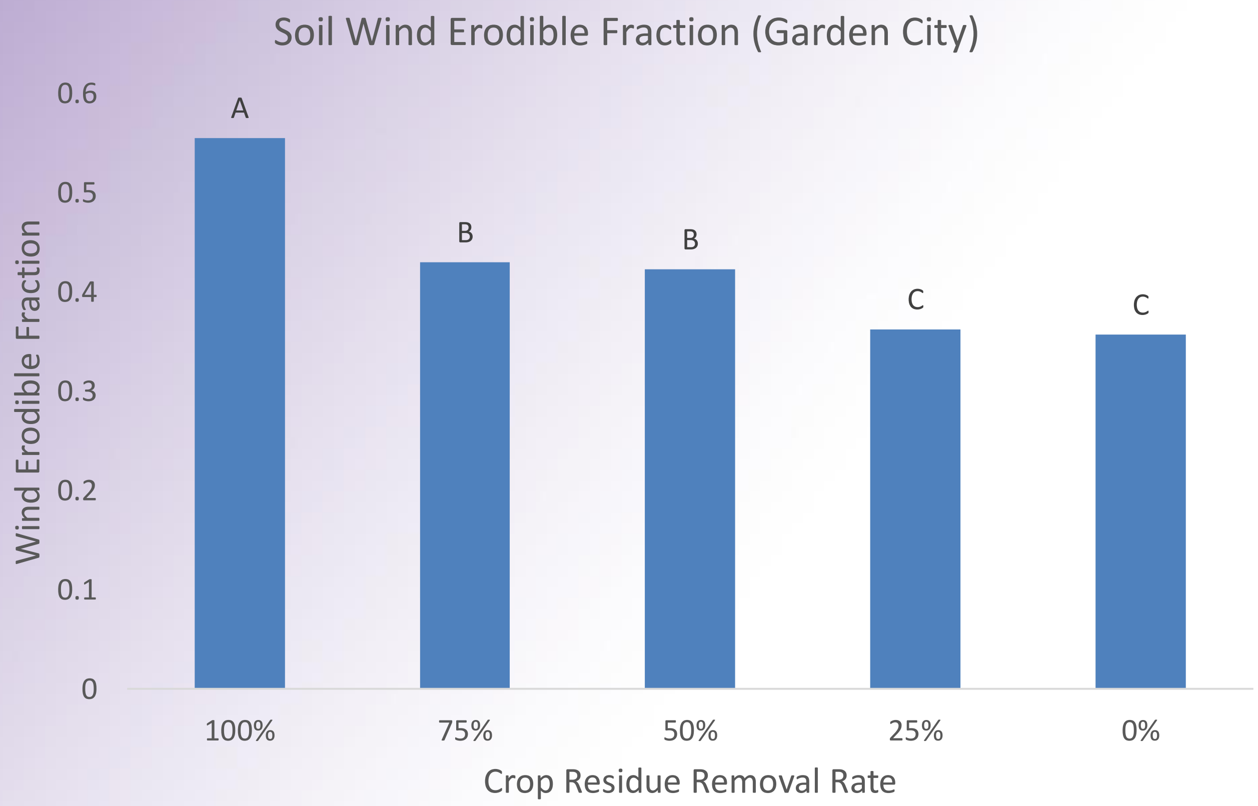
Outline

- Justification
- Objectives
- Method Development
- Results
- Conclusions

Justification

- Importance of crop residue to soil, particularly in semi-arid area.



Data: Yuxin He

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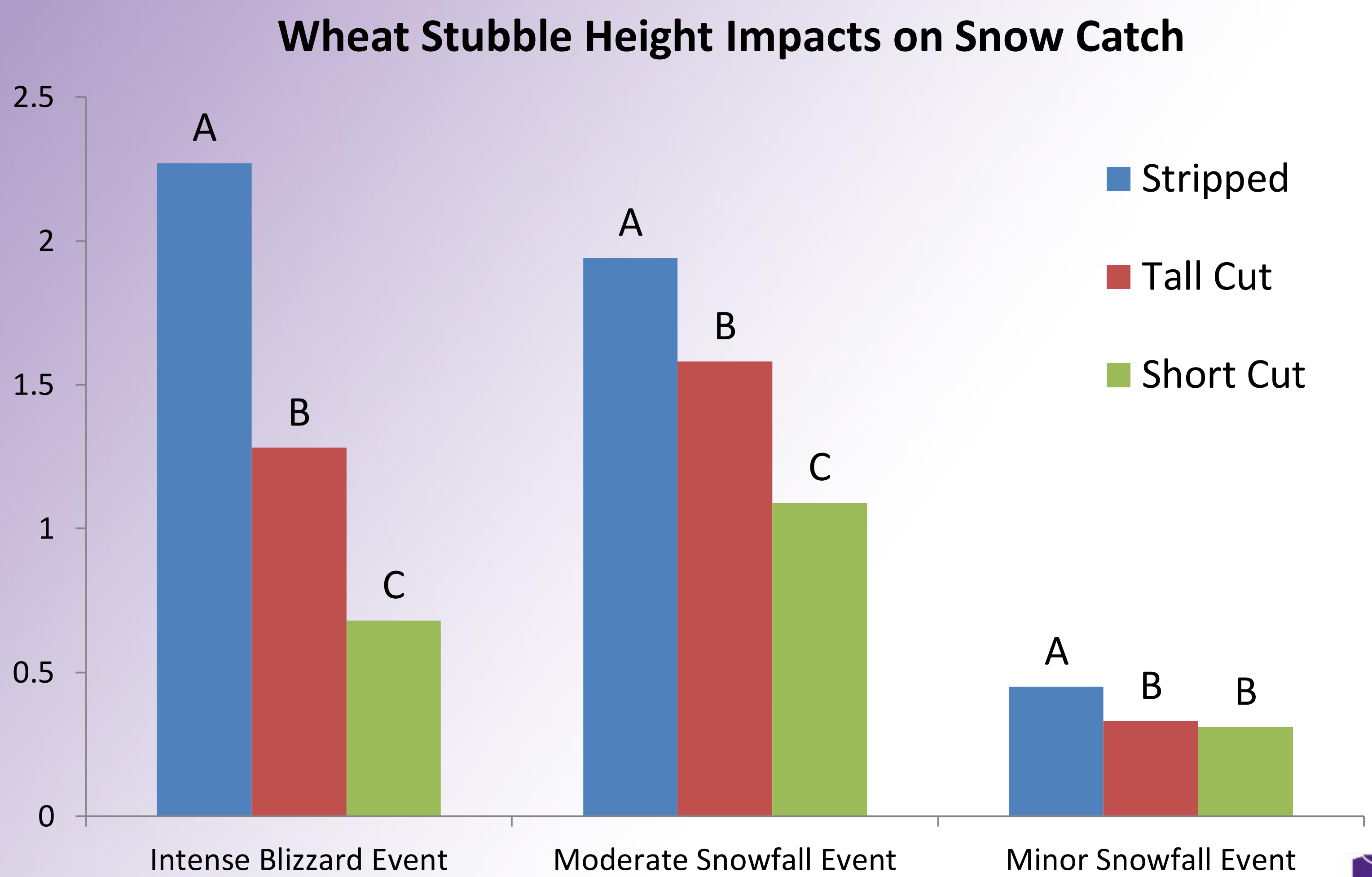
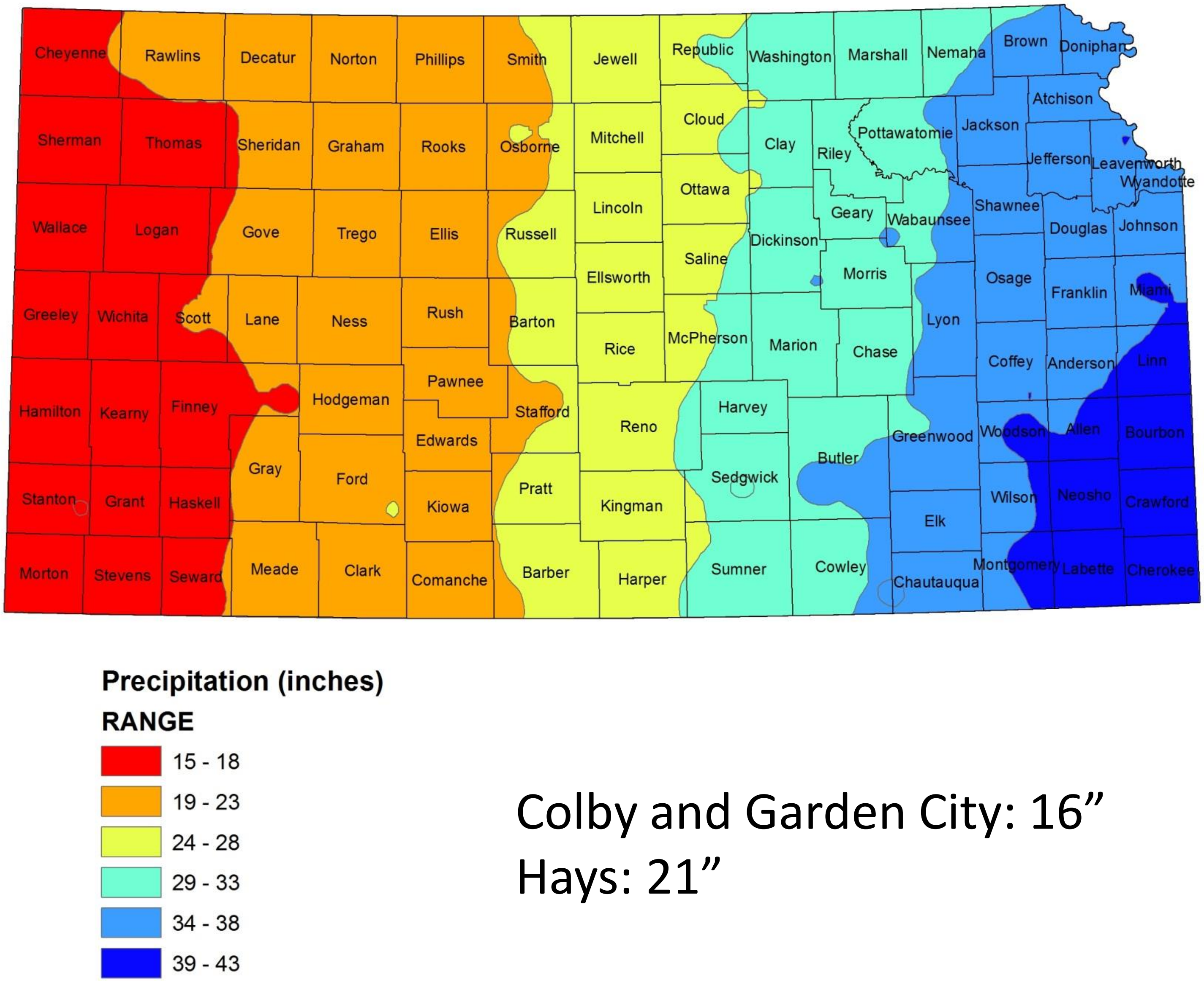
Justification



