Managing Crop Residues for Productivity, Ecosystem Services and the Bio-Economy

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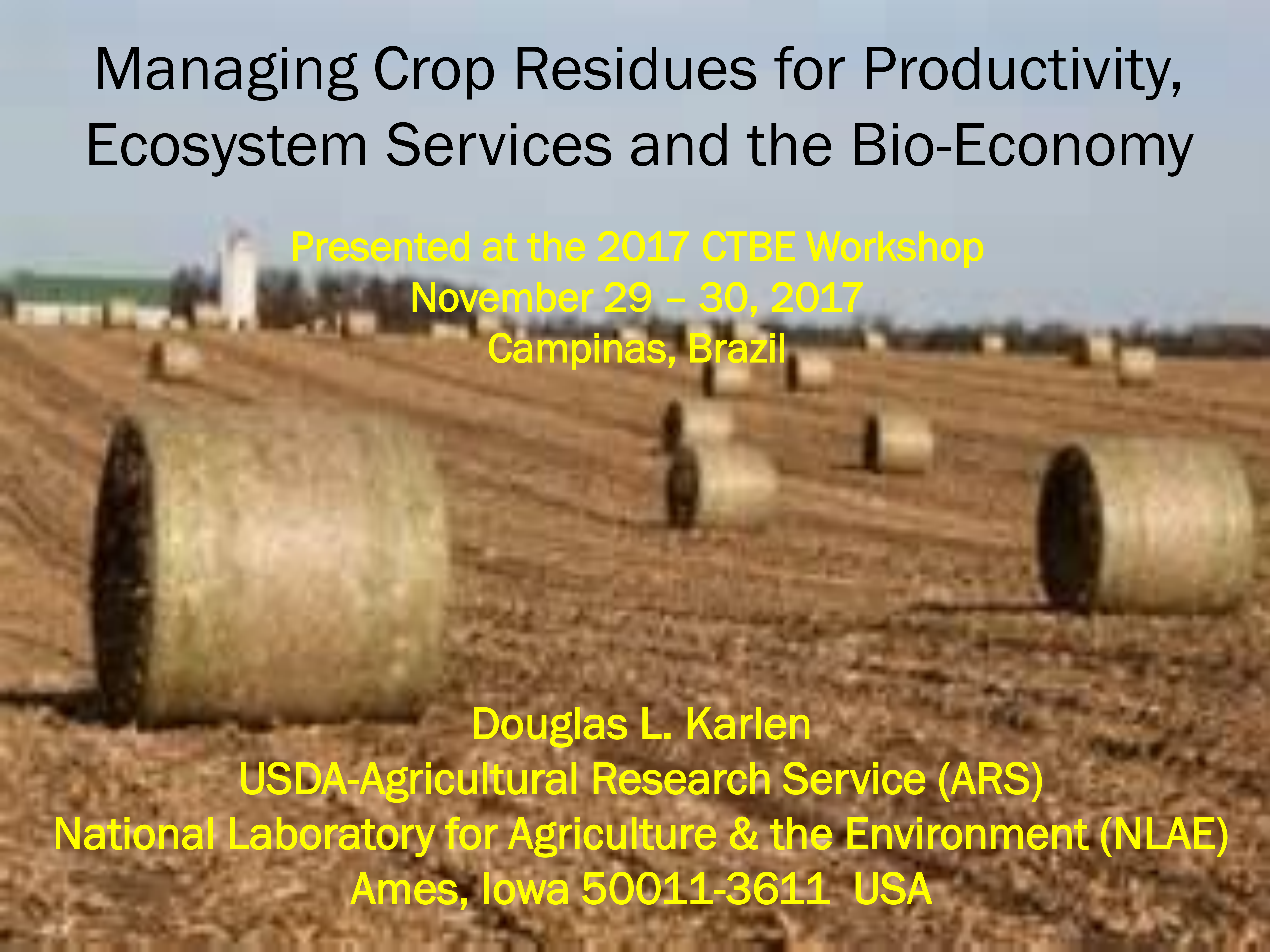

