2015 Agricultural Abstracts - Presentations

Determination of Sugarcane Harvesting Efficiencies from CAN and GPS Data


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Improving harvesting efficiencies and logistics is one of the challenges sugarcane farmers face. CAN bus and GPS data were recorded while harvesting with a 3520 John Deere sugarcane harvester. Algorithms were developed to identify machine states from the recorded data. Three machine states: cutting, turning and stopped were identified from the data recorded in five sugarcane plots in Florida. Time spent in the cutting state varied from 46 to 76%, in the turning state from 8 to 17%, and in the stopped state from 9 to 38%. Up to 20-30% improvements in field efficiencies is possible by implementing the insights learned from the analysis of data collected from sugarcane harvesters.

Utilizing UAS’s (Drones) and Remote Sensing Technology for Precision Agriculture

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Remote sensing has been around for many years but the technology is currently evolving. In recent years, the cost of sensors (cameras) has decreased as the technology has increased. The ability to put several different sensors on Unmanned Aerial Systems (UAVs) as well as manned aircraft gives a new perspective in precision agriculture. This presentation will focus on general UAS applications, workflow to implement a UAS or manned aircraft, current FAA regulations, and sample photographed data sets from sugarcane. NDVI or Normalized Difference Vegetation Index measures biomass and helps us interpret what we see in the field. Several slides will be shown depicting a variety of problems such as topography issues and fertilizer inputs.

Relationships Between Sugarcane Canopy Reflectance and Yield Components Across a Large Number of Genotypes

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Sugarcane (Saccharum spp.) growth and yield components are important traits in breeding and cultivar selection programs. Canopy reflectance of sugarcane during the growing season may be used to evaluate genotypes in growth and yield potential in the early stages of a sugarcane
breeding program. The objectives of this study were to identify sugarcane genotypic variation in canopy reflectance and yields and to determine if there were any putative relationships between canopy reflectance and the yield variables. In the Stage 2 fields of the Canal Point sugarcane breeding and cultivar development program, canopy reflectance data were collected five to six times from each of 156 to 164 randomly selected genotypes during growing seasons (March – July) in 2011-2013 using a multispectral radiometer. Both simple vegetation index \((VI = \frac{R_{800}}{R_{680}})\) and normalized different vegetation index \([NDVI = \frac{(R_{800} - R_{680})}{(R_{800} + R_{680})}]\) were calculated based on reflectance values at 680 and 800 nm. Yield components, including stalk population, mean stalk weight, cane yield, commercial recoverable sucrose, and sucrose yield, were determined in late October. Genotypic variation in canopy reflectance mainly occurred at the wavelengths centered 800 and 980 nm. Stalk population and cane yield were most highly correlated with reflectance at these two wavebands and NDVI \((r = 0.50 - 0.68****)\). The best time to measure canopy reflectance for yield potential estimation across genotypes was from March to April (before canopy closure). Therefore, canopy reflectance measurements at early growth stage (110 - 150 days after planting) may be used as a tool to estimate yield potential for a wide selection of genotypes in sugarcane breeding programs.

Evaluation of Optical Sensing and Variable Nitrogen Rate Application in Louisiana Sugarcane Production Systems

