

The Regional Feedstock Partnership: Herbaceous Energy Crops and CRP Land for Biomass Production Across Environmental Gradients

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Biomass 2009

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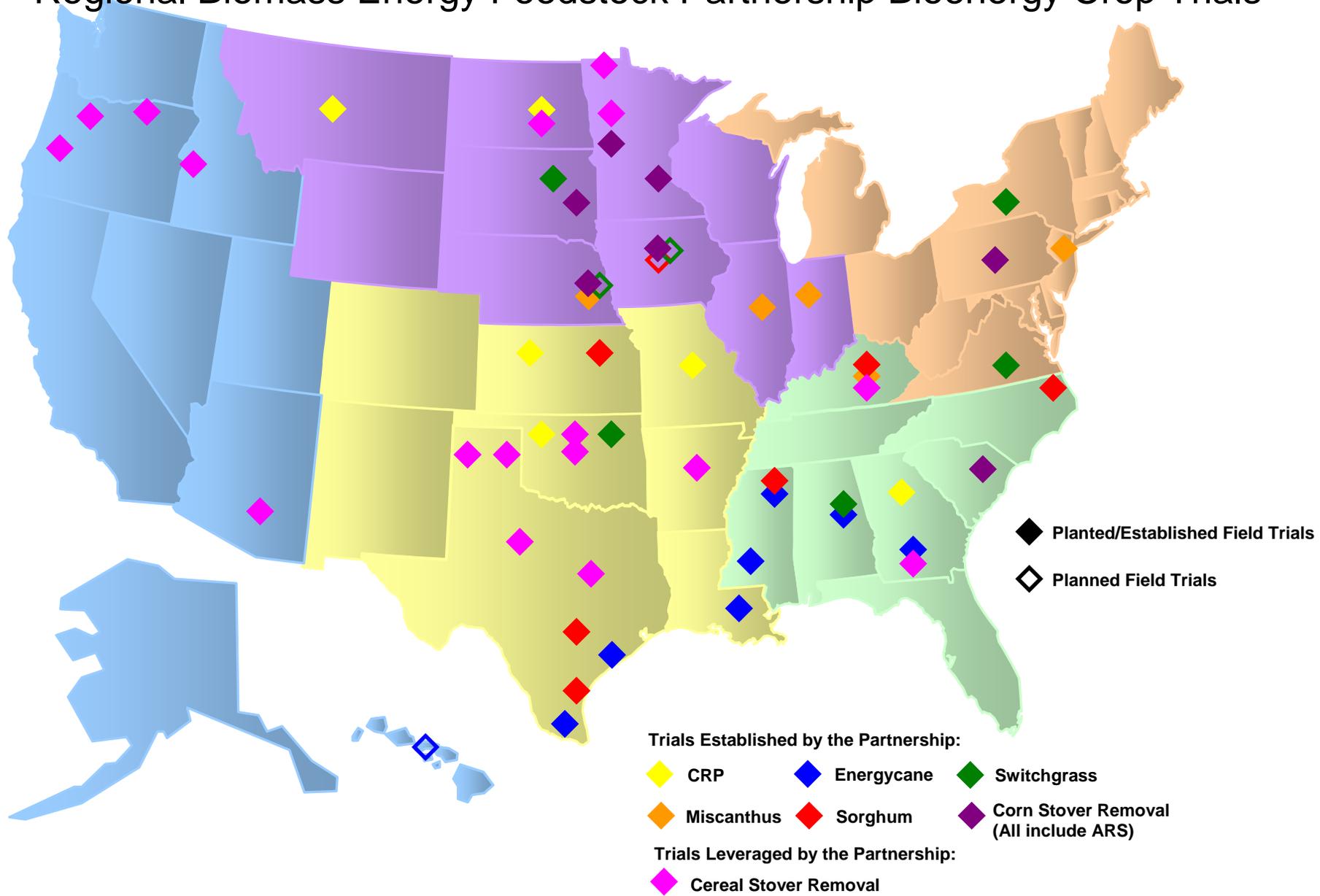
Many collaborators

Overall Objective

- Perform replicated field trials of diverse herbaceous biomass feedstocks at different locations for assessing potential expansion of these feedstocks as a bioenergy resource