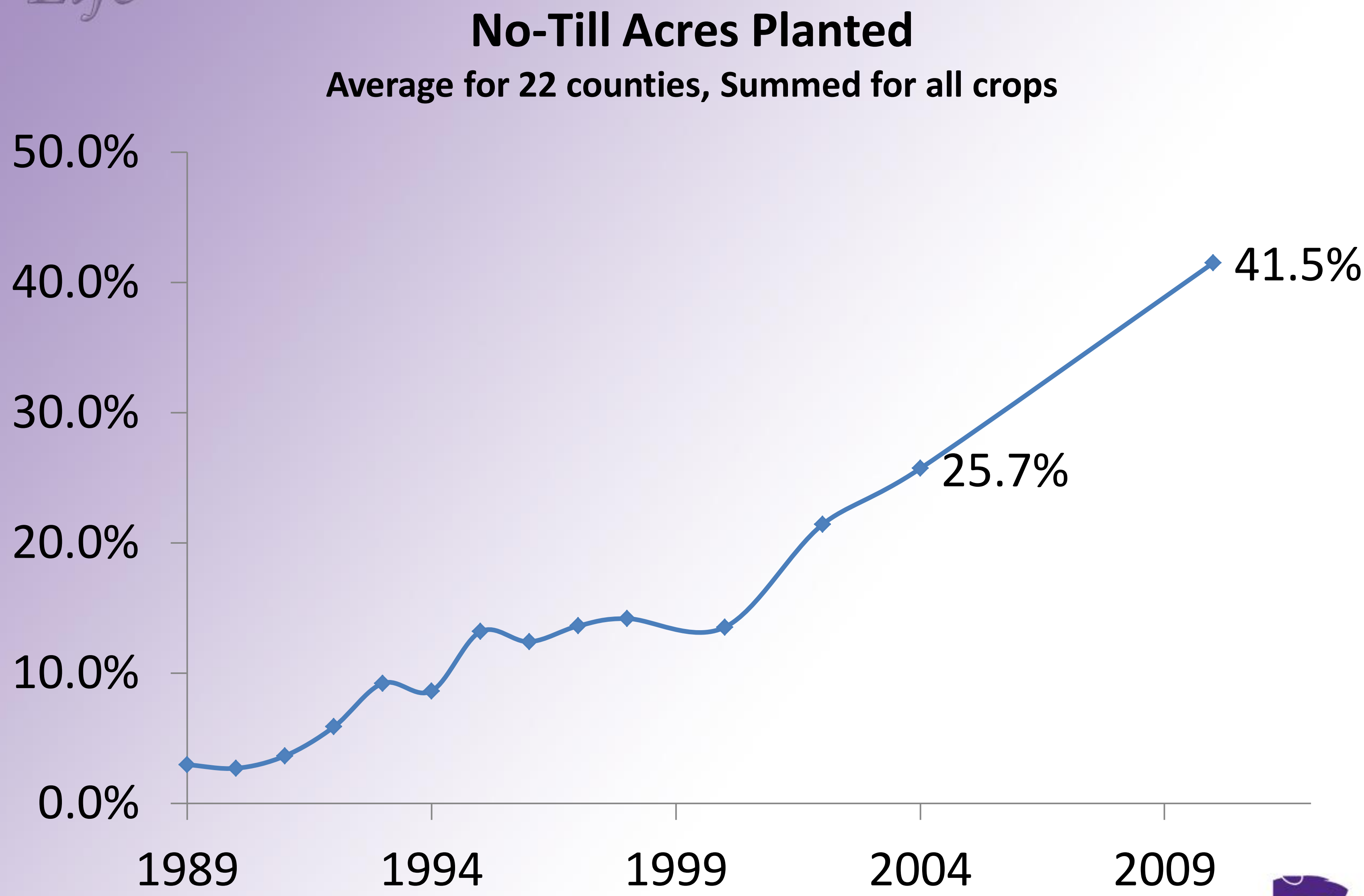
Data: Lucas Haag



Colby and Garden City: 16”

Hays: 21”