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Nitrogen (N) is the most limiting nutrient and considered the biggest expense among fertilizer inputs in sugarcane production. A need-based N application can be implemented with the use of optical sensor technology allowing acquisition of sugarcane N status in the absence of soil and plant tissue testing. A sensor-based N decision tool was developed for sugarcane production in Louisiana wherein N recommendation is derived from predicted sugar yield potential and estimate of plant-available N at the time of fertilization. Large-field demonstration plots were established in 2012 in two producers’ field in Donaldsonville and one at the LSU AgCenter Sugar Research Station in St. Gabriel, LA. The treatments included farmer’s standard N practice (based on LSU AgCenter N recommendation), and N recommendations based on (a) stalk N removal rate + soil mineral N (nitrate and ammonium) test and (b) optical sensor readings. All treatments were replicated three times for each site and superimposed to plots with size ranging from 9,000 ft² to 33,000 ft² (application resolution). At harvest, 15 randomly selected stalks were collected for primary yield components (theoretical recoverable sugar, Brix, sucrose and moisture content) prior to entire-plot harvesting. In 2013, optical sensor based-N recommendation consistently obtained higher net return than the farmer’s standard N practice averaging $55 ac⁻¹. Recommendation made based on stalk N removal rate + soil mineral N
earned the highest net return of $223 ac$ in one site but lost $23 ac$ in another site. In 2014, optical sensor-based N recommendation performed better over the farmer’s standard practice in only one site recording a net return from N fertilizer of $223 ac$. On the hand, losses were incurred ($47 and 95 ac$) from the other two sites which can be partially attributed to a delayed N application timing. Similarly, stalk N removal rate + soil mineral N had a positive net return in only two sites. Our results demonstrate the potential of optical sensor-based N recommendation as a viable approach for site-specific N management in sugarcane production in Louisiana.

Quantification of Red Stripe Variability in Louisiana Sugarcane Using Precision Agriculture Methods

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Red stripe of sugarcane caused by Acidovirax avenae subsp. avenae consists of two forms – leaf stripe and top rot. Symptoms of red stripe in Louisiana over the past 25 years have been limited to the leaf stripe form which causes no measurable yield losses. During 2010, the more severe top rot form was observed in several commercial sugarcane fields. Both forms were found, either separately or together. Two fields of cultivar HoCP 00-950, one plant-cane (PC) crop and one first-ratoon (FR) crop, affected by top rot were subdivided into 113 and 84 plots, respectively. Each field was grid-soil sampled (at several intensities) and red stripe ratings were collected at each point at two separate times. Soil properties exhibited significant variability (CV = 6 - 64%) and were spatially correlated in 12 of 28 cases with a range of spatial correlation varying from 43 to 95-m. Red stripe ratings were also highly variability with a CV ranging from 65 to 92% and were spatially correlated in 3 out of 4 cases with a spatial range of 19 to 84-m. Sugarcane yields exhibited a CV ranging from 6 to 27% and were spatially correlated in 4 out of 6 cases with a range varying from 6 to 490-m. Red stripe ratings were correlated with several soil properties, when locations were combined, including phosphorus, potassium, zinc and calcium. Red stripe ratings were also significantly correlated with sugarcane yields, most notably TRS ($r = -0.34^{***}$ to $-0.61^{***}$) and sugar ($r = -0.21^{**}$ to $-0.36^{***}$). Contour plots of soil properties and red stripe ratings levels also clearly suggested a link between these two parameters. Red stripe symptoms were also observed in nitrogen fertility trials conducted with HoCP 00-950 in two soil types. The incidence was higher among plots in clay soils verses lighter, more silty soils. Disease incidence also increased with increasing rates of added nitrogen in the heavy clay soil compared to the no nitrogen-added plots. In the lighter soil, disease incidence was higher among treatments with added nitrogen compared to the control, but incidence did not differ among plots with the different rates of added nitrogen fertilizer. Finally, in a planting study, results suggested that using red stripe infected cane as a seed source can result in significantly lower shoot emergence counts, stalk counts and subsequent cane and sugar yields. These combined data suggest that red stripe disease cane exhibit a variable rate of infection in commercial sugarcane fields. The disease can also significantly decrease cane and sugar yields. The rate of infection is influenced by soil properties and cultural practices, suggesting that proper management of these factors may help control the extent and spread of the disease.
Genetic Modification: A Moving Target for Sugarcane Varietal Resistance to Sugarcane Rusts

