

USDA-ARS
Lincoln, NE
Grain, Forage, & Bioenergy Unit
Soil & Water Unit



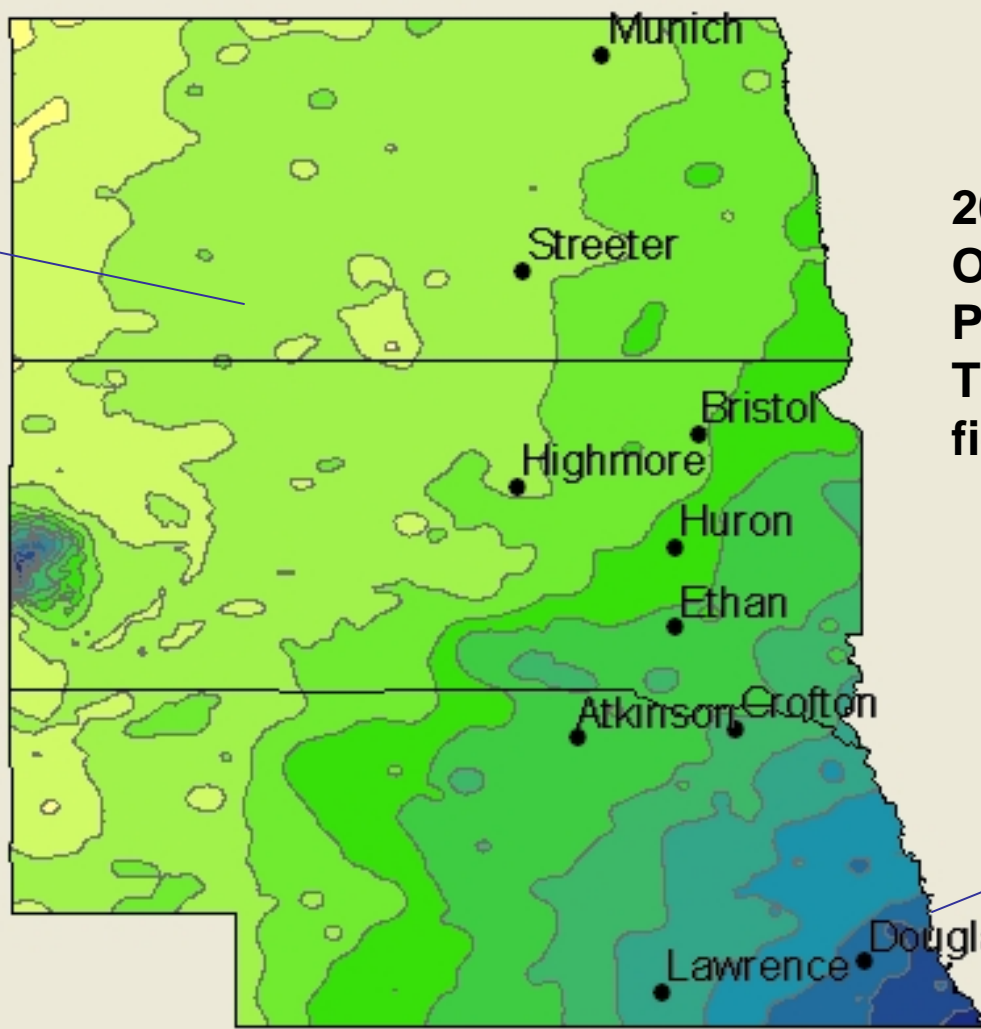
Forage & Biomass

Ken Vogel (genetics), Rob Mitchell (management),
Gautam Sarath (molecular biology) & Staff



Northern Plains Switchgrass Field Scale Production & Economic Trials

15"-17"
Annual
Precipitation



2000-2006
On-Farm
Production
Trials: 15-20 acre
fields

31"-33"
Annual
Precipitation

Energy Production in the Great Plains – On farm economic study.