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18 Years of Corn Stover Research Shows That:

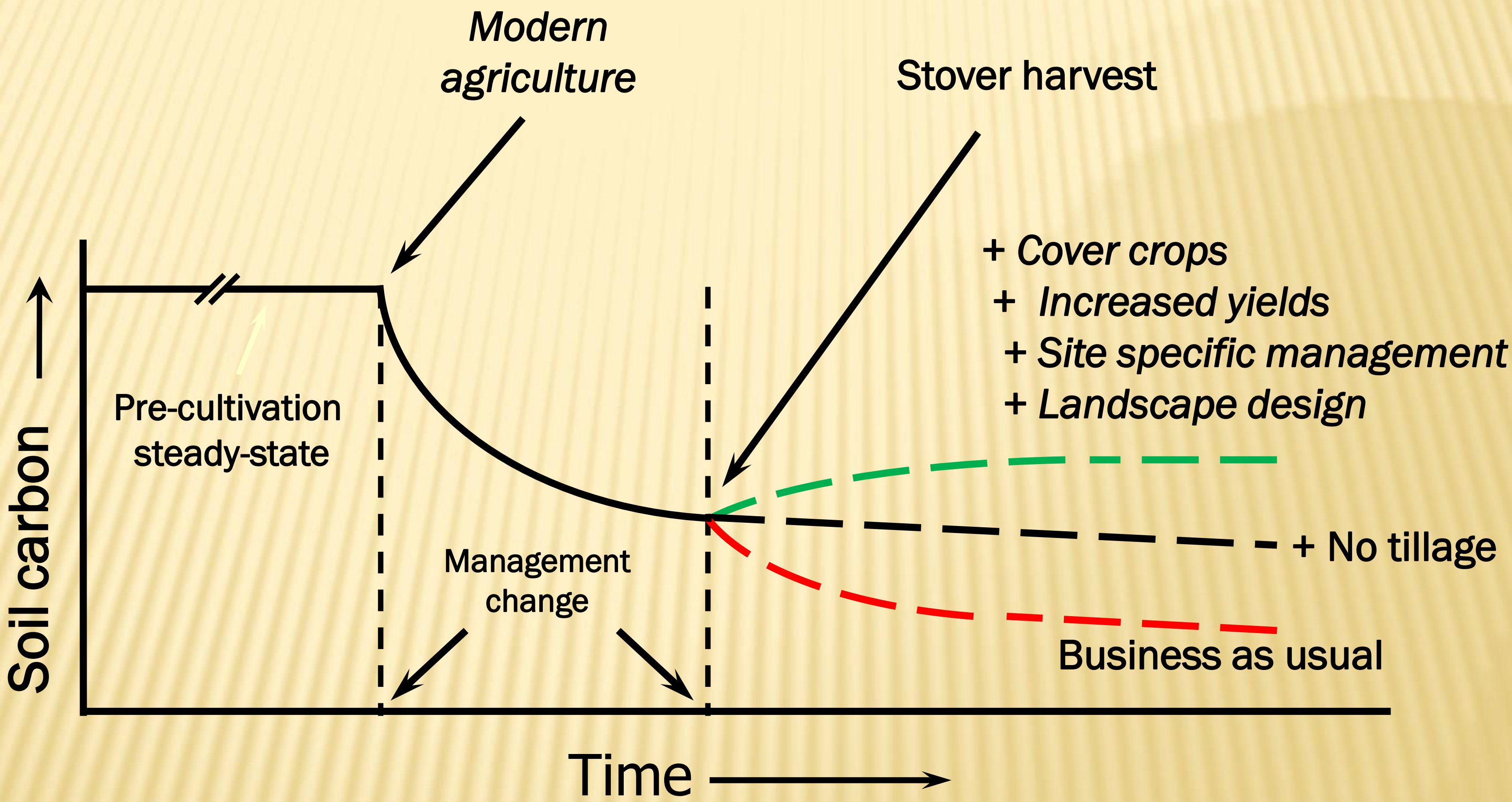
Management challenges such as lower soil temperature and N immobilization may cause some people to refer to crop residues as “trash” but in reality they are critical resources that provide many ecosystem services