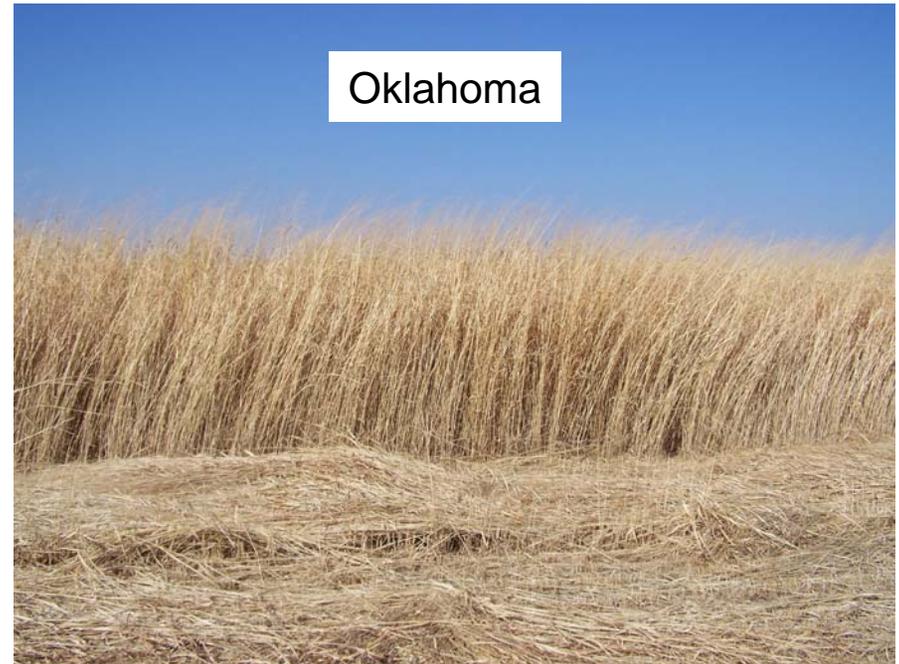
- Selections
 - Switchgrass
 - *Miscanthus x giganteus*
 - Energycane
 - Sorghum
 - CRP

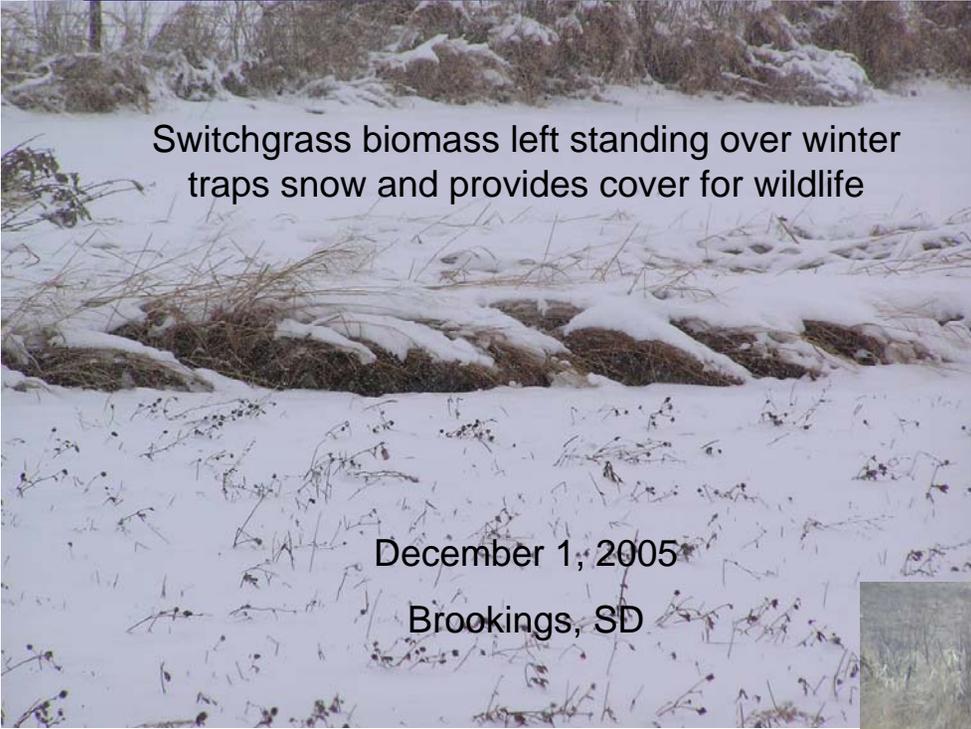
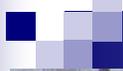
Regional Biomass Energy Feedstock Partnership Bioenergy Crop Trials



