

Biochemical Characterization of *Amaranthus* Cell Wall
as a Lignocellulosic Biomass Resource in biorenewable
Energy Production

Andre Salazar
Olga A. Zabolina
Biochemistry Department
Iowa State University

Amaranthus – Biomass Resource

- Amaranthus – Food Production
 - Agricultural seed
 - Environmentally tolerant and adaptable
- Amaranthus – Energy Production
 - Plant cellulose and monosaccharides
 - Lignocellulosic ethanol
- Amaranthus – Potential Economic Impact
 - Sustainable Supplement to grain production

Research Objective

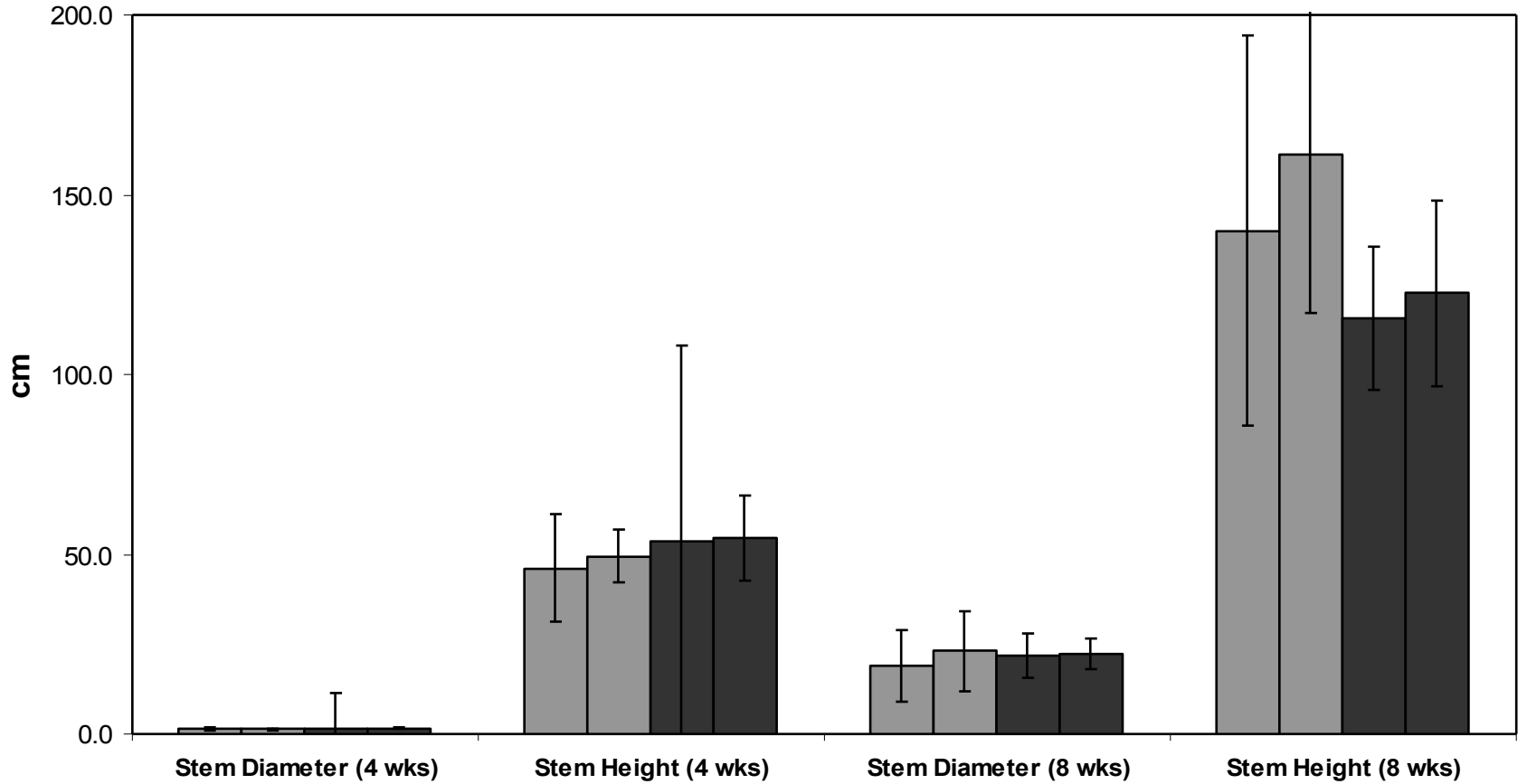
- Hypothesis
 - Amaranthus is a viable biomass resource for lignocellulosic ethanol production in comparison with plant resources under evaluation.
- Objectives
 - Determine biochemical carbohydrate properties of Amaranthus cell wall
 - Compare Amaranthus to other plants proposed as biomass resources in lignocellulosic ethanol production
 - Improve Amaranthus biomass model with the inclusion of cell wall biochemical properties