No-Till Acres Planted



Producer Concerns

Producer Concerns

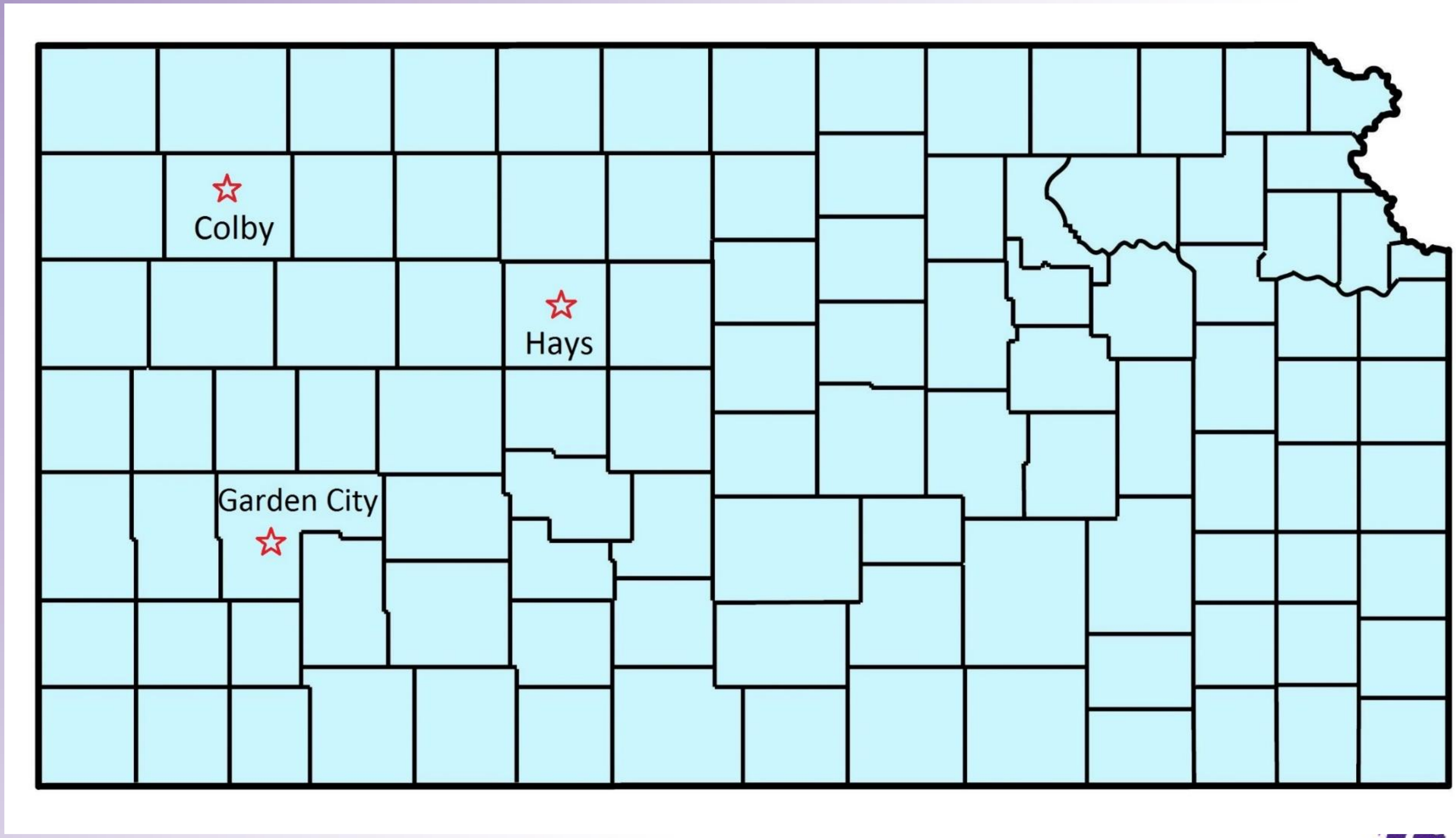
Objective

- To study the effects of liquid fertilizer rate and timing on decomposition of wheat straw.
- To measure the above ground biomass.
- To measure physical parameters of wheat straw.
  - Shear stress
  - Specific energy

Method Development

- Three experiment locations: Hays, Colby, and Garden City.
- The experimental design: randomized complete block with four replications.
- Plot size: $6.1m \times 6.1m$.

Research Sites



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Treatment

<table>
<tr><th></th><th>Treatment</th><th>N rate (kg/ha)</th><th>S rate (kg/ha)</th><th colspan="2">Fertilizer application timing</th></tr>
<tr><td>1</td><td>Control</td><td>0</td><td>0</td><td></td><td></td></tr>
<tr><td>2</td><td>Urea20</td><td>11.2</td><td>0</td><td rowspan="6">Sept. 2011</td><td rowspan="6">Sept. 2012</td></tr>
<tr><td>3</td><td>Urea40</td><td>22.4</td><td>0</td></tr>
<tr><td>4</td><td>Urea60</td><td>33.6</td><td>0</td></tr>
<tr><td>5</td><td>ATS15</td><td>7.7</td><td>16.8</td></tr>
<tr><td>6</td><td>ATS30</td><td>15.5</td><td>33.6</td></tr>
<tr><td>7</td><td>Mixed</td><td>49.1</td><td>33.6</td></tr>
<tr><td>8</td><td>Urea20</td><td>11.2</td><td>0</td><td rowspan="6">Feb. 2012</td><td rowspan="6">Feb. 2013</td></tr>
<tr><td>9</td><td>Urea40</td><td>22.4</td><td>0</td></tr>
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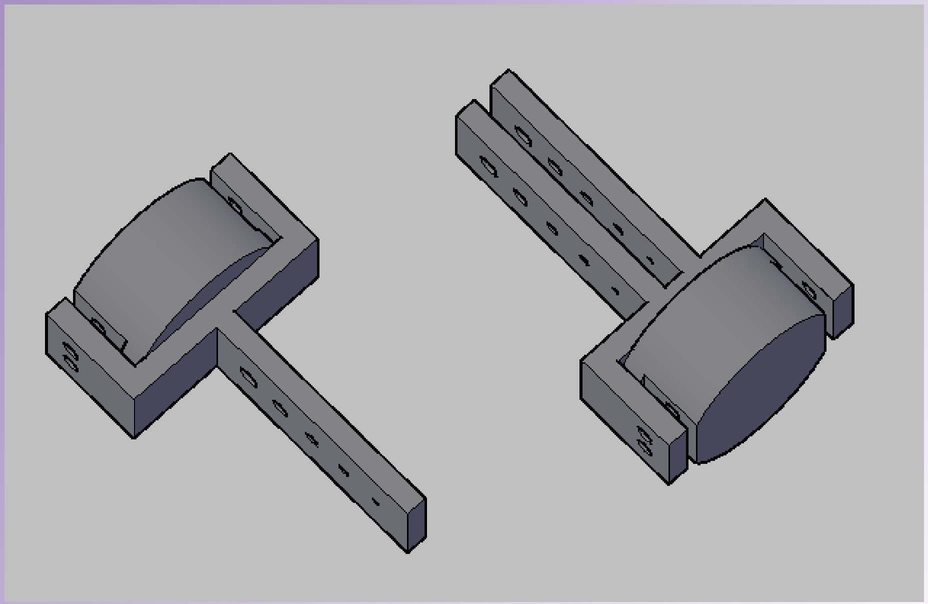
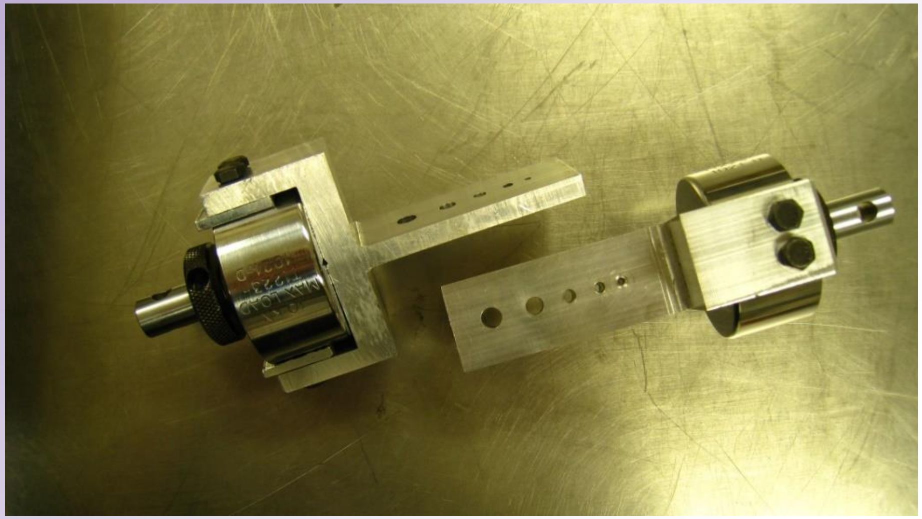
</table>

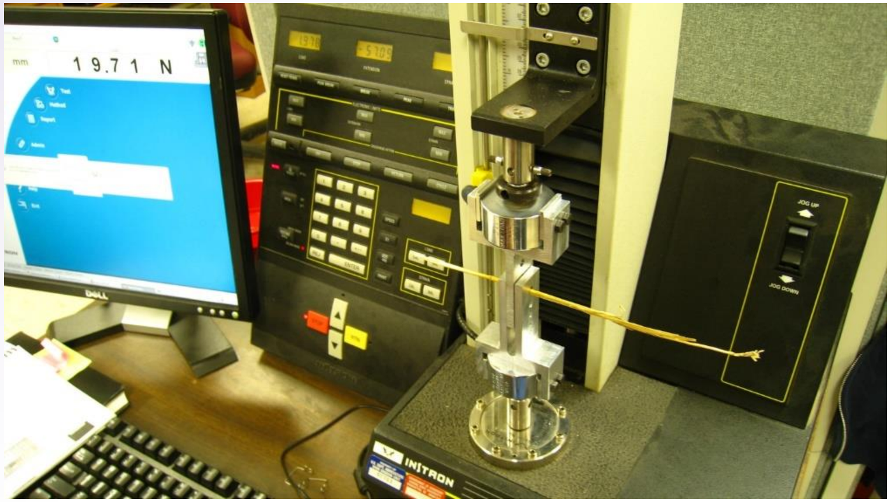
Method

- Sampling size: $0.61m \times 0.61m$
- Sampling time: Summer 2012, Jun. 2013 and Oct. 2013.
- Sample was dried at 54 ℃ for 3 days and weighed to calculate total aboveground biomass.

