International Sorghum for Biofuels Conference

Workshop # 3

Sustainability and Agronomic Issues

Top 5: Challenges / Knowledge Gaps

Challenges / Knowledge Gaps	Impact				Implementation		
	A. Productivity	B. People	C. Countries / Geograph	D. Overall	E. Difficulty	For top 5 in column E, capture reason for why difficult to address	F. Cooperation Needed
1. Biotic and Abiotic Stress Management (weeds, insects, diseases, other stresses) (31)	24	17		22	22	Multidimensional challenge – a moving target	30
1. Nutrients and Water Management (26)	24	26		29	12		12
1. Soil resource use and sustainability (several items under, carbon, nutrients) (23)	22	24		19	17	Timeframe to assess impacts/benefits, cost, pressure on marginal lands	12
1. Cropping Systems including rotations, cover crops (18)	18	13		19	6		6
1. Climate Change Impacts and Mitigation (16)	8	20		15	31	Policy, time scale, technical challenges	18

Key Messages

- Agronomy and Sustainability are integrated and cannot be addressed separately
- All five of the top issues involve an integrative approach across disciplines
- We had a very lively discussion that brought up the passionate nature of the topics

1. **Biotic and Abiotic Stress Management (weeds, insects, diseases, other stresses) (31)**

- Integrated stress management / on a regional basis - S
  - Determine how these stresses impact the crop / use to prioritize research
  - Stress matrix – differential impact of stress on sugar, biomass, other products
  - Stress tolerance/avoidance of different species and cultivars
  - Alternative biotic stress control (chemical, genetic, biological, mechanical, cultural)
  - Determine interactions
  - Approach it from the systems perspective, assessing multiple stresses in the same experiment

2. **Nutrients and Water Management (26)**

- On-site management for productivity
- Develop timing and rate guidelines for nutrient management (N, P, others) - S
- Identify nutrient and water requirements for these crops and tissue composition - S
- Understand WUE / NUE compared to other crops - S
- Interaction with tillage system and cropping systems - S
- Prevent and minimize off-site impacts
- Nutrient, pesticide, and sediment losses (runoff, percolation, lateral flow) - SM

3. **Soil resource use and sustainability (several items under, carbon, nutrients) (23)** - S

- Determine nutrient removal rates
- Identify the components that maintain / build soil organic matter. Define baseline, threshold carbon values. Define carbon pool sizes and fluxes under different managements and systems.
- Determine changes in soil properties: physical, biological, and chemical properties: compaction, structure, aggregation, acidification, etcetera.
- Identity and sustaining beneficial microbial communities
- Determine impact on erosion, soil erosion control
- Emergence of new technologies

4. **Cropping / tillage systems incl. rotations, cover crops (18) - S**

- Cover crops as a supplement to inorganic nitrogen fertilizer
- Tillage system comparisons
- Identify a menu of crops that maximize economic value
- Determine the agronomic practices that maximize sorghum productivity (e.g. Impact of rotation crop)
- Integration of sorghum with grazing systems
- Enhance wildlife benefits of sorghum systems
- Maintaining ground cover in systems that extract a large fraction of the residues
- Include break crops in rotation: mitigate pest and disease cycles
- Design cropping systems that balance resiliency, flexibility and profitability – M

5. **Climate Change Impacts and Mitigation (16)**

- LCA of optimized cropping systems (supports inclusion in the renewable energy mix, assessing potential for carbon trading) - M
- Determine the impact of atmospheric CO2 and temperature changes elevation on crop/cultivars growth, phenology, water use, and nutrient demand; assess interaction with other factors - S
- Model / measure the impact of sorghum production systems on greenhouse gas emission and the environment - SM
- Model / measure the impact of climate change on sorghum production systems - S
- Identify early indicator species for climate change (insects, weeds, diseases) that can interact strongly with sorghum systems - S

Collaboration

Benefits

- Sustain agriculture
- Social and political stability
- Acceleration of problem solving
- Efficient use of resources
- Issues are so complex we cannot address them without collaboration

Collaboration

Barriers

- Limited reward for integrative approach to research
- Limited expertise to assess new issues like LCA, policy analysis
- Limited interdisciplinary training in agricultural sciences and policy makers
- Slow response time of research (and policy) system to current demands
- Articulating complex issues in vernacular term to the general public
- Funding amount and duration to conduct integrated research needs to increase significantly for teams to deliver products from integrated research
- Expectations for deliverables on a quick turnaround when developing the teams require longer time frame

Collaboration

Potential Next Steps

- Motivational resources
- Additional forums to identify targets and establish team to address this issues
- Establish training grant to prepare next generation of integrative researchers and systems scientists
- International consortiums to facilitate and finance the development of international teams (including private global companies)
- Closer linkages across disciplines and among government agencies, academic institutions and private companies from the US and abroad (shared positions/sabatticals).
- Foster institutional collaborations instead of competition