Enhancing pulse productivity on problem soils by smallholder farmers: Challenges and opportunities

Workshop held August 14-18, 2011 at Penn State

Goal:

"... formulate recommendations on future **research** foci to achieve **major increases** in pulse productivity under **edaphic and abiotic stress** conditions in small-holder farm settings."

Bob Herdt, Cornell (facilitator)

Jim Beaver, U Puerto Rico
Steve Beebe, CIAT
Jonathan Lynch, Penn State
Mark Westgate, Iowa State

I. Rao, CIAT
Jeff White, USDA/ARS

Sieg Snapp, MSU

45 participants

US PLGUs	19	(11 universities)
CG	8	(CIAT, ICRISAT, IITA, IRRI)
USDA/ARS	6	
African NARS	6	
USAID	4	
USDA	1	
McKnight	1	

working groups:

- genetic improvement
- phenomics
- BNF/plant microbe interactions
- systems analysis and management

each group developed

- goals and potential
- actions and outputs
- outcomes

Genetic Improvement

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- raw material for soil microbiologists, agronomists, modeling

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- Better understanding of how genotype affects phenotype;
- A platform incorporating genomic tools for legume breeding.

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- Better understanding of stress tolerance, useful for guided breeding and modeling system impacts/future climates.
- Genetic information will benefit other breeding objectives, including biotic stress resistance and biofortification.

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Substantial impact can be realized by deploying traits of known value such as **root hairs**, **Al resistance** and **Mn tolerance** in breeding programs.

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- integration of genetic and management technologies for improved Integrated Crop Management.

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Outcomes include all of those listed for Genetic Improvement, including improved efficiency of breeding programs, improved germplasm, and improved understanding of relevant processes that will guide model development and Integrated Crop Management strategies.

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- identification of enabling interactions between a broader array of soil microbes and legumes that promote favorable plant growth and suppress soil-borne diseases.

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- characterization of host response with and without environmental stress, to explain a “BNF-gap” under stress;
- cross-legume comparisons to reveal host traits explaining differences in BNF efficiency.

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Actions/Outputs related to establishing a Regional Rhizobia Resource Center:

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- industry standards for inoculant quality control, quality control detection, and inoculant production at large scale and on-farm.

BNF/plant microbe interactions

Outcomes:

- Increased pulse production by smallholder farmers.
- New knowledge about the effects of crop management and soil conditions on soil microbial dynamics will inform needed changes in cropping systems management.
- Establishing the genetic basis for superior plant-microbe interactions will speed development and deployment of improved varieties with greater yields in degraded soils.
- Creation of the Regional Rhizobium Resource Center will provide training, germplasm curation, and inoculum production, which are critical for improving BNF on a regional scale.

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Four advances and innovations can support the required transformation of legume systems agronomy in Africa:

- Simple, robust ecophysiological models combined with geospatial tools can simulate pulse productivity as affected by crop and soil management scenarios in Africa. The cost and time required to generate a similar set of data using conventional agronomic trials is prohibitive.

Systems analysis and management

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Improved crop and soil management are fundamental to ensuring that gains through genetic improvement attain their full potential and that such gains are truly sustainable.

Our goal is to identify and promote promising crop management options for pulse agroecosystems that emphasize more efficient use of existing or readily available resources and that ultimately improve the productivity, profitability and sustainability of smallholder agriculture.

Four advances and innovations can support the required transformation of legume systems agronomy in Africa:

- Simple, robust ecophysiological models combined with geospatial tools can simulate pulse productivity as affected by crop and soil management scenarios in Africa. The cost and time required to generate a similar set of data using conventional agronomic trials is prohibitive.
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- Advances in fundamental understanding of soil processes.
- Widespread recognition and acceptance of farmer participatory research.
- Networking tools can ensure that producers have access to information in a timely and location-relevant manner and can provide feedback to the research community in a cost-effective manner.

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- *Ex-ante* and *ex-post* socio-economic analyses will be conducted to evaluate the impact of promising strategies.

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Outcomes:

QSA in coordination with participatory research will accelerate locally-appropriate adaptations to African pulse agroecosystems that are more diverse, productive and resilient to edaphic and climatic constraints. This research approach also permits the development agronomic practices that are more attuned to the needs and limitations of specific target environments.

closing thoughts