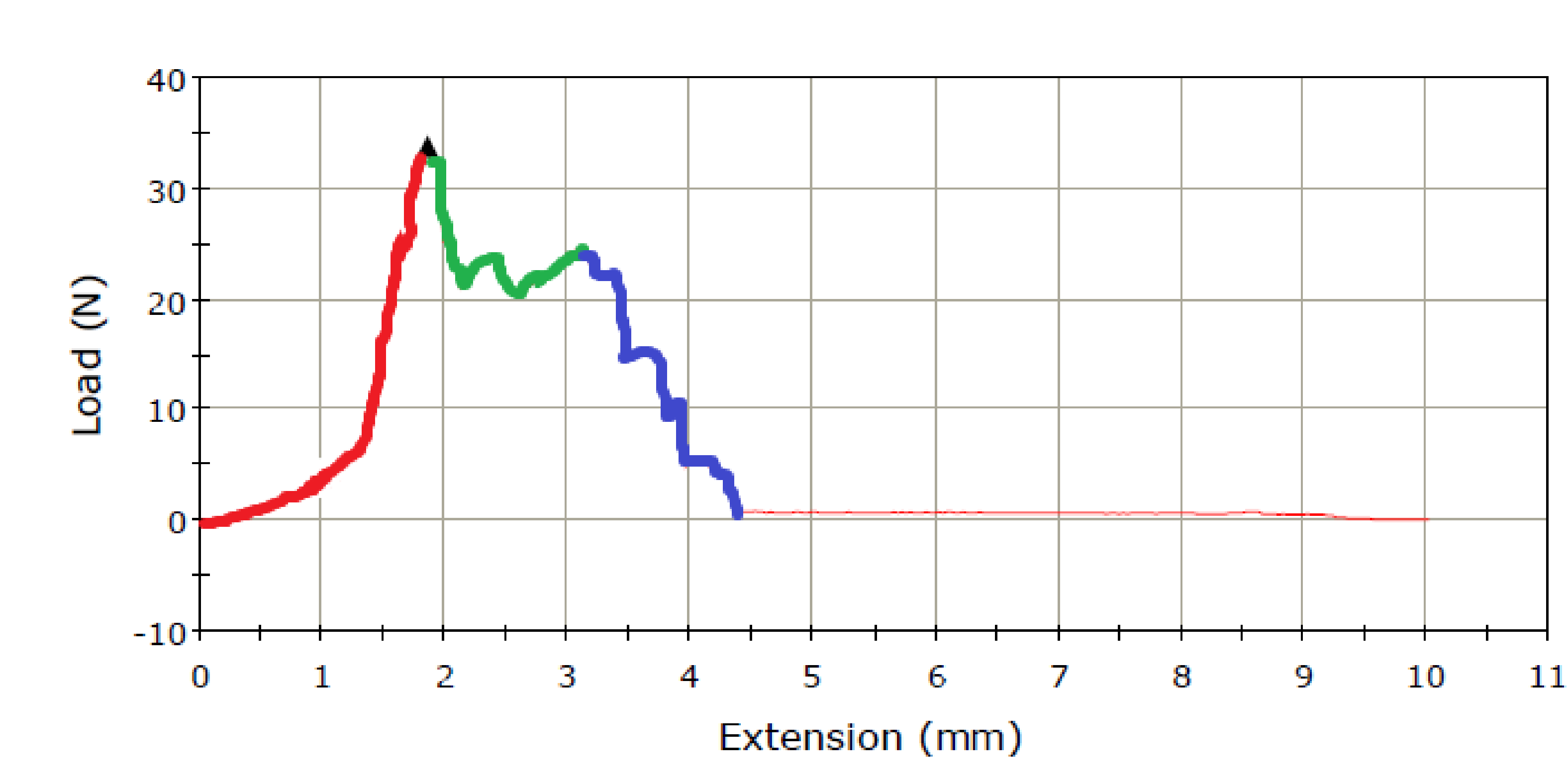
Shearing Test







Shear Force



Calculation and Statistics

$$\tau_s = \frac{F}{2A}$$

Where
τ_s is the shear stress (MPa)
F is the shear force at failure (N)
A is the wheat straw wall area at failure cross-section (mm^2)

$$SE = \frac{TE}{A}$$

Where
SE is the specific energy (J/mm^2)
TE is the total energy (J)
A is the wheat straw wall area at failure cross-section (mm^2)

SAS 9.3 was used. MIXED and GLM procedures were applied.

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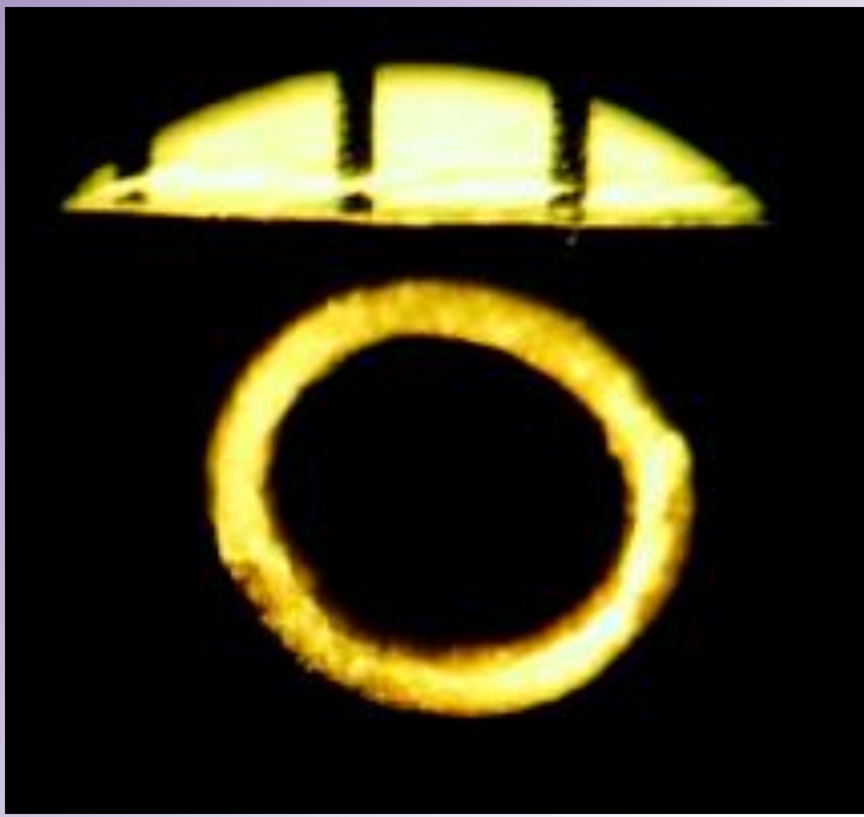
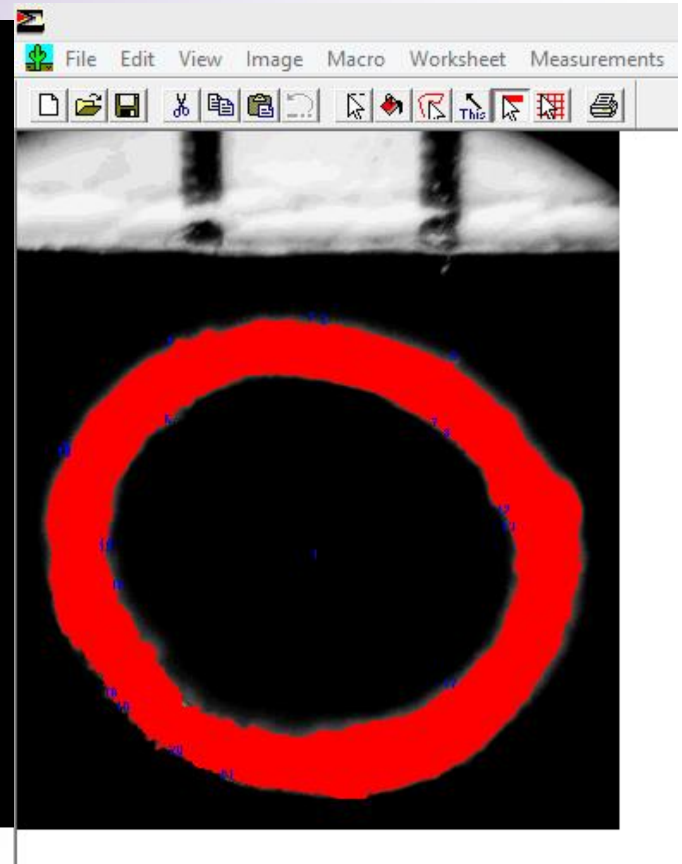
Cross-sectional Area