- Field shown at left had a five year cumulative average cost of \$30/U.S. ton switchgrass biomass including land costs.
- Average costs for 10 farms was \$49/ton; experienced farmer's costs were \$36/ton.
- Economic analyses in review (UNL Ag Economist)
- Data from trials being used for net energy balance analysis.
- Soils sampled before & after trials – C sequestration research (ARS Lincoln & Mandan, ND.)

Switchgrass field in NE South Dakota in 2005. Yields averaged 4 tons/acre.



Take Home Lessons

- Economic production efficiency can be improved via research and producer training.
- Improved high yielding cultivars/hybrids with improved conversion efficiency will be needed.
- Additional agronomic research on fertility, establishment, seed quality, & other factors.
- Feedstock harvesting and storage research.
- Adaptation and production trials in other potential biomass production areas are needed.

Switchgrass biomass energy

Current Goals & Research

- Goals
- Full establishment in 1 year with 50% yield.
- Be at full production second year.
- Goal of 10T/A (Midwest); improved ethanol yield/ton.
- Fully documented environmental benefits
- Tools and Products
- Weed control, no-till planting, seed quality.
- Breeding - Biomass specific cultivars & F1 hybrids, improved conversion
- Molecular biology, cell wall modification & seed quality.
- Environ. studies/ C sequestration.

Establishment & Seed Quality

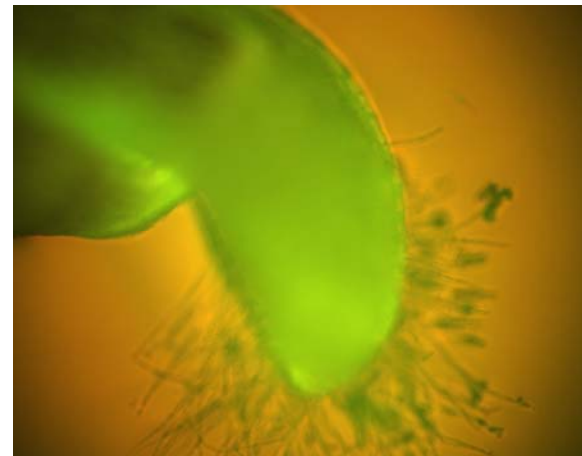
- Weed control with Paramount
- or quinclorac



Different seed quality tests

Biochemical & molecular studies on mechanisms of switchgrass dormancy and germination.

Sarath et al., 2006. Nitric oxide accelerates seed germination of warm season grasses. *Planta* 223:1154-1164.



Fluorescence microscopy of Pv seeds incubated on FDA for 2 days

**Breeding Progress for Conventional
Switchgrass Cultivars
Yield Trial Mead, NE 2003-2005**

Cultivar	Year released	Biomass yield (Mg/ha)	IVDMD (g/kg)
Trailblazer	1984	14.0	525
Shawnee	1995	14.6	548
NE 2000C1	In seed increase	16.5	538
NE Late YD C4	In seed increase	15.6	552