Switchgrass

- Alabama – David Bransby
- New York – Don Viands
- Oklahoma – Rodney Farris
- South Dakota – Vance Owens
- Virginia – John Fike
- Iowa – Emily Heaton (2009)
- Nebraska – Rob Mitchell (2009)





Switchgrass biomass left standing over winter
traps snow and provides cover for wildlife

December 1, 2005

Brookings, SD

Harvest options and flexibility



Switchgrass Biomass After Snow Melt

March 30, 2006

Wildlife habitat



Switchgrass Experimental Design

- Relatively large experimental units (about 0.4 to 0.5 ha)
- Four replicates across landscape
- Nitrogen (0, 56, 112 kg ha⁻¹) to be applied in 2009
- Locally adapted cultivar at each location



2008 Switchgrass Results

- No yield data
- Establishment primary consideration
- Baseline soil samples collected at all locations

2009 Switchgrass Plans

- Evaluate current stands for establishment success
- Apply N treatments pending successful establishment
- Establish new trials at Ames, IA and Lincoln, NE
- Collect yield data at established sites

Miscanthus x giganteus

- Illinois – Tom Voigt
- Indiana – Zac Reicher
- Kentucky – David Williams
- Nebraska – Roch Gaussoin and Rob Mitchell
- New Jersey – Stacy Bonos and Jim Murphy



Miscanthus x giganteus in Illinois



2004-2006 Yields (tonnes/hectare)

■ Northern Illinois

- M. x g. – 22.0
- Switchgrass – 4.9

■ Central Illinois

- M. x g. – 34.7
- Switchgrass – 11.6

■ Southern Illinois

- M. x g. – 35.4
- Switchgrass – 6.0



Vegetative propagation



Harvesting rhizomes



Harvested rhizomes



Planting rhizomes

Miscanthus x giganteus Experimental Design

- Relatively small experimental units (100 m²)
- Planting from asexually propagated plants
- Four replicates
- Three nitrogen treatments (0, 60, 120 kg ha⁻¹) begun at planting in 2008



2008 *Miscanthus x giganteus* Results

- No yield data
- Establishment primary objective
- Baseline soil samples collected at all locations



2009 *Miscanthus x giganteus* Plans

- Evaluate current stands for establishment success and replant as necessary
- Apply N treatments
- Analyze soil samples collected in 2008
- Collect initial yield data

Energycane

- N Georgia - Charlie Brummer (2008)
- S Georgia - Bill Anderson
- Hawaii - Goro Uehara, (2009)
- Louisiana – Ken Gravois
- C Mississippi - Jimmy Ray Parish
- N Mississippi - Brian Baldwin
- E Texas - Jürg Blumenthal
- SE Texas - Ted Wilson, et al.

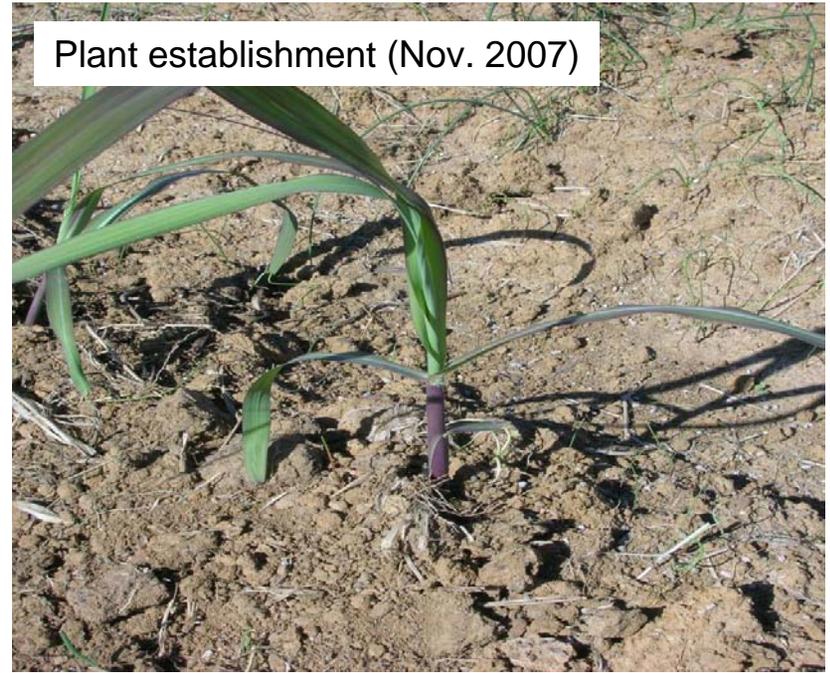


Energycane establishment

Planting seed cane (Sep. 2007)



