Sustainable Bioenergy Grain Crop Production Systems

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The Future of Grain Crops

- More intensive production
- Less surpluses and subsidies
- Higher prices with more volatility
- Improved nutrient cycling
- More need for sustainable production

No-tillage wheat following corn

Sustainability

- Soil quality
- Economic viability
- Pest management
- Nutrient cycling
- Biodiversity

No-tillage soybean following corn

Pennsylvania Issues

- Integration with existing animal based agriculture
- Diverse land resource base
- Many rural, small scale landowners
- Commodity processing industries in proximity to large markets

Sustainable Cropping Toolbox

- No-tillage
  - Less soil erosion, esp. on sloping lands
  - Moisture conservation
  - Reduced energy and labor
  - Lower cost of production
  - More potential for biomass removal
  - Increased management

No-tillage corn following wheat

Sustainable Cropping Toolbox

- Winter Cover Crops
  - Increased growth and capture of radiation in fall and spring
  - Soil erosion control
  - Increased revenue generation
  - Improved drought tolerance

No-tillage wheat following corn

Sustainable Cropping Toolbox

- Nutrient Cycling
  - Integration of animal and energy production
  - N, P and K of biofuel crops are recycled for crop use
  - Lower cost of production
  - Energy balance of crop production improved

Sustainable Cropping Toolbox

- Soil specific production
  - Use marginal lands for perennial crops
    - Switchgrass
    - Cool season grasses
    - Agroforestry?
  - Use drought prone soils for winter crops
    - Barley, wheat, triticale, canola

Example System

Corn	Barley	Soybeans
May-Sept	Sept-June	June-Nov

- All crops planted no-till: low energy use, soil erosion
- Outputs: Corn grain, corn stover, barley grain, barley straw, soybean grain
- Animal Use: Corn grain and stover (silage), soybean meal, barley straw
- Energy: Barley or corn grain, soybean oil
- Nutrients recycled in cattle manure, N fixed in soybeans
- Good drought tolerance, pest management due to no-till and crop rotation

Example Potential System

Corn silage	Canola	Soybeans
May-Sept	Sept-June	June-Nov

- All crops planted no-till: low energy use, soil erosion
- Outputs: Corn silage, canola grain, soybean grain
- Animal Use: Corn silage, canola meal, soybean meal
- Energy: Canola oil, soybean oil, canola straw?
- Nutrients recycled in cattle manure, N fixed in soybeans
- Good drought tolerance, pest management due to no-till and crop rotation
- Oilseed crushing spread across seasons

Winter Barley Research

- Screening lines for yield, winter hardiness, height, and disease resistance
- Release of new hulled lines
- Evaluation and demonstration of hulless lines for ethanol production

'Doyce' hulless barley

Canola and Rapeseed Evaluation

- Evaluating prospective winter and spring types
- Developing economic comparisons with existing crops
- Evaluating the potential of on farm pressing

Winter canola

Challenges

- Large scale biorefineries demand large quantities of uniform feedstocks
- Our ag systems generate diverse feedstocks in moderate quantities
- Can our ag systems provide a portion of the feedstocks to regional biorefineries and utilize coproducts effectively?
- Can smaller scale bioenergy systems be developed to use flexible feedstocks?

Conclusions

- Cropping systems can be intensified to sustainably provide additional bioenergy feedstocks
- No-tillage, cover cropping, nutrient management, and soil specific production are essential components
- New opportunities exist in biofuels systems, cropping systems and variety development

Questions?