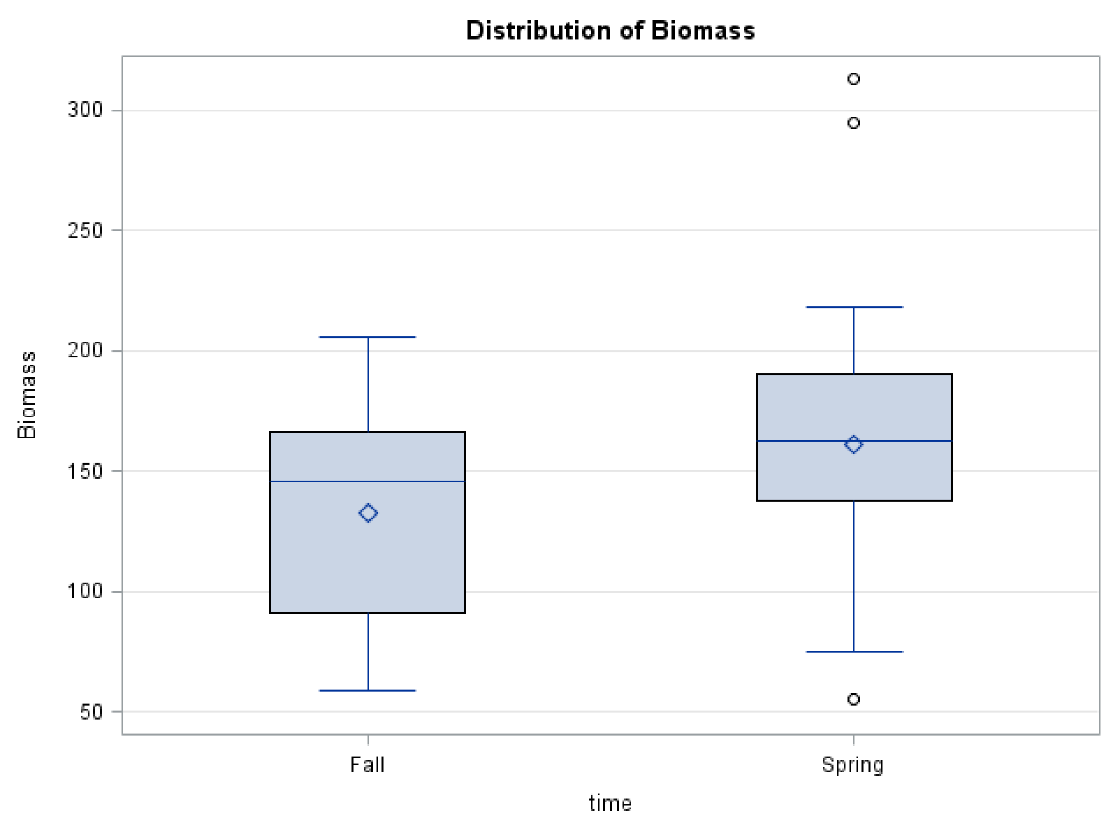


A microscope and camera was utilized to capture images of the cross-sectional area of wheat straw. The images were then analyzed with the software program SigmaScan 5

Results

2012 summer							
		Biomass		Specific Energy		Shear Stress	
		F-value	P-value	F-value	P-value	F-value	P-value
Colby	trt	0.26	0.9329	0.66	0.655	1.14	0.3613
	time	2.85	0.1022	0.21	0.6519	0.24	0.6295
	trt*time	1.41	0.2513	0.34	0.8828	0.74	0.6021
Hays	trt	0.62	0.686	4.6	0.0025	2.3	0.0662
	time	0.05	0.8253	5.96	0.0199	1.82	0.1862
	trt*time	0.5	0.7724	2.09	0.0896	1.51	0.2112
Garden City	trt	1.51	0.2115	3.81	0.0071	0.97	0.4496
	time	0.37	0.5484	0.54	0.4659	1.6	0.2136
	trt*time	1.27	0.2979	1.38	0.2561	2.56	0.0440

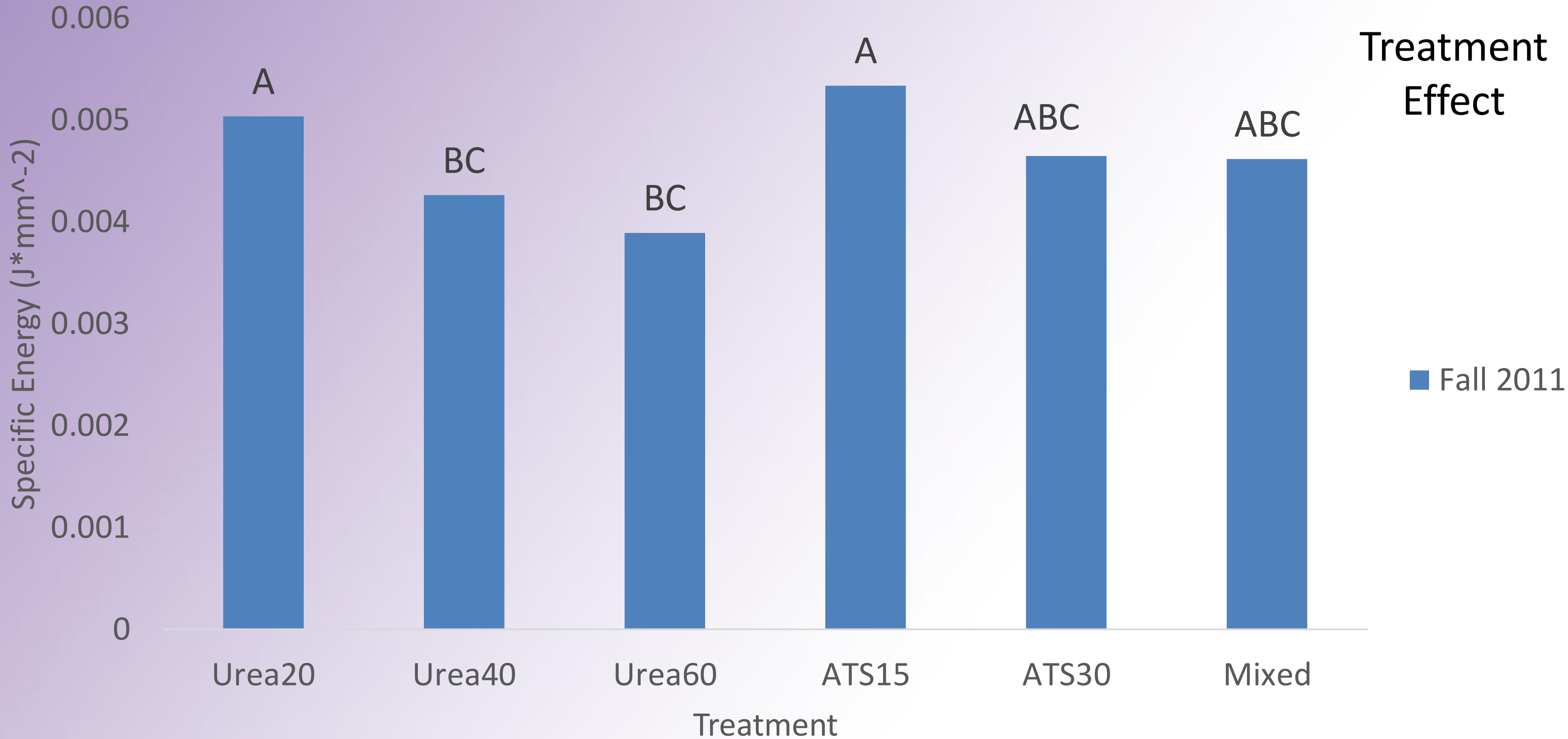
Summer 2012 Colby Biomass



Timing Effect

	Mean	Std.	P-value
2011 Fall	132.362	40.80213	0.1022
2012 Spring	161.2186	62.50508	