Experimental Information

- Plants
 - *Amaranthus cruentus* – DB98246
 - *Amaranthus hypochondriacus* – PI558499
- Plots
 - Single row (each plant) – 20 ft long, 5 ft apart
- Biochemical Analysis
 - Plant – Stem diameter and height, and mass
 - Cell Wall – Cellulose, lignin, monosaccharides
- Data Statistical Analysis
 - Mean Comparison – Anova
 - Covariance Comparison – Correlation

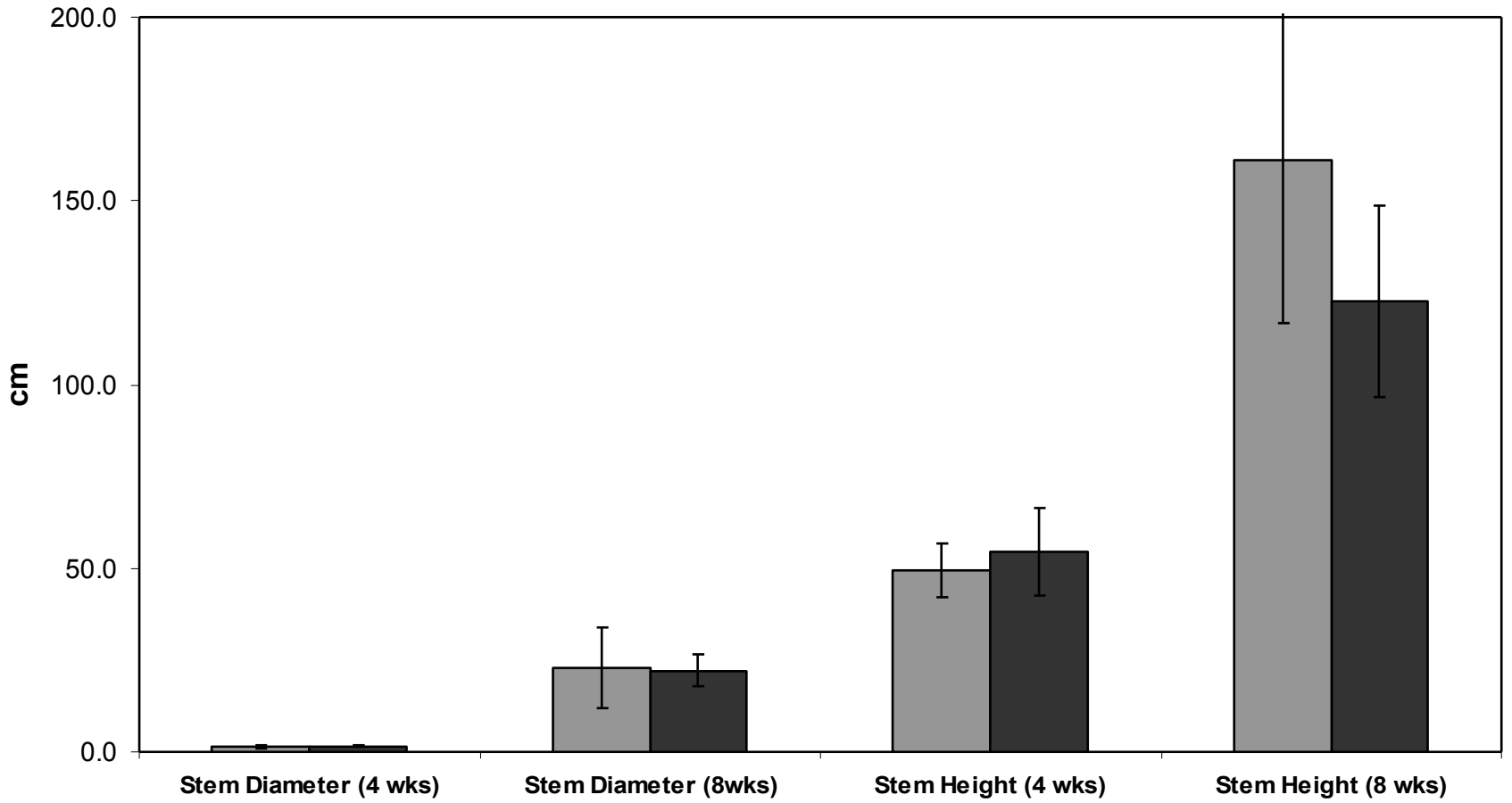
Field and Sample Data

- A. cruentus (Field)
- A. cruentus (Sample)
- A. hypochondriacus (Field)
- A. hypochondriacus (Sample)



