Tifton ARS Bio-energy Program

As part of the research mission, the Grass CRIS (Drs. Jeff Wilson, Andrea Maas and William Anderson) within the Crop Genetics and Breeding Research Unit at Tifton, Georgia is developing cultivars and hybrids of herbaceous biomass energy crops and associated production practices for USDA Plant Hardiness Zones 8, 9, and 10 with emphasis on bermudagrass and napiergrass for ligno-cellulosic conversion to bio-energy. Other bunch-type perennial grasses and annuals such as pearl millet are also being evaluated. Grain pearl millet is being evaluated as a supplement to corn for the starch to ethanol conversion industry that is currently being established in Georgia. The corn CRIS (Drs. Matt Krakowsky and Xinzhi Ni) within the unit is developing corn hybrids with aflatoxin resistance and productivity for the Southeast while the peanut CRIS (Dr. Corley Holbrook – RL) is investigating the potential of developing peanut cultivars for increased oil production for conversion to bio-diesel and bi-products.

More specifically, a large plant introduction nursery of bermudagrass (*Cynodon* sp.) has been assessed and a smaller core collection developed to investigate aspects that are useful for forage and biofuels [yield, lignocellulose degradability to fermentable sugars and valuable co-products – **ARS – Athens, GA (Akin, Himmelsbach, Snook)**; **Peoria, IL (Dien)** and stress tolerances]. Preliminary data indicates a correlation between forage rumen digestibility and conversion to ethanol. Near Infrared Spectroscopy (NIRS) is proving useful for evaluations of bermudagrass germplasm for digestibility and we are currently working on using NIRS for estimates of ethanol production – **ARS - Athens (Barton); Peoria, IL (Dien)**. We are also accessing this germplasm for abiotic stress tolerance such as drought and salinity **- ARS – Tifton (Maas)**, and biotic stresses such as fall armyworm **ARS – Tifton (Ni).** Molecular variability has been assessed via AFLPs which is an initial effort to supplement traditional breeding with molecular marker assisted breeding. Bermudagrass cultivars were recently evaluated for conversion to syngas by pyrolysis – **ARS – Wyndmoor, PA (Boatang)**.

A similar approach is being pursued with napiergrass (*Pennisetum purpureum*) with a plant introduction collection present at Tifton. Earlier work has indicated that current cultivars of napiergrass yield up to 5 tons/acre dry matter more than available cultivars of switchgrass or bermudagrass. Preliminary work **(Dien)** has indicated that conversion yields of napiergrass leaves and stems to ethanol via the fermentable sugar platform are comparable to switchgrass but lower than bermudagrass. Napiergrass improvement has high potential due to the availability of germplasm with high genetic diversity and the ability to be intercrossed with annual pearl millet (*P. glaucum*) for traits such as altered lignin (brown midrib) and apomixis propagation.

Grain pearl millet has been demonstrated to be a high quality feed for poultry and wildlife. It is currently being evaluated for starch conversion to ethanol and dried distillers grains (DDGs) used for poultry and animal feed. Data indicates similar yields but faster conversion rates to ethanol and higher value DDGs. With recent investments toward starch-to-ethanol processing plants in Georgia, pearl millet provides an excellent supplemental grain source that can fit into numerous cropping systems in the South. Current research **- ARS - Tifton – (Wilson, Maas)** involves breeding for greater yields

and stress tolerances. Stress tolerance or resistance work includes drought and chinch bug **(Ni).**

Other potential perennial and annual grass and legume bio-energy feedstocks are being tested at Tifton. An integrated testing program is being formed for the Southeast with fellow federal and state collaborators **[ARS – Houma, (Richard, Lingle, Tew); Booneville (Burner); U. Georgia, U. Florida, Auburn U., Miss. St., etc]**. Some of the species to be evaluated are switchgrass, Miscanthus x giganteus, sugar or energy cane, sweet sorghum, perennial peanuts, other legumes, and native grasses.

Efforts to improve corn germplasm and hybrids for the South **ARS -Tifton – (Krakowsky)** include resistance to insects such as fall armyworm, corn earworm, maize weevil, and stink bugs **(Ni)**, and with reduced aflatoxin contamination. We also examine insect resistance mechanisms in different crops. Because of the great demand for corn as both poultry feed and ethanol production in the state of Georgia, in collaboration with **U of Georgia** (Drs. Dewey Lee - Grain Crop Agronomist and David Buntin - Grain Crop Entomologist), we initiated examination of potential insect pest problems for two corn crops per year in Georgia.

Earlier assessments of oil crops that have potential for production of bio-diesel revealed that peanut produces more oil per acre than any other crop. Peanut germplasm is being assessed for oil quantity **ARS – Tifton (Holbrook); Raleigh (Dorner)**. Collaborators with the University of Georgia will determine methods of inexpensive harvest and oil extraction methods with the addition of using peanut crop residues as animal feed.

The two other Tifton location ARS units **[Southeast Watershed Research Unit (SEWRL) and Crop Protection and Management Research Unit (CPMRU)]** work with CGBRU and have the facilities and expertise necessary to address important aspects to biomass feedstock production. The effects of alternative cropping systems, removing crop residues and production of dedicated biomass feedstocks on soil and water quality are being researched by SEWRL. Members of CPMRU are involved in monitoring pests (insects, weeds, disease) and researching methods of control under altered crop management. This unit also has the ability to study the invasiveness of weeds or potential dedicated biomass feedstocks under intensive mono-cultural cropping systems.