Sustainable Corn Stover Harvest Strategies for Midwest Agricultural Landscapes

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Presentation Overview

- An overview of the USDA-ARS REAP – DOE Regional Corn Stover – Sun Grant Partnership
- What has been learned regarding sustainable corn stover harvest?
- Landscape management strategies for increasing the quantity of corn stover that can be harvested in a sustainable manner
REAP/Regional Partnership Sites

USDA National Agricultural Statistics Service 2010

27-29: Saunders Co., NE
1-9: Boone Co., IA
36: Darlington Co., SC
18-20: Stevens Co., MN
10/11: Warren Co., IL
21/22: Rice Co., MN
25/26: Redwood Co., MN
23/24: Dakota Co., MN
21/22: Rice Co., MN
25/26: Redwood Co., MN
23/24: Dakota Co., MN
12/13: DeKalb Co., IL
10/11: Warren Co., IL
14/15: Pike Co., IL
16/17: Champaign Co., IL
30-33: Centre Co., PA
36: Darlington Co., SC

USDA National Agricultural Statistics Service 2010
Utilized Multiple Harvest Technologies
What has the REAP/Regional Partnership Done?

- Compiled 239 site-years of stover harvest data
  - Effects on subsequent grain and stover yields
  - Effects on soil organic carbon (C) & aggregation
  - Effects on microbial community
  - Effects on GHG emissions

- Prepared a special 2014 issue of *BioEnergy Research*

- Developed the *Landscape Environmental Assessment Framework (LEAF)* and other tools to:
  - Estimate available residue
  - Quantify economics
  - Ensure ecosystem service benefits are sustained

This involved ARS, DOE, university, and private industry partners
What has the Partnership learned?

- Corn grain yields ranged from 5.0 to 14.3 Mg ha\(^{-1}\) (80 to 227 bu/acre)

- Average grain yield response to stover harvest was minimal:
  - 9.8, 10.1, and 10.1 Mg ha\(^{-1}\) (156, 160, and 160 bu/acre) for:
    - No, moderate (3.9 Mg ha\(^{-1}\) or 1.7 tons/acre), or high removal (7.2 Mg ha\(^{-1}\) or 3.2 tons/acre)

- Sustainable stover harvest rates are site specific – averages are meaningless

- Diversifying the Midwest landscape can increase sustainable quantities of harvestable stover
BUT– Excessive Stover Harvest Can:

- Compaction & crusting
- Degrade structure & aggregation causing –
- Water & wind erosion
- Reduced plant growth
- Impaired soil biology
- Decreased yield
- Reduced Soil Productivity
Other Lessons

- Compared to harvesting only grain – N, P, and K removal are increased by at least 16, 2, and 18 kg Mg\(^{-1}\) of stover
- Minimum residue return projections for 35 studies were 6.38 ± 2.19 Mg stover ha\(^{-1}\) yr\(^{-1}\)
- For grain yields ≤ 11 Mg ha\(^{-1}\) (175 bu ac\(^{-1}\)), ten years of stover harvest, even with no-tillage, resulted in reduced POM (particulate organic matter) accumulation
- Low corn yields shifted the dry aggregate distribution toward smaller soil aggregates
- Insufficient yields resulted in undesirable shifts in the microbial community
- Overall, sustainable supplies of corn stover may be lower than initially projected because of weather-induced yield variability
Strategies for Landscape Diversification

- Living mulches
- Oilseeds
- Double or relay cropping
- Cover Crops
Another strategy – an alfalfa paradigm shift

REAP goal – diversify landscape, provide feedstock, improve soil health, & protect water quality
Alfalfa Leaf Protein Collection & Extraction

Create market-pull for perennials by starting with a familiar crop
U.W. Platteville Pioneer Farm

Soil profile & water quality data is being collected in 2 watersheds to establish a baseline as we scale up for future full-scale studies.
Research Needs for Landscape Diversification

- Effective and efficient strategies for including cover crops in stover harvest systems
- Low-disturbance equipment for incorporating animal manures to improve soil health and increase harvestable stover supplies
- No-tillage technologies that incorporate site-specific, on-the-go seeding and seedbed adjustments to help encourage adoption of those practices
- Innovative harvest methods and new uses for perennial crops to diversify crop rotations for improved soil health, increased yield, and sustainable stover supplies
Summary & Conclusions

- REAP/Regional Partnership recommendations
- Develop sub-field stover harvest practices
- Decrease tillage intensities
- Utilize cover crops
- Diversify the landscape with perennials, cover crops, oilseed crops, or where feasible by double-cropping
- Continue research and development of the Landscape Environmental Assessment Framework (LEAF) which Dave Muth will discuss in greater detail in the next presentation
Developing Sustainable Stover Harvest Strategies was the First Step Toward Solving Landscape Energy and Ecosystem Challenges

Any Questions?