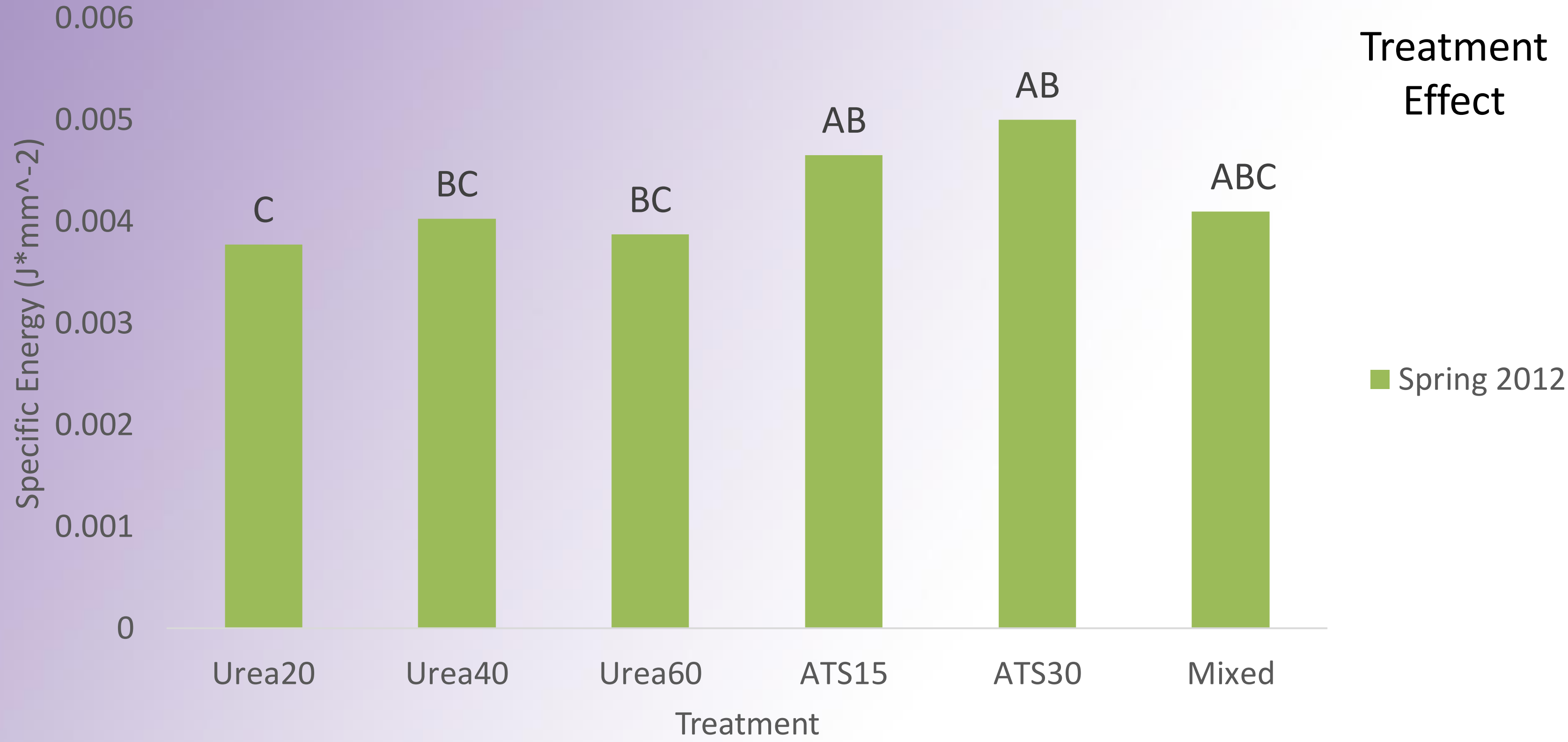
2012 Summer Hays Specific Energy



	2011Fall	2012Spring
Urea20	0.005035	0.003773
Urea40	0.00426	0.004025
Urea60	0.003892	0.003872

	2011Fall	2012Spring	P-Value
ATS15	0.005337	0.004653	0.1016
ATS30	0.004643	0.004997	
Mixed	0.004617	0.004097	

2012 Summer Hays Specific Energy



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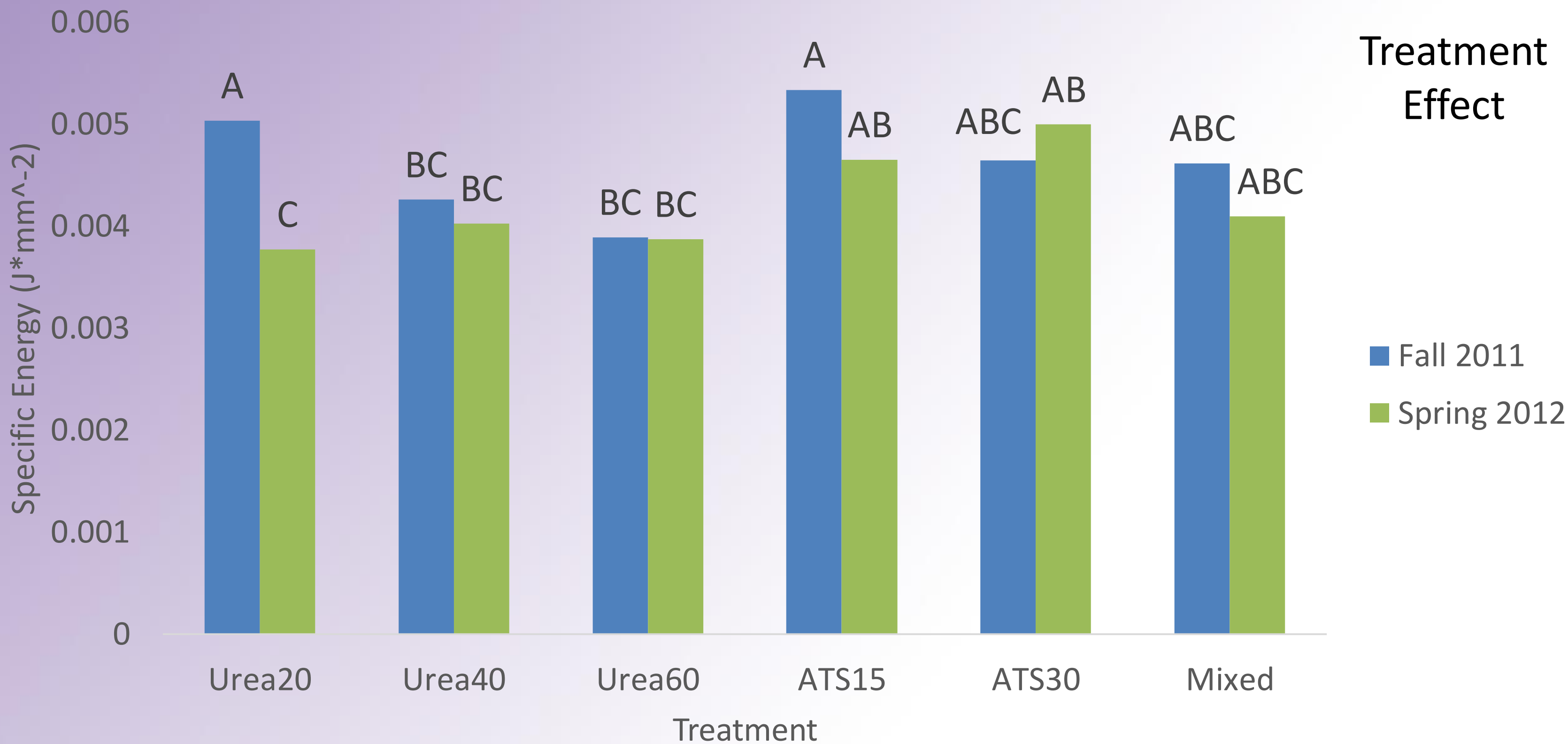