Improve biomass yields – hybrid cultivars

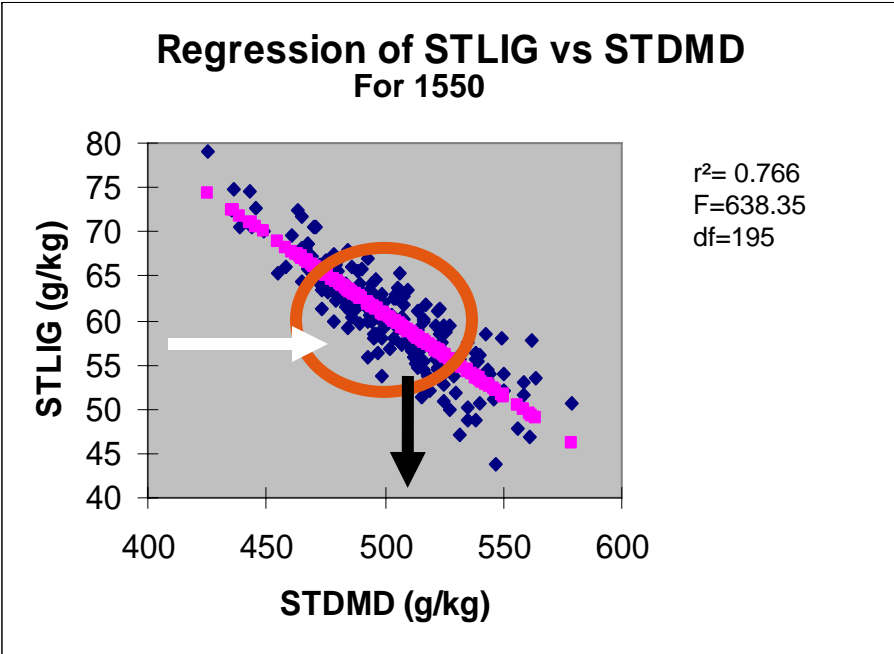


Strain	Yield tons/acre
Kanlow & Summer F1's	9.4
Kanlow	7.1
Summer	6.1

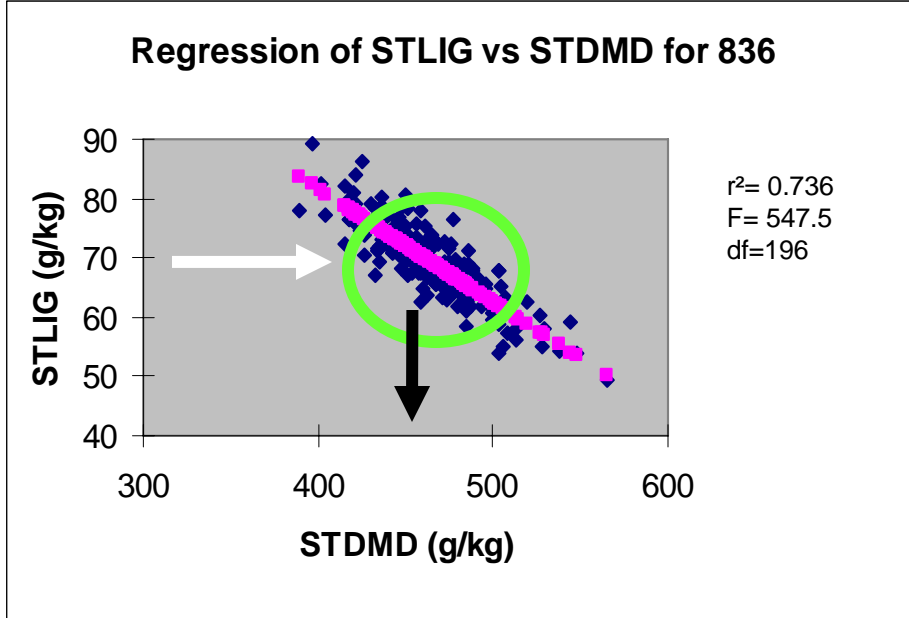
- Improved hybrid cultivars with modified cell walls could improve ethanol yields & reduce costs.