Managing soil organic carbon (SOC) is crucial and requires more residue (C) input than erosion control

Therefore, crop residue removal or harvest rates must not exceed sustainable, site-specific levels

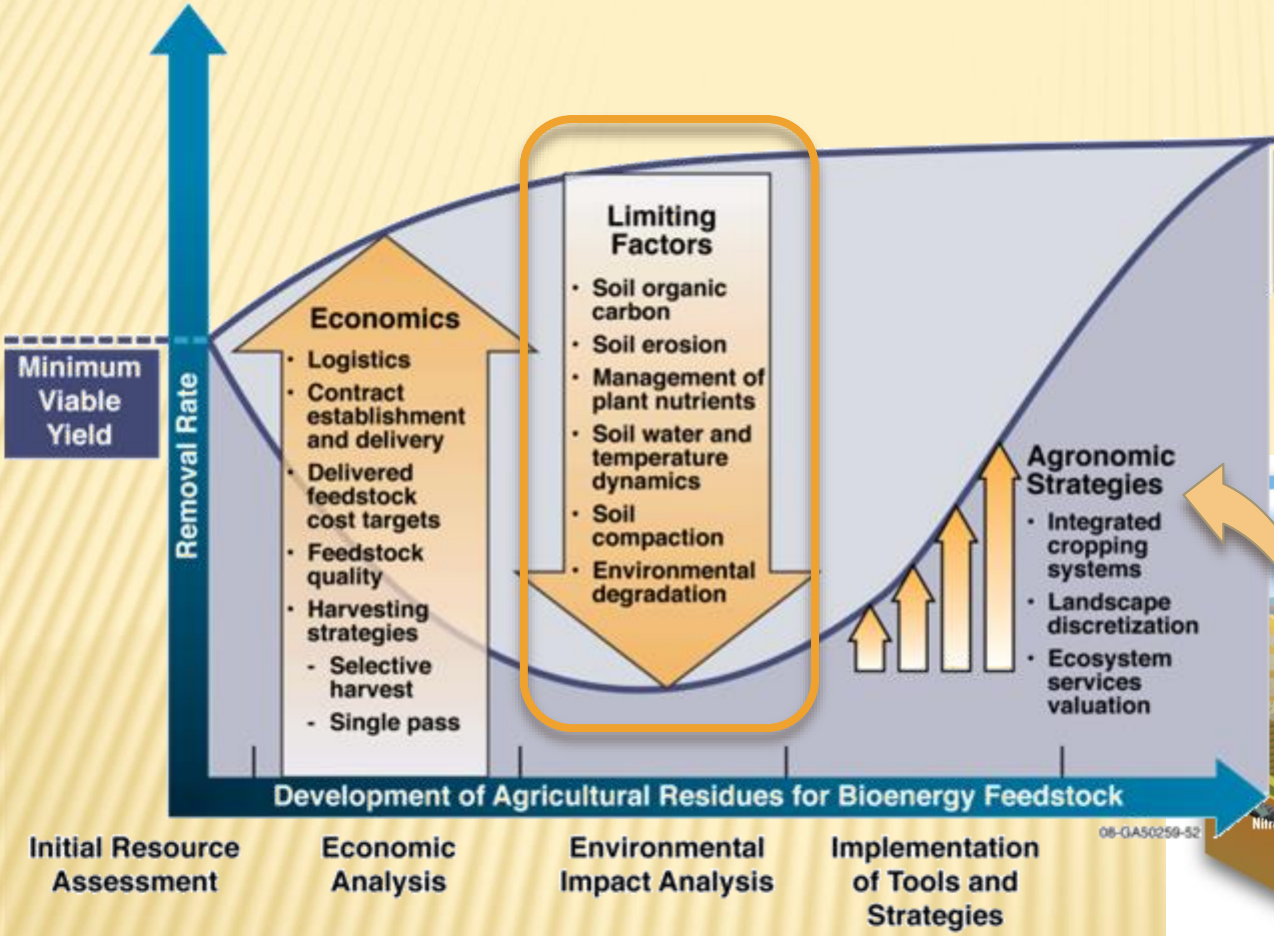
Adopting reduced- or no-tillage practices and adding cover crops will improve the sustainability of stover harvest