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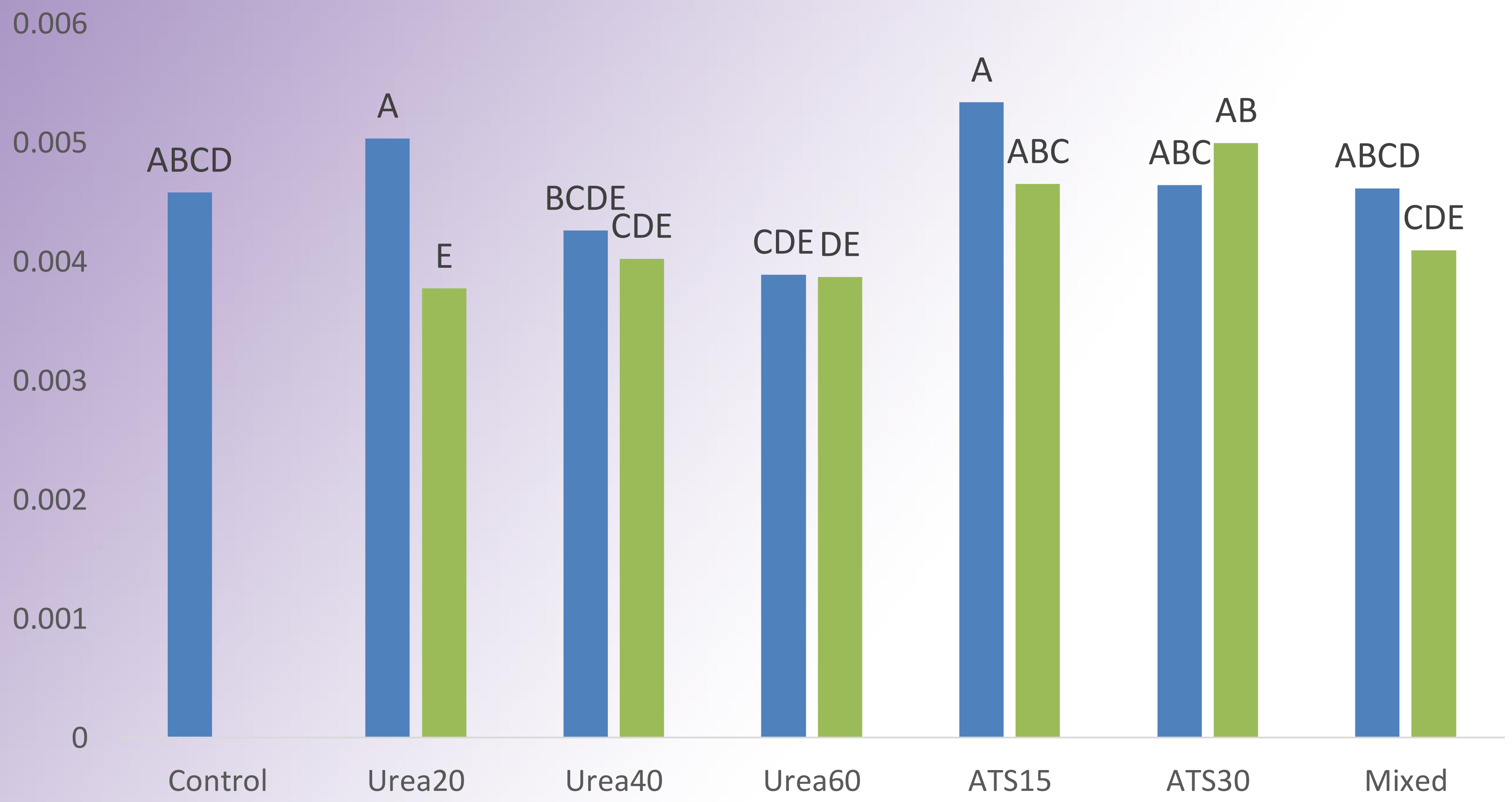
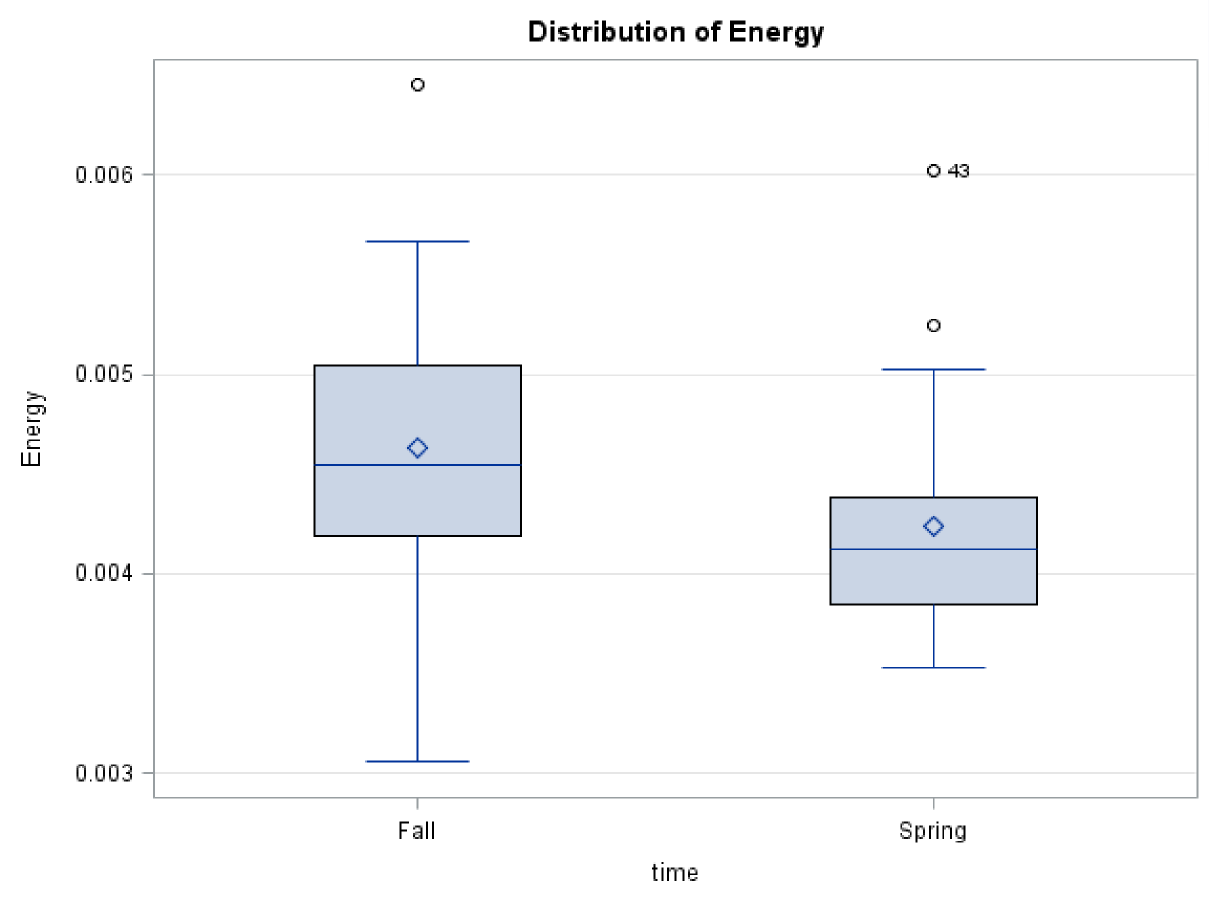