There is considerable genetic variation in lignin content in germplasm

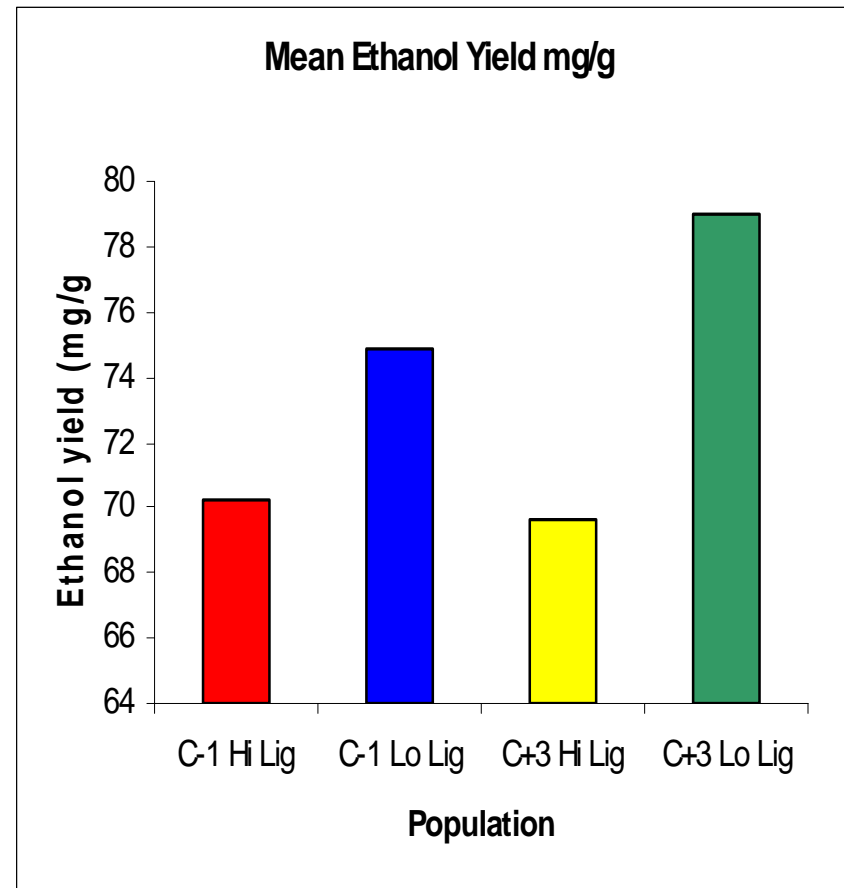
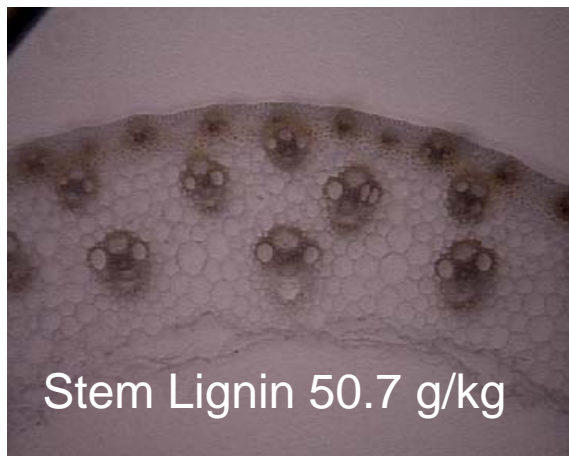
3 cycles for High DMD