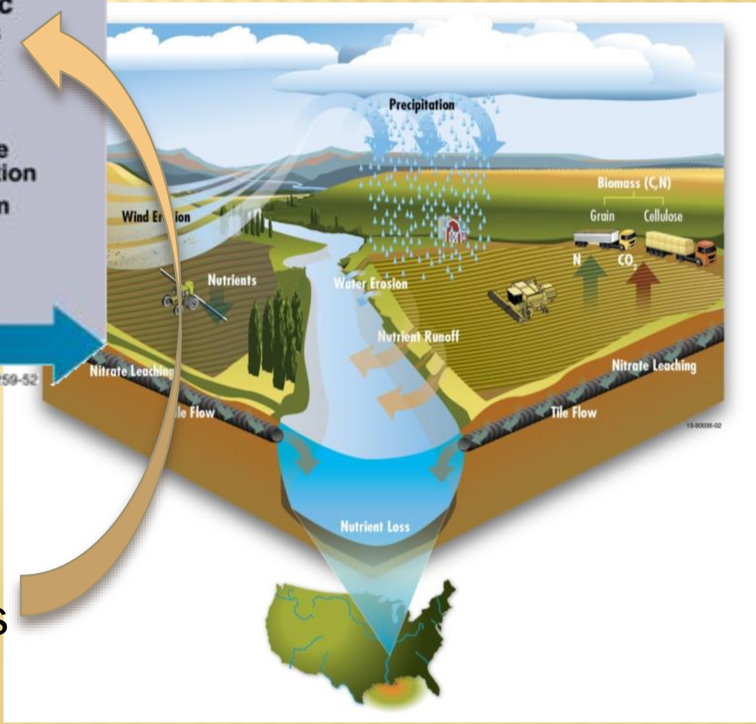
Why Managing SOC is Crucial



Δ *SOC = input - output*

Soil Health Assessments – Provide guidance for sustainable biomass feedstock production





Research focused on quantifying limiting factors, so we can develop effective agronomic strategies for delivering sustainable feedstock supplies