Plant establishment (Nov. 2007)



Feb. 2008





Energycane Experimental Design

- Plots 10 x 6 m (governed by germplasm availability)
- Four replicates
- Genotype by location (five genotypes common to all locations)
- Locally adapted cultivar at each location

2008 Energycane Results

- Data limited, some information obtained from USDA-ARS Sugarcane Unit plots established in 2006-2007 at same, and additional locations
 - Tissue samples
 - Sap samples
 - Base yield
 - Cold tolerance/hardiness
- Germplasm proliferation and establishment primary consideration in 2008
- Baseline soil samples collected at all locations

2009 Energycane Plans

- Emergence data – date and rating (shoots/plot)
- Date of 50% emergence and soil temp
- Data **during** growing season
 - Height, bi-weekly
 - Brix monthly from sacrifice row

2009 Energycane Plans

- End of Season Harvest Data
 - Each location needs to fix that time
 - Stalk count and diameter
 - Final height
 - Rating after first hard frost
 - Final Brix – want a 50 ml sap sample, freeze
 - Fresh harvest weight
 - Sap yield
 - Stalk moist (post-crush) weight
 - Stalk dry weight
 - Stalk samples for fiber analysis

Sorghum

- Texas (2 locations)
 - B. Rooney
 - G. Odvody
- Kansas – S. Staggengborg
- Iowa – K. Moore
- Kentucky – T. Pfieffer
- Mississippi – B. Maccoon
- North Carolina – R. Heiniger



Types of Sorghums

- Grain Sorghum
 - Grain
 - Stover
- Forage Sorghum
 - Hay, Grazing
 - Silage
- Sweet Sorghum
 - Soluble Sugars
 - Bagasse
- Energy Sorghum
 - High biomass
 - Stover



Energy Sorghum

- Uses established forage production systems, processing systems developing
- Forage Sorghum PS Hybrids 12 dry T/acre
- Energy Sorghum PS Hybrids:
 - Experimental Lines 12-15 dT/acre
 - Experimental Hybrids ~ 20% Heterosis (+2-3 dT)
 - Dedicated Energy Crop NOT Dual Purpose
- Application throughout the U.S.



Sorghum Experimental Design

- Medium experimental units (0.05 to 0.10 ha)
- 3 to 4 replications
- Nitrogen as recommended for forage sorghum production
- Rainfed, no supplemental irrigation
- Single, end of season Harvest (2008 only)
- 6 Genotypes
 - Forage sorghum (2)
 - Silage sorghum (2)
 - Sweet sorghum (1)
 - Grain sorghum (1)



2008 Sorghum Results

- Harvestable Yield in 6/7 locations
 - Iowa – not planted due to wet spring
 - Planting Dates - mid March to early June
 - Harvest Date - late September to late November
- Yields
 - 4 T/A (grain check) to 12 T/A (PS Forage Hybrid)
 - Sugar Yields low in all EXCEPT sweet sorghum
- Composition
 - Biomass composition samples collected in most locations
 - NIR Scans completed in CS and will use sorghum composition model co-developed by NREL and Texas A&M
- Soil Sampling – at College Station as part of the sustainability portion of this project (J. Heilman, TAMU)

2009 Sorghum Plans

- Crop Rotation following Standards for a Region
- Modify Harvest Schedule to fit Type
 - Multiple Harvest
 - Forage Sorghum Hybrids
 - Single Harvest
 - Energy Sorghum Hybrids
 - Sweet Sorghum (most locations)
 - No Grain Sorghum (consistently lowest yield in 2008)
- Hybrid Selection
 - 2 Energy Sorghum Hybrids (Ceres, Edenspace)
 - 2 Forage Sorghum Hybrids
 - Sweet Sorghum Variety (and Hybrid?)