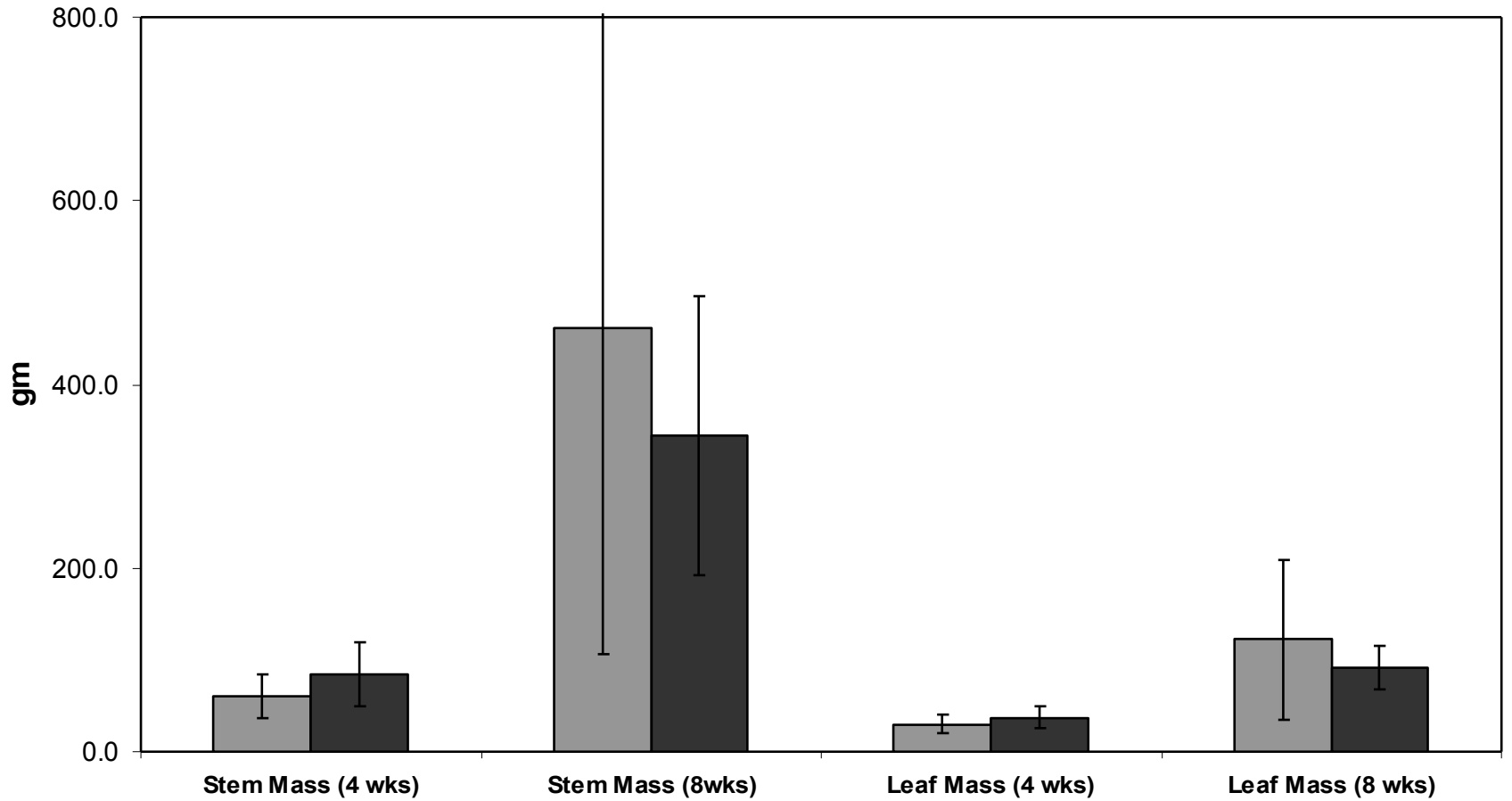
Plant Stem Properties

■ *A. cruentus* ■ *A. hypochondriacus*



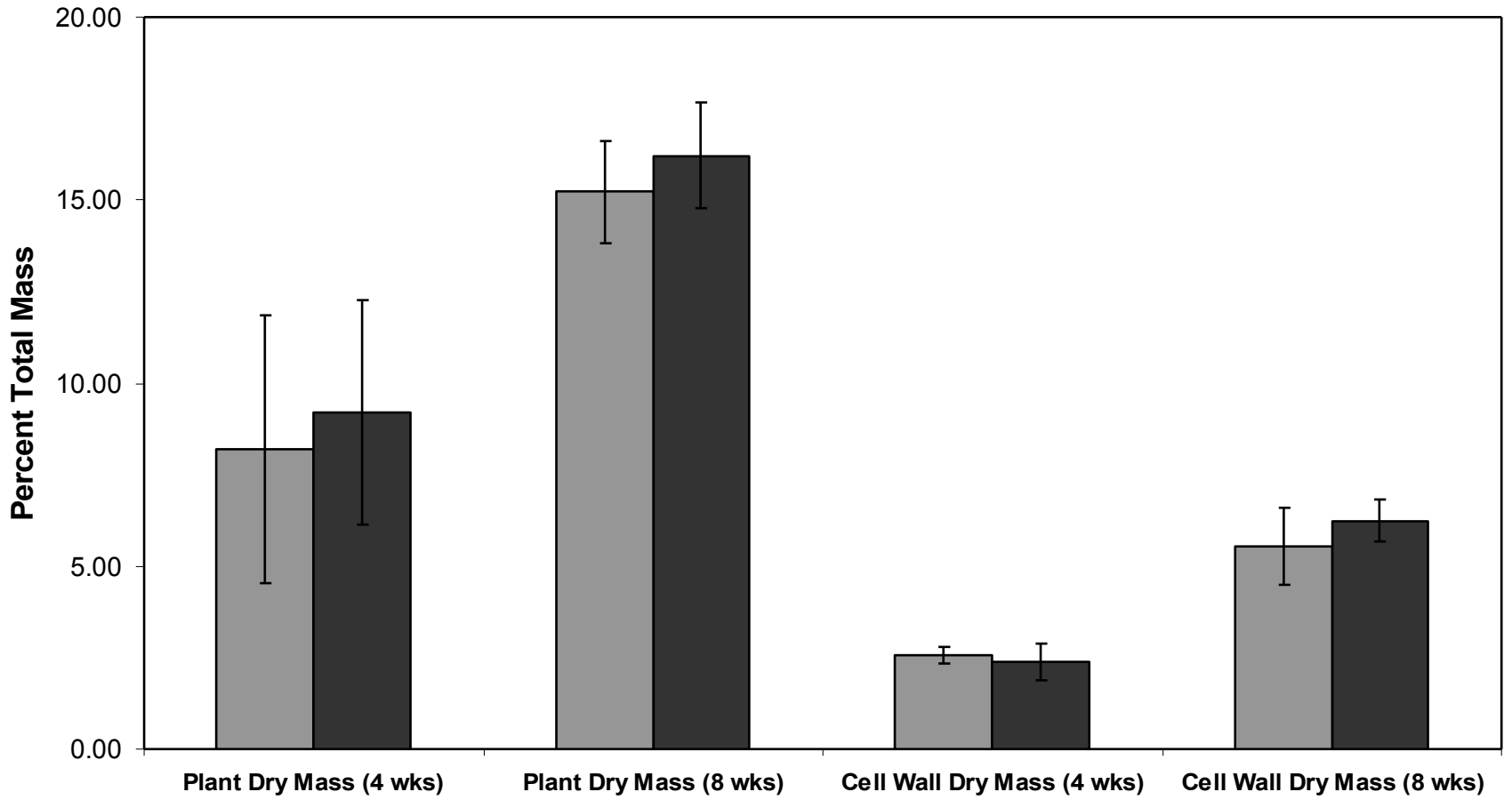
Plant Mass Results

■ A. cruentus ■ A. hypochondriacus



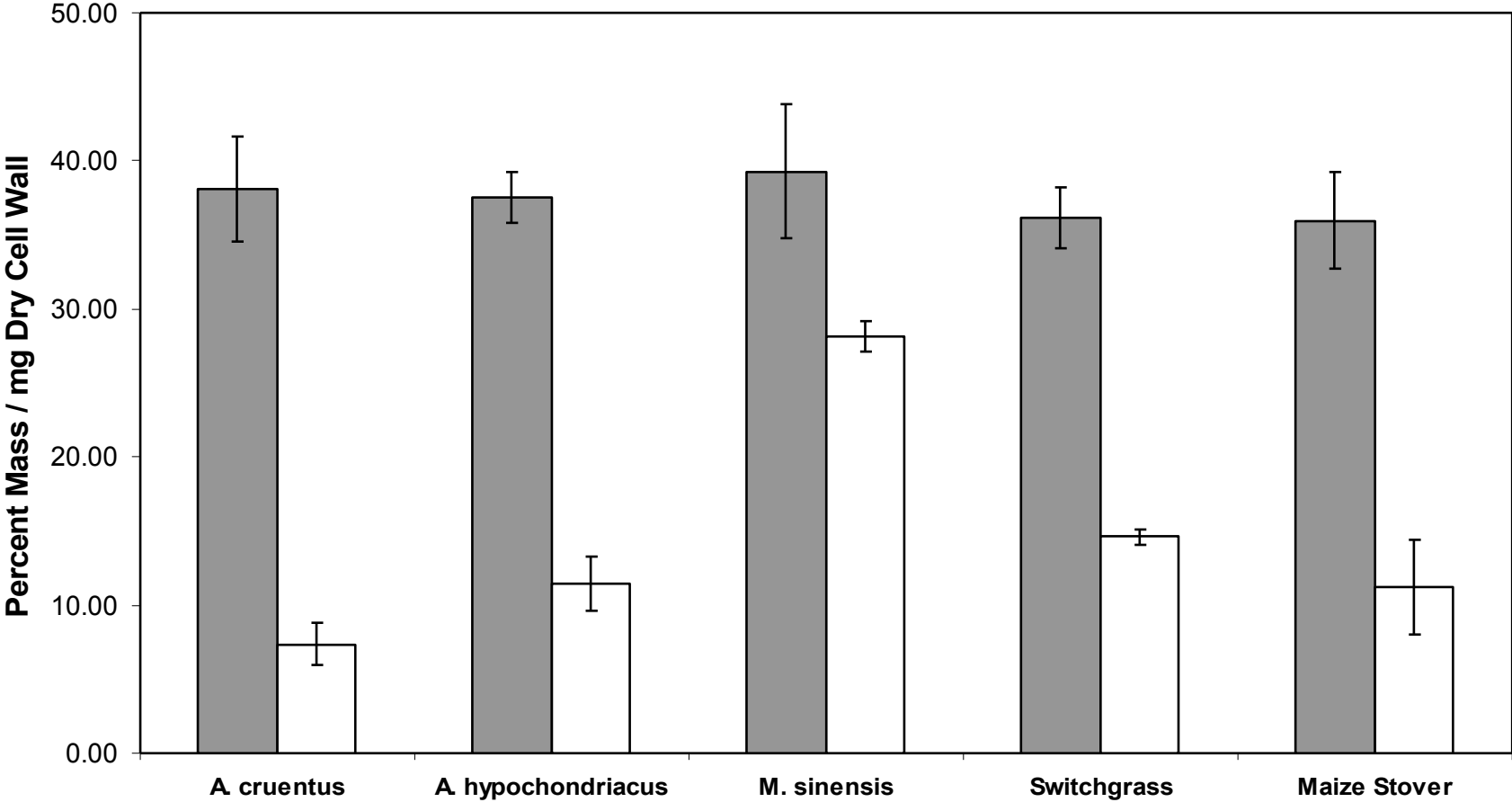
Plant Dry Mass Results

■ *A. cruentus* ■ *A. hypochondriacus*



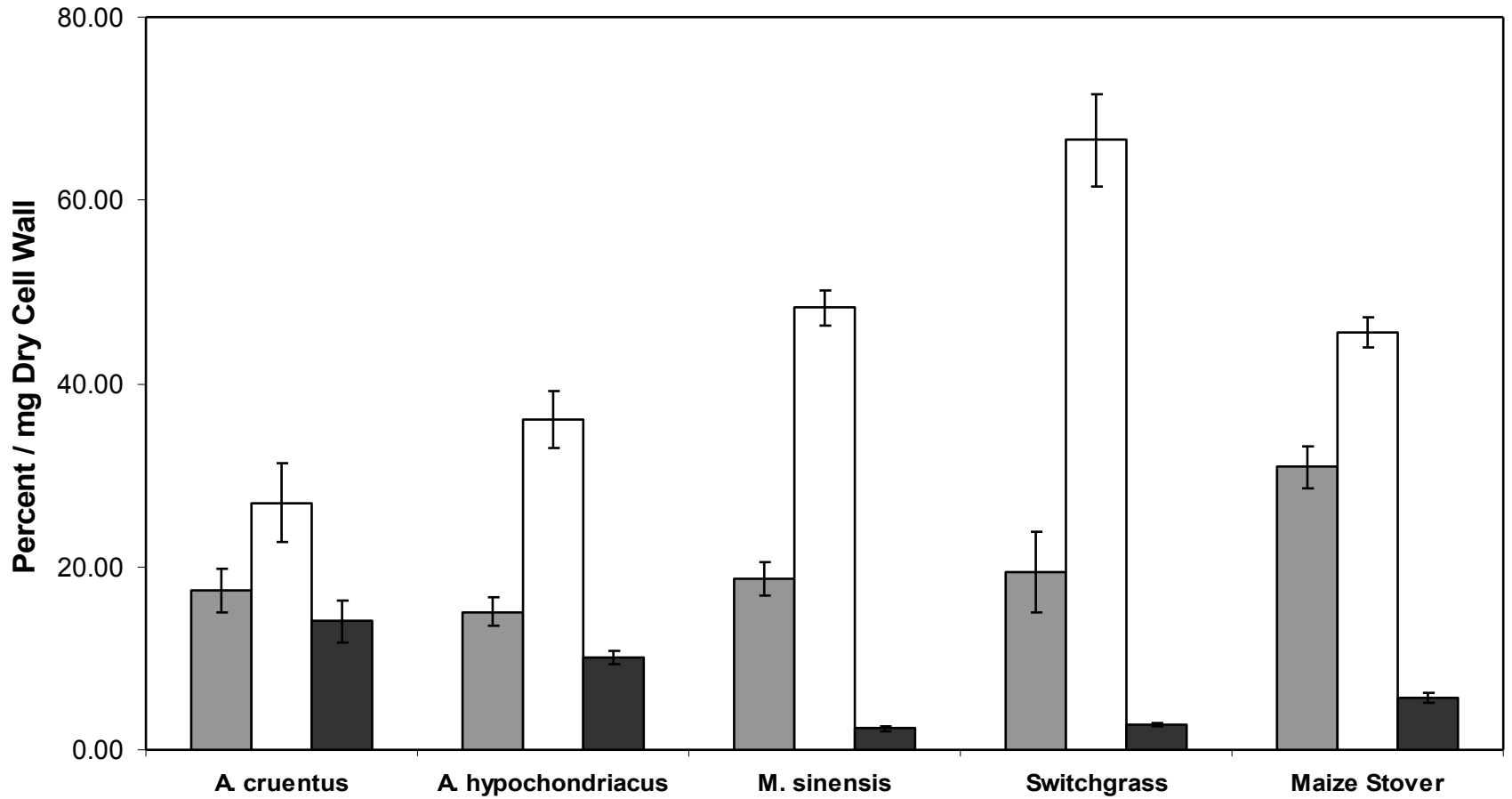
Cellulose and Lignin

■ Cellulose □ Lignin



Percent Total Monosaccharide Molecular Mass

■ Glucose □ Xylose ■ Galactose



Summary

- Amaranthus Plants
 - Stem and Leaf measurements – No significant difference
 - Plant dry and cell wall mass – No significant difference
 - Cellulose and lignin – No significant difference
 - Xylose – *A. hypochondricus* > *A. cruentus*
- Biomass Plant Comparison
 - Cellulose – No significant difference
 - Lignin – *M. sinesis* > switchgrass > *Amaranthus*
 - Glucose – Maize > *M. sinesis*, switchgrass, *Amaranthus*
 - Xylose – Switchgrass > *M. sinesis*, Maize > *Amaranthus*
 - Galactose – *Amaranthus* > *M. sinesis*, Maize, switchgrass
- Correlation – Plant measurement to mass

Conclusions

- Amaranthus Plants
 - No significant difference
 - Xylose content
- Biomass resource
 - Amaranthus comparable to other resources
 - Cellulose – Equivalent content
 - Lignin – Less content
 - Monosaccharide – Equivalent to Maize stover

Additional Research

- Amaranthus
 - Analyze cell wall biochemical properties at 16 wks
 - Evaluate results for correlations
 - Evaluate data fit into biomass model