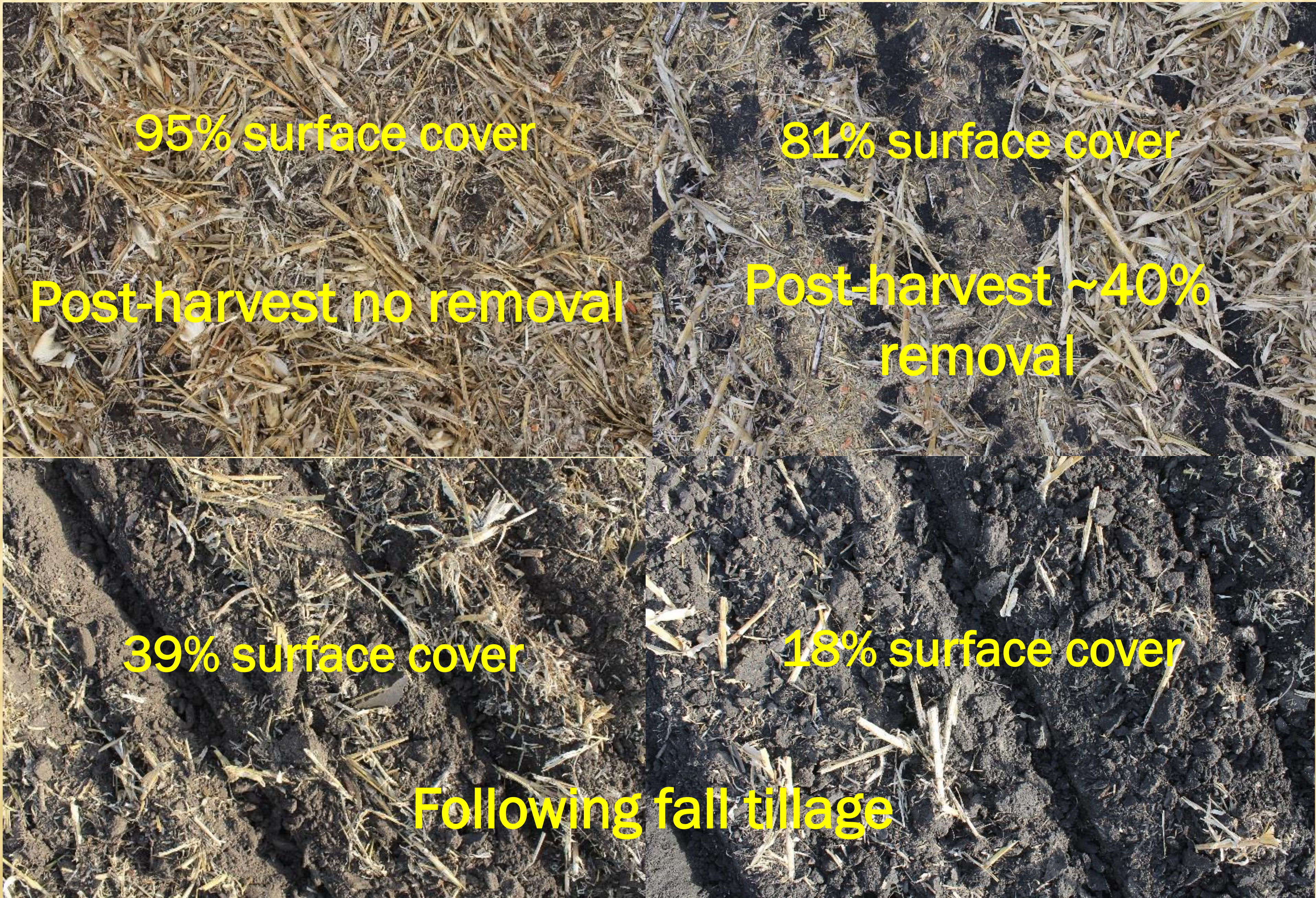
Excessive Stover Harvest

Leaves soil vulnerable to wind and water erosion

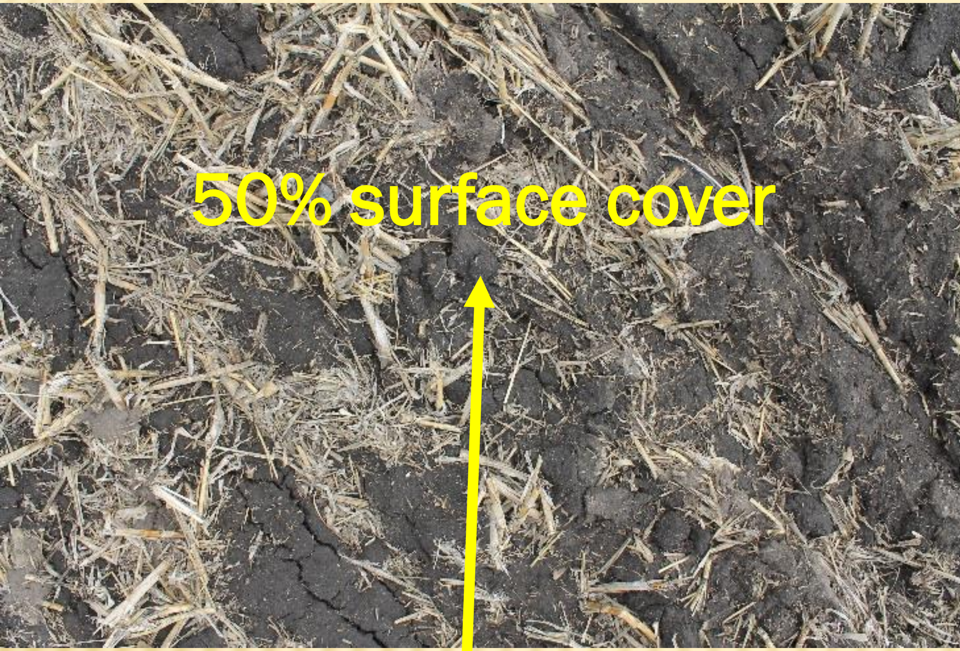
Depletes food supply for soil microorganisms

Depletes soil organic matter, negatively impacting water & nutrient retention

Stover Harvest vs Tillage Effects on Surface Cover

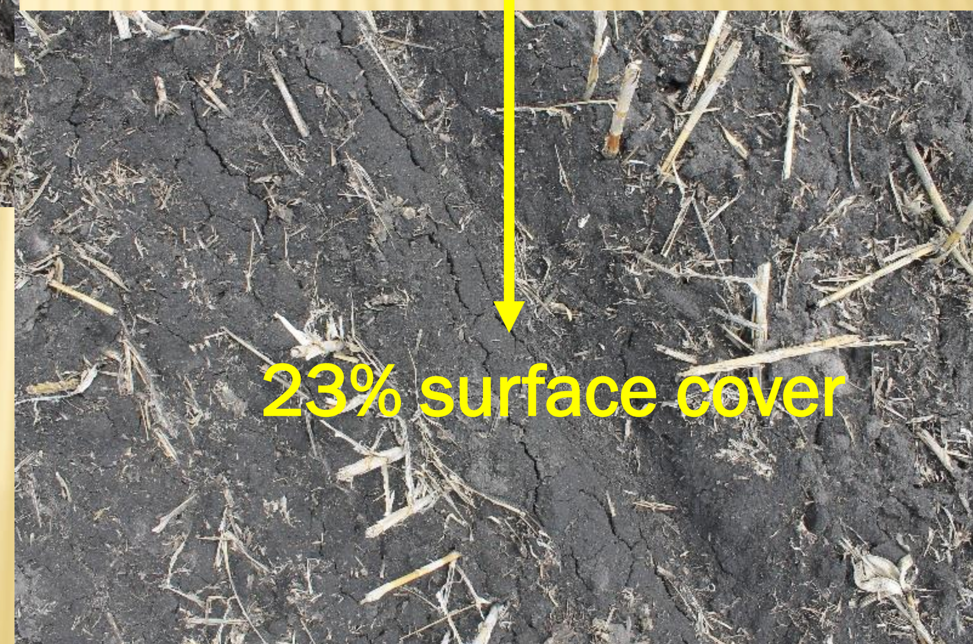


Soil Surface Cover Prior to Spring Tillage & Planting



No stover harvest followed by fall tillage and winter weathering

~40% stover harvest followed by fall tillage and winter weathering



Reduce Tillage Intensity By Using Cover Crops

Roller-crimper to kill cover crop

No cover crop

Harvested cover crop

Potential cover crops – cereal rye, triticale, spring oat, tillage radish, pea, & other species