Conservation Reserve Program

- Current enrollment (Nov. 2008): 33.57 mil. ac
- Major resource
 - New introduced grasses and legumes: 3.4 mil. ac
 - New native grasses: 7.2 mil. ac
 - Permanent wildlife habitat: 2.6 mil. ac
 - Existing grasses and legumes: 15.3 mil. ac
- Expiration schedule
 - 2008: 1.2 mil. ac
 - 2009: 3.9 mil. ac
 - 2010: 4.5 mil. ac
 - 2011: 4.4 mil. ac
 - 2012: 5.6 mil. ac

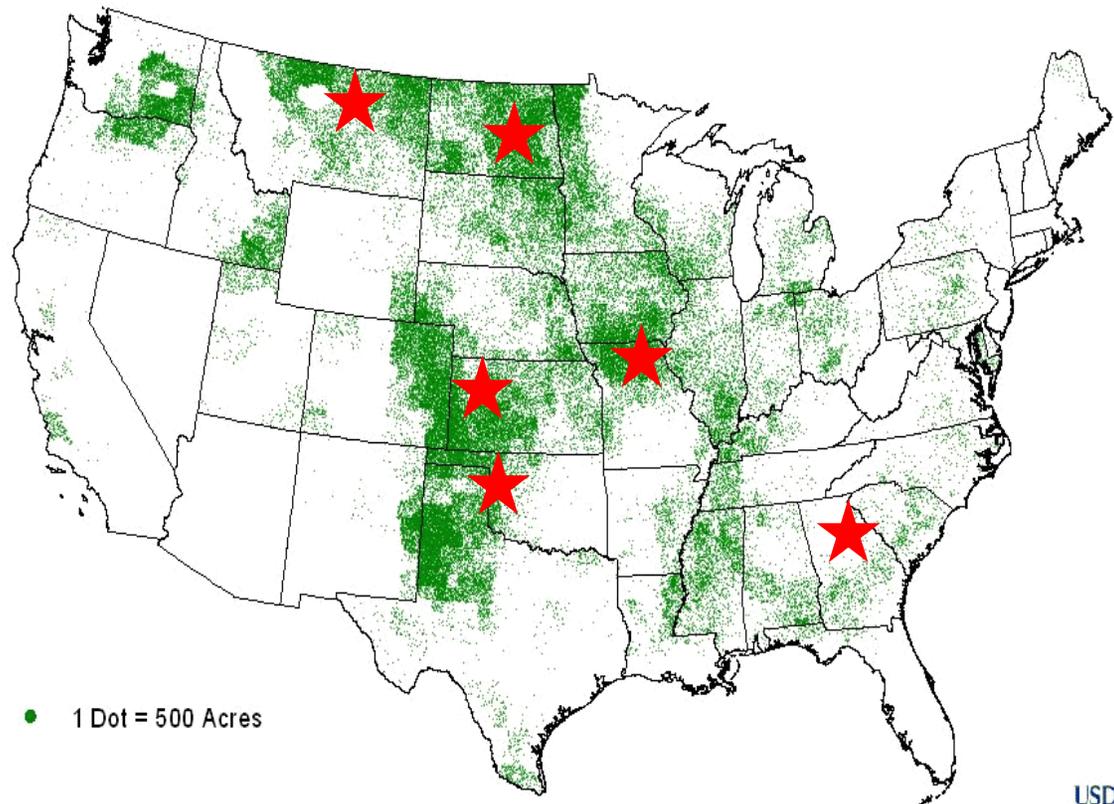


CRP Biomass Feedstock Production Sites

CRP Enrollment, FY 2007 (Cumulative)

CRP Acres, All Signup Types and Practices

Aberle, Ezra	N. Dakota
Harmony, Keith	Kansas
Chen, Chengci	Montana
Jordan, Carl	Georgia
Kallenbach, Robert	Missouri
Kakani, Gopal	Oklahoma



CRP Field Experiments

Location	Species ^{\$}	Fertility (N lb/ac)	Harvest Timing*
Carrington, ND	Warm mix (SW, BB)	0, 50, 100	PSC, AKF
Hays, KS	Warm mix (BB, SW)	0, 50, 100	PSC, AKF
Moccasin, MT	Cool mix (TW, TF)	0, 50, 100	PSC, EGS
Bishop, GA	Cool mix (TF)	0, 75, 150	2 cuts: PSC, EGS
Columbia, MO	Cool mix (TF, SB)	0, 50, 100	2 cuts: PCS, EGS
Fargo, OK	Warm mix (SW, BB)	0, 50, 100	PSC, EGS

^{\$} SW: switchgrass, BB: big bluestem, TW: tall wheatgrass, TF: tall fescue, SB: smooth brome