$P = 0.0019$

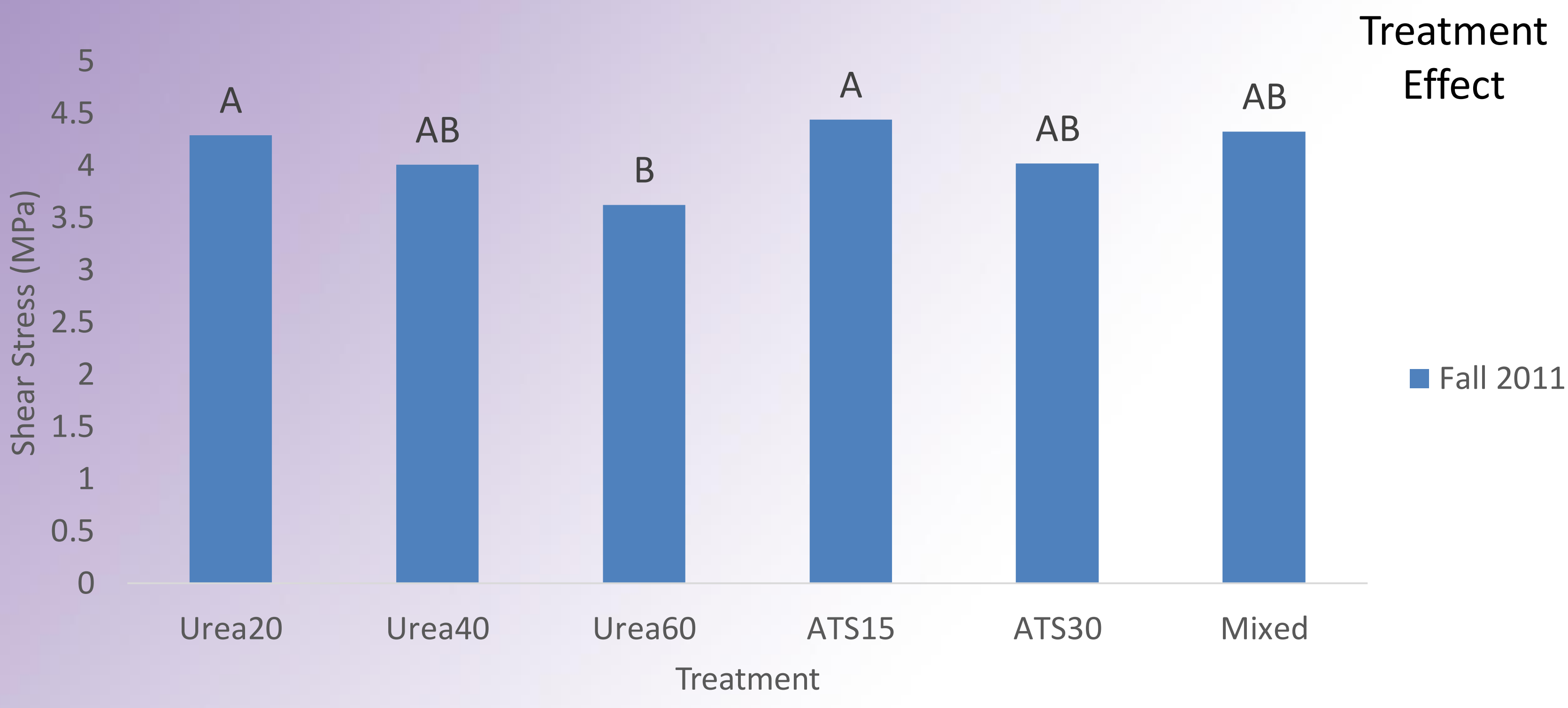
2012 Summer Hays Specific Energy



Timing Effect

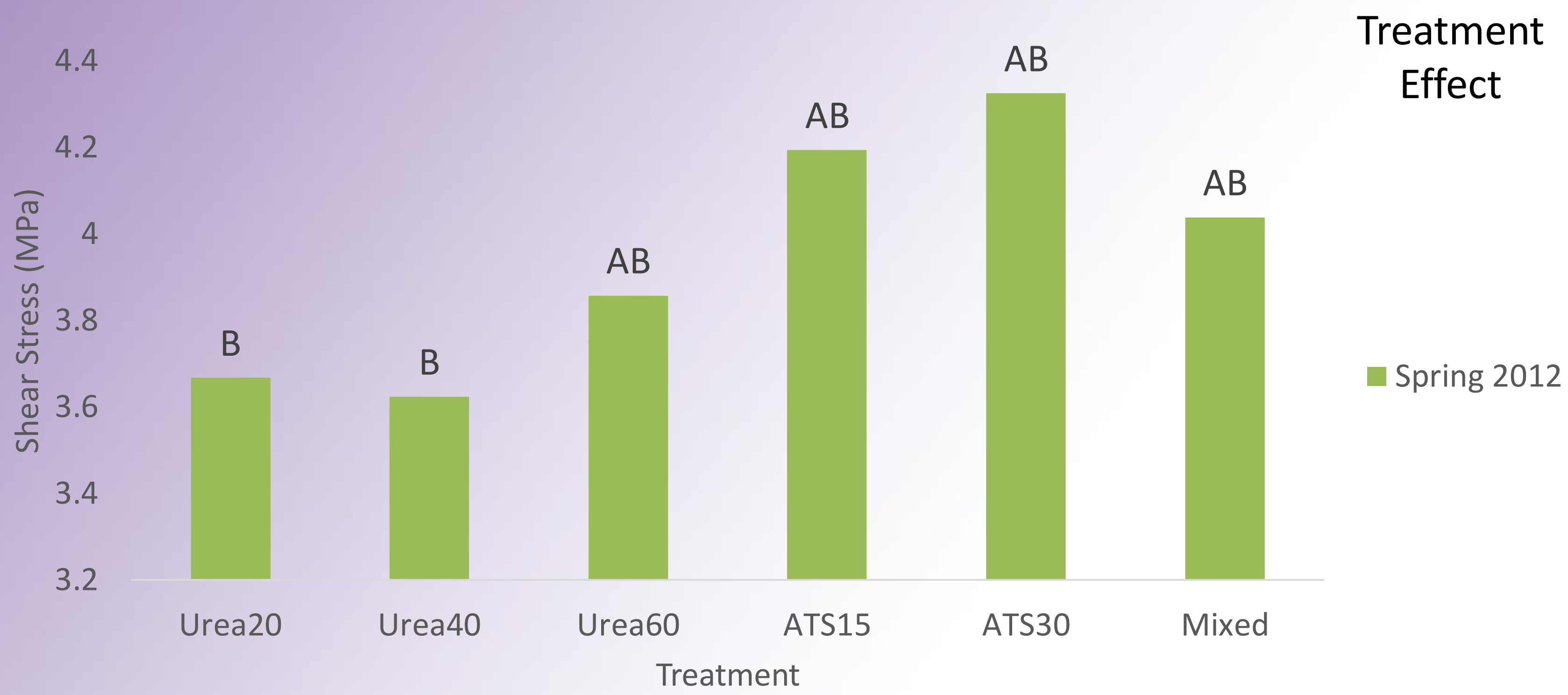
	Mean	Std.	P-value
2011 Fall	0.0046311	0.000739	0.0199
2012 Spring	0.0042361	0.000578	

2012 Summer Hays Shear Stress



	2011Fall	2012Spring		2011Fall	2012Spring	P-Value
Urea20	4.291057	3.666604	ATS15	4.43766	4.192987	0.3276
Urea40	4.00651	3.623078	ATS30	4.019987	4.324161	
Urea60	3.623553	3.857081	Mixed	4.325874	4.037497	

2012 Summer Hays Shear Stress



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2012 Summer Hays Shear Stress

$P = 0.0794$

Conclusion

- Colby biomass: fall treatment < spring treatment
- Specific energy seems more sensitive to time issue.
- Shear stress seems to be more affected by treatments than liquid fertilizer application timing.

Conclusion

- Detailed statistical analysis required in the future.
- More work is in process including chemical analysis of wheat straw.
- Additional work needed such as chamber study for better control of environmental variables.

Thank you!!

Fluid Fertilizer Foundation

USDA ars

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