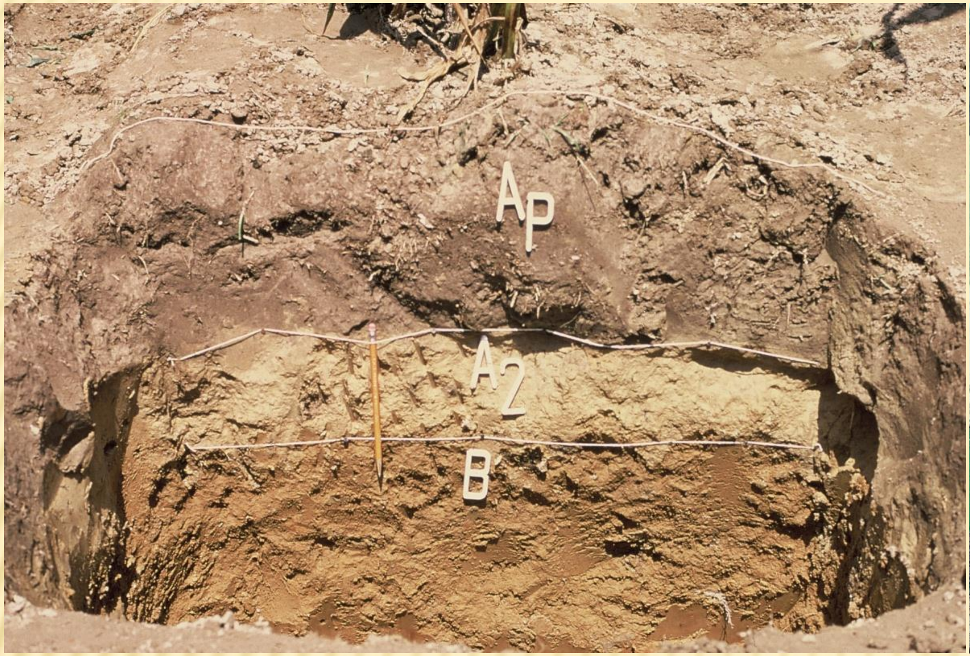
Potential Cover Crop Species

Tillage Radish

Cereal Rye

Kura clover –
living mulch

My Cellulosic Feedstock Research Began in 1979



The initial stover harvest studies were conducted in the southeastern U.S. on Norfolk loamy sand

The A2 or E horizon impaired root growth and limited yields

Conventional and conservation tillage planting equipment had to be equipped with in-row subsoil shanks to physically disrupt the E horizon

Initial Feedstocks and Planting Improvements

Corn stover and winter rye were both harvested as potential bioenergy feedstocks

Using a flail chopper resulted in high contamination with soil (ash)

Conservation tillage equipment however, improved significantly

Single-Pass Technologies 2005 – 2015

2005

2009 – 2012

2006 – 2008

2013 – 2015

Site-Specific Harvest Increases Sustainability of Cellulosic Feedstock Production

Our 2005 to 2015 studies with a single-pass John Deere harvesting system enabled us to differentially harvest corn stover and then vary the post-harvest tillage depth using real-time GPS, yield monitors and the RUSLE2 soil erosion model.

Our harvest speed (max. 3 mph) was the limiting factor so in 2016 we switched to the CornRower™ system which should have site-specific capabilities by 2018


NEW HOLLAND


NEW HOLLAND

Summary and Conclusions

- Harvesting corn stover and other crop residues is not a new concept – it's been a common farming practice for centuries
  - What's new is its use as a bio-economy feedstock
- Crop residues have many roles including protection against soil erosion, provision of soil carbon, and cycling of plant nutrients
- Nutrient management research shows that "Balance is the key"
- For sustainable feedstock production, corn grain yields should be ≥11 Mg ha^{-1}
  - That grain yield will provide at least 4 Mg ha^{-1} for soil protection

The Ultimate Goal: Healthy Soils → Healthy Landscapes → Vibrant Bio-Economies