* PSC: peak standing crop, AKF: after killing frost, EGS: end of growing season

CRP

N response on CRP in North Dakota

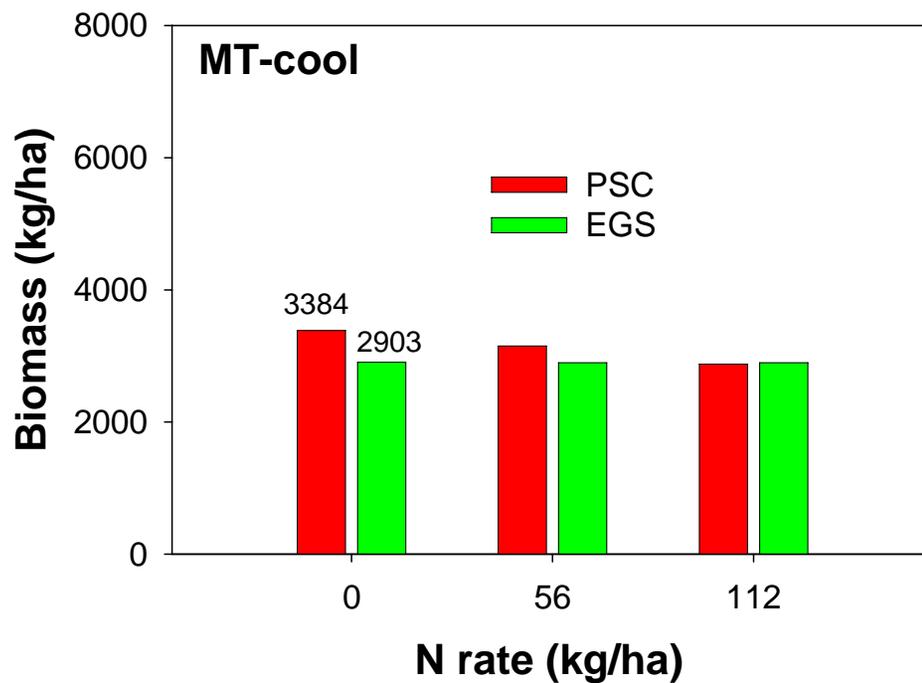
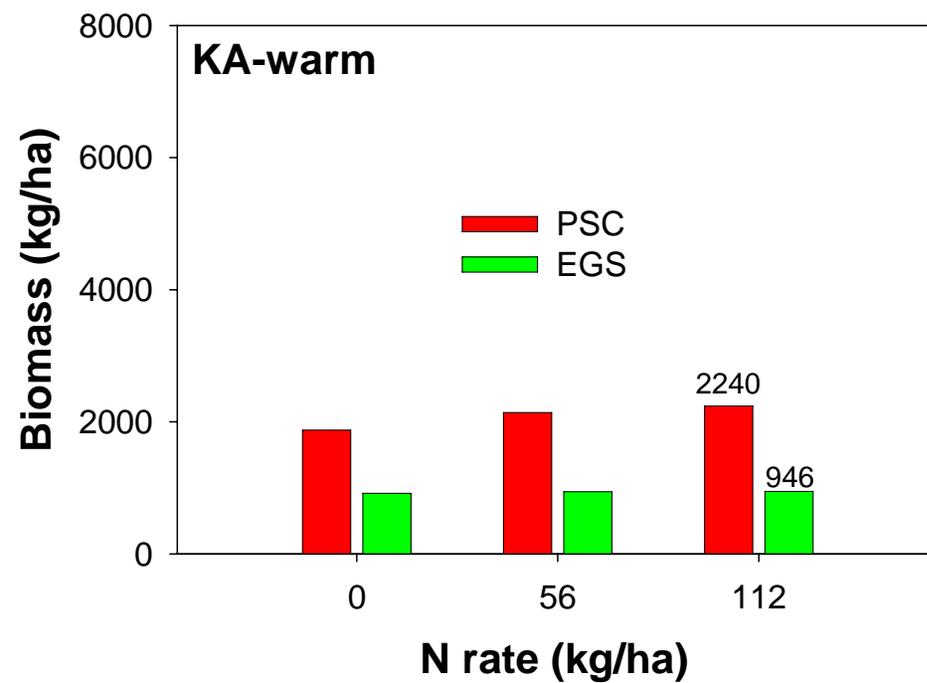
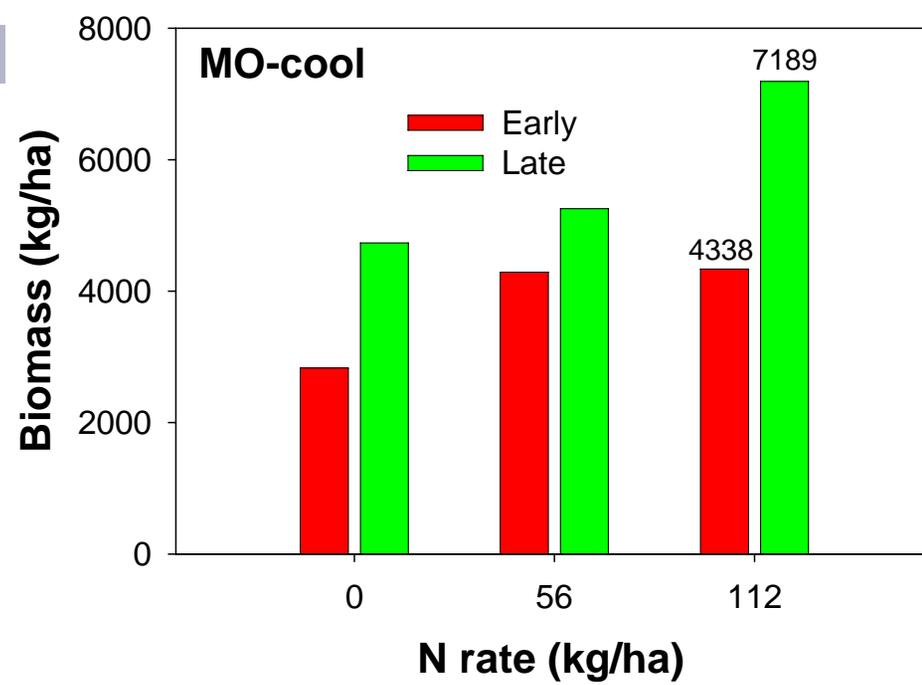