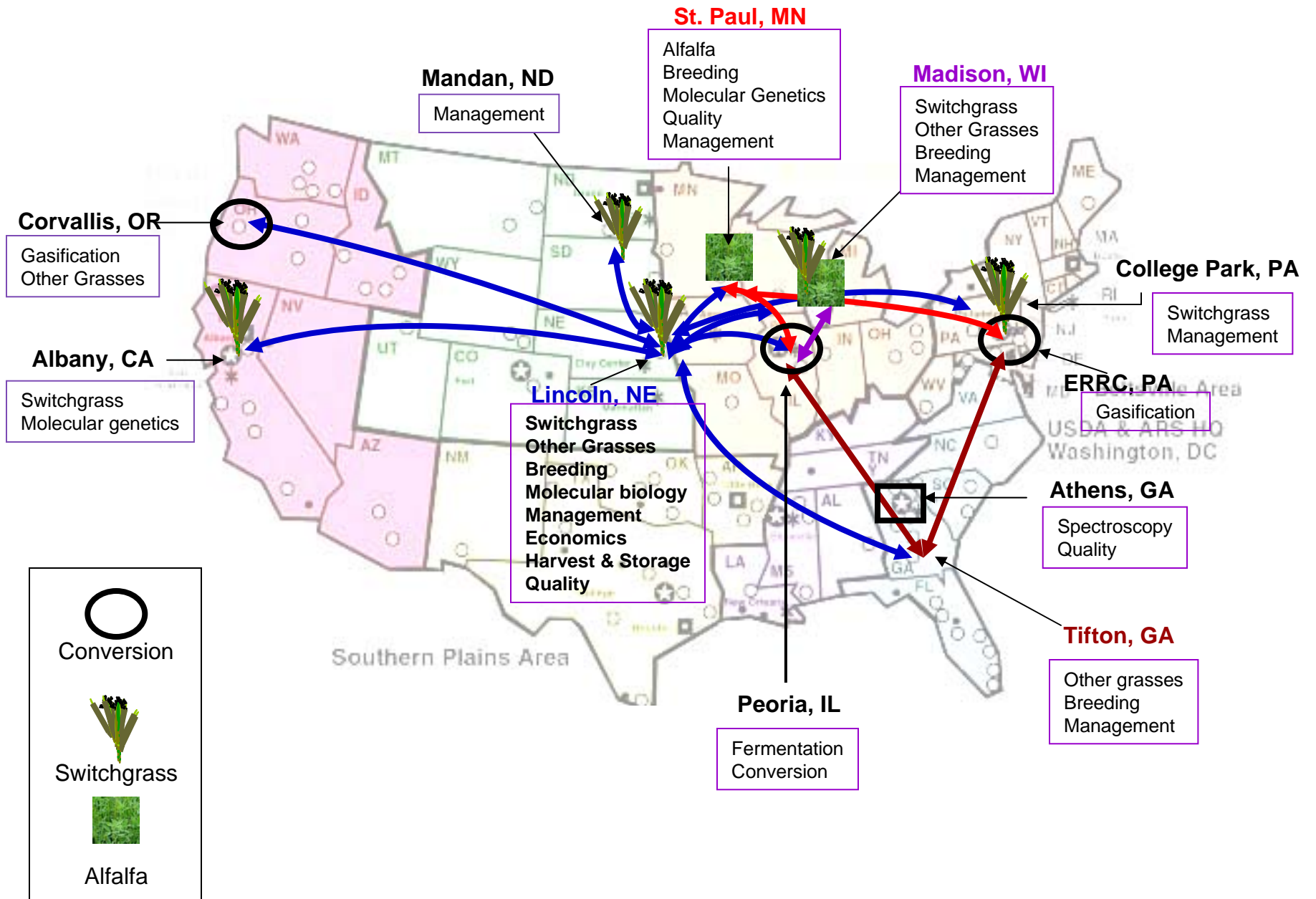
1 cycle for low DMD



Genetic effects on lignin, anatomy & ethanol yield from switchgrass cellulose



ARS Switchgrass and other Herbaceous Bioenergy Crop Research



Genetic improvement of sorghum for enhancing energy yield, nutrient availability, and disease resistance.



