From:	Bill Rooney
To:	"Avant, Bob"; "gkganjegunte@ag.tamu.edu"; "John Mullet"
Cc:	"David Baltensperger"
Subject:	mini proposal
Date:	Thursday, August 20, 2009 11:56:00 AM
Attachments:	FAO 0000123 Salt Tolerance in Sorghum.docx

Bob:

I've visited with David, Girisha and John. Attached is a draft two page proposal that attempts to cover a few topics as defined by the earlier e-mails. John and Girisha have not had a chance to edit - if they would like I would ask them to make edits and send directly to you as I will be out tomorrow and I won't have time to work on this again until late next week (which will be too late). I assumed that I did not need to detail a budget. If that is wrong, please just make a best guess based on the funding level (or have these other guys attempt to do so).

If no edits from them, please use as needed.

regards,

bill

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Summary

Title: Designing Salt Tolerant Bioenergy Sorghum

Faculty: William L. Rooney, Professor, Department of Soil and Crop Sciences, College Station; John Mullet, Professor, Department of Biochemistry and Biophysics, College Station; Garisha Ganjegunte, Assistant Professor, Department of Soil and Crop Sciences, El Paso. Texas AgriLife Research and Texas A&M University

Overall Goal: The overall goal of this research is to evaluate sorghum germplasm for salinity tolerance and to develop enhanced salt tolerance in bioenergy sorghum genotypes. This will will improve biomass production in regions with poor quality irrigation water and saline soils.

Specific Objectives:

1. Screen sorghum germplasm for accessions with elevated salt tolerance and establish existing agronomic productivity of bioenergy sorghum under in saline production systems of West Texas.
2. Characterize the genetics of salinity tolerance in bioenergy sorghum and utilize this information to develop salt tolerant bioenergy sorghum genotypes.

Background and Rationale:

The C4 grass sorghum has been identified as a superior plant species for lignocellulosic bioenergy production due to this plant's ability to produce ~10-15 dT of biomass per acre in good production environments. Further genetic improvement of bioenergy sorghum could potentially increase biomass yields to ~20 dT/acre under good agricultural conditions and adapt this crops for production in less favorable environments. The development of high yielding bioenergy crops is of central importance to the successful establishment of a large-scale biofuels industry for several reasons; (1) high yielding bioenergy crops will reduce the cost of biomass per unit of biofuels produced, (2) high yielding bioenergy crops will reduce competition for land and between food and fuel crops by minimizing bioenergy production footprints, (3) high yielding bioenergy crops will reduce the cost of transporting biomass to biorefineries by increasing the amount of biomass that can be generated near a biorefinery, and (4) high yielding bioenergy crops will significantly reduce carbon emissions per unit of transportation fuel produced generating carbon credits and positive environmental impact.

Further development of high yielding bioenergy crop species is expected occur over the next ten years through improvements in bioenergy crop genetics and management in three parallel ways; (1) increasing the yield of bioenergy crops in good environments with maximum inputs of nitrogen, phosphorous, etc., (2) increasing the yield of bioenergy crops in regions and environments that have specific production constraints such as drought or saline soils and with reduced inputs to expand the amount of land available for production and to reduce competition with food crops, and (3) modification of the composition of bioenergy crops to optimize the yield of biofuels derived from specific conversion processes.

The proposed project will focus on the development of bioenergy sorghum for regions with saline soils and those that must rely on poor quality irrigation water. The development of lignocellulosic bioenergy crops that can be grown on saline soils or with poor quality irrigation water will reduce competition between food and fuel crops and expand the acreage available for bioenergy production. The acreage of saline soils across the world has expanded greatly over the past 50 years due to irrigation in regions with high evaporation and low rainfall. In some regions this land has been abandoned and could be brought back into production if saline tolerant bioenergy crops were available. In other regions, poor quality irrigation water is available that could be used for production of bioenergy crops if these crops had an increased level of salt tolerance. Moreover, increasing the salt tolerance of bioenergy crops may increase yield in regions of good agricultural production because saline soils affect production in some sub-areas of even good production regions.

Sorghum is an ideal species to utilize for the development of salt tolerant lignocellulosic bioenergy crops for the following reasons; (1) sorghum has been identified as one of the most promising crops for lignocellulosic bioenergy production, (2) the ~40,000 accessions in the sorghum germplasm are very diverse and were collected from all regions of the world including regions with saline soils making it likely that genes (or alleles of genes) for salt tolerance are present in the collection, (3) sorghum is diploid and inbred making the search for and utilization of beneficial gene alleles for any trait relatively easy, (4) the sorghum genomics platform is well established allowing targeted searches for genes that could increase salt tolerance and facilitating gene identification and IP capture, (5) the impact of genes for salt tolerance on yield can be tested in the field using high yielding lignocellulosic bioenergy sorghum genotypes allowing direct tests of utility, and (6) genes for salt tolerance discovered in sorghum can be transferred to other C4 grasses by wide hybridization or direct gene transfer using the native sorghum promoters for optimal gene expression. Moreover, the genetic and biochemical basis of salt tolerance has been identified in other cereals (exclusion of Na from shoots/leaves based on the action of inducible sodium transporters). This prior knowledge about salt tolerance in related crop species will accelerate the search for salt tolerance in sorghum germplasm, aid gene identification, and the development of energy sorghum with improved salt tolerance.

Technical Plan by Objective:

Objective 1.

a. A high through-put salt tolerance screening system will be established and used to screen up to ~2,000 sorghum genotypes for variation in seedling salt tolerance
b. Field experimental plots will be established at Pecos and El Paso(?) using bioenergy sorghums. The replicated tests will be irrigated with water of different salinity levels. Irrigation will be performed at a level appropriate for bioenergy sorghum production. At harvest, both yield and composition will be analyzed. The production data will also be compared with the concurrent bioenergy sorghum production at other locations

Objective 2.

a. Sorghum germplasm with variation in genes known to confer salt tolerance will be identified and targeted for salt tolerance screening
b. Populations for mapping and isolation of salt tolerance genes will be created and analyzed (phenotypic and genetic) to complete gene discovery and develop improvement procedures to enhance salinity tolerance.