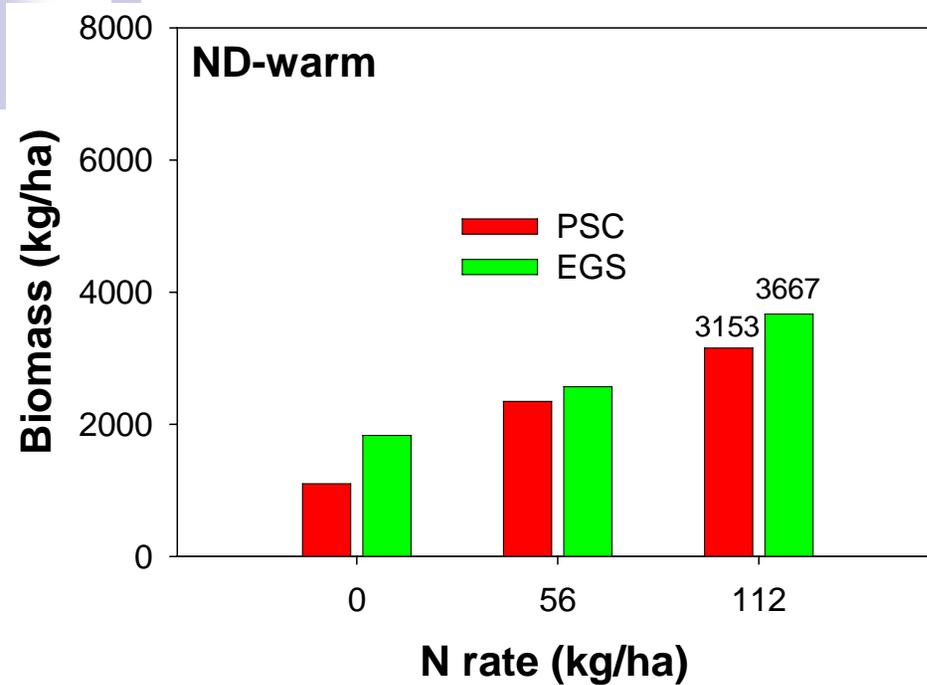


Summer CRP harvest Montana



Fall CRP harvest Montana





2009 CRP Plans

- Continue field trials at the same locations
- Adjust fertilizer rates and harvest timing
- CRP renovation with high yielding switchgrass and legume