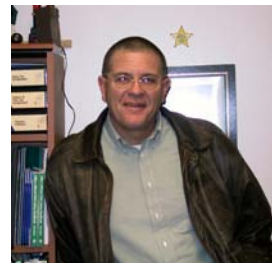
Biomass & altered cell wall chemistry



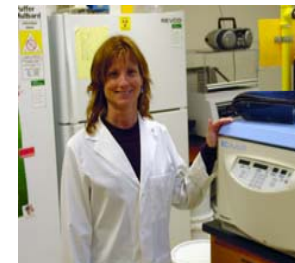
Altered starch chemistry



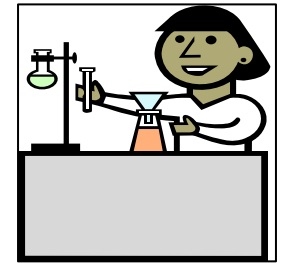
Lignin & plant fitness



J Pedersen



D Funnell

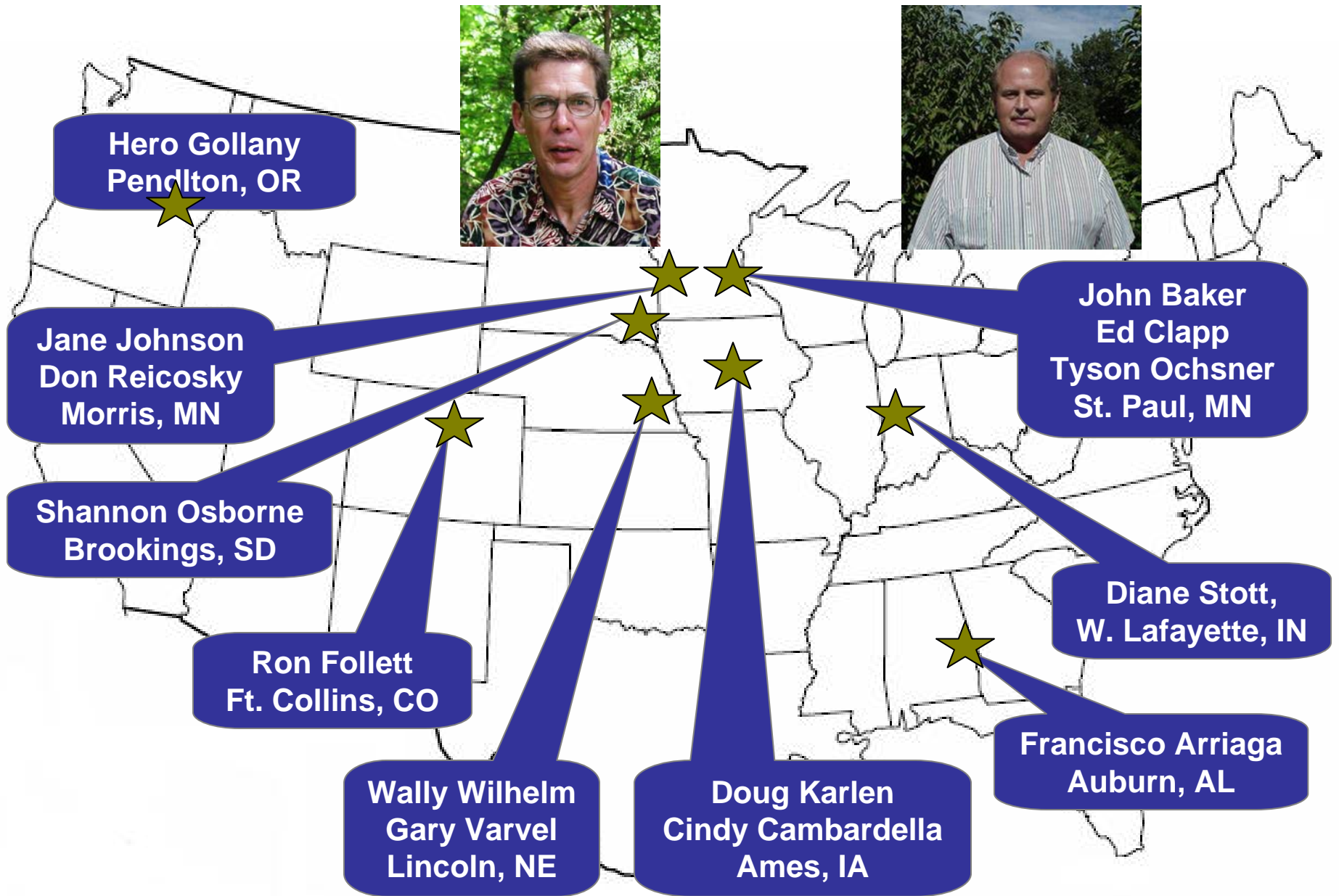


Vacant

Carbon sequestration Study- Corn vs Switchgrass, Mead, NE

- Quantify carbon sequestration on cropland converted to switchgrass.
- Compare to no-till corn.
- Ten year experiment in eastern NE established in 1998.
- In 2000, plots split and stover removed (50%) on split half of corn plots.
- Cooperative ARS-Ft. Collins (R. Follett) & NRCS National Soils Lab





REAP Effort – Soil & Water Unit Lincoln