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Historically, brown rust (caused by *Puccinia melanocephala*) and orange rust (caused by *Puccinia kuehnii*) have been two of the most destructive diseases of sugarcane in Florida. Varietal differences in response to sugarcane rusts have been observed since the first report of brown rust in Florida during 1979. Two of the most widely planted varieties at that time, CP63-588 and CL41-223, occupied nearly 50% of the state’s sugarcane crop area and these varieties were highly susceptible. Their phase out began almost immediately and by 1986, a newer variety, CP72-1210 occupied 61% of the acreage. Most likely because of occurrence of pathogenic variants in *P. melanocephala*, this formerly brown rust resistant variety soon succumbed to the pathogen, and by 1998 was near absent from the variety census. Over the decades, this scenario has been repeated with numerous varieties, but with the identification of the *Bru1* resistance gene, breeders were able to make progress in breeding for more durable resistance to brown rust. Florida’s sugarcane area covered with brown rust susceptible varieties decreased from a high of 67% in 1987, to only 16% in 2007, and the disease situation was looking less dire. With the arrival of orange rust in Florida in 2007, the presence of this second rust pathogen has drastically complicated the sugarcane breeding effort, as new promising varieties continue to fall to this disease. As of 2014, nearly 90% of Florida’s sugarcane crop area was rated as susceptible to either one or both of the rust diseases. While host-plant resistance to sugarcane rusts remains the ultimate goal, there is evidence that, in Florida, physiological variants or races of both sugarcane rusts will make this goal a moving target, presenting plant breeders with a huge challenge in the coming years.

Importance of Ratoon Stunt and Yellow Leaf in Florida Sugar Cane League Increases

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Ratoon stunt caused by *Leifsonia xyli* subsp. *xyli* (Evtsuhenko et al.) and yellow leaf caused by *Sugarcane yellow leaf virus* (SCYLV) are important diseases for the sugarcane industry in Florida. Although sugarcane clones germinated from true-seed are disease-free of these systemic diseases at the start of the CP Cultivar Development Program, natural infection takes place in time to infect sugarcane clones. The objective of this study was to determine the incidence of ratoon stunt and yellow leaf in the Florida Sugar Cane League (FSCL) increases, the seedcane source for commercial planting; thereby evaluating the potential problem. The FSCL increases were tested for ratoon stunt and yellow leaf using standard tissue blot immunoassays for both
diseases. The FSCL increases are in 7 locations on muck and 3 locations on sand. Also, some sand varieties are grown only at one sand location (Townsite). Clones may be increased only on one soil type or both depending on their yields obtained in variety trials. Sampling was done at random (50 leaves for yellow leaf and 30 stalks for ratoon stunt) in each of the FSCL increase locations. For ratoon stunt all clones at all locations were RSD free except CP06-2042 from the Hilliard location which had 6.7% infection. Yellow leaf incidence was variable among varieties and locations. CP08-1110 showed no infection in all three locations. Out of ten locations only four percent of leaves of CP08-2022 from Duda were infected. Similarly, CP07-2137 had 4% infection at Hilliard out of three locations. CP06-2042 was tested at nine locations and leaves from the Knight and Lykes locations had 10 and 2% infection, respectively. CP07-2320 was grown at ten locations and all the samples were infected variably at different locations except there was no infection at the Eastgate and Hilliard locations. Five Townsite varieties were also tested for the presence of sugarcane yellow leaf virus, CP06-3103 showed 100% infection, CP06-2495exhibited 20% infection and the other three clones were virus free. In conclusion, the incidence of ratoon stunt is minimal. Yellow leaf infection depends on the clone and location. Thus, in the case of some clones, clean seedcane must be established via alternative methods other than the FSCL increases to obtain disease-free seedcane.

Is Columbus Grass (*Sorghum almum*) an Alternative Host of Sugarcane Yellow Leaf Virus in Florida?

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*Sugarcane yellow leaf virus* (SCYLV), the causal agent of yellow leaf disease, is widespread in Florida and up until now, sugarcane was the only known natural host of this virus. We tested several grasses growing near sugarcane fields for the presence of SCYLV using tissue blot immunoassay (TBIA) with antibodies raised against this virus. A total of 170 samples of corn (*Zea mays*), 23 of elephant grass (*Pennisetum purpureum*), 4 of goosegrass (*Eleusine indica*), 13 of paragrass (*Urochloa mutica*), and 4 of sorghum (*Sorghum bicolor*) all tested negative. However, 170 out of 489 samples (35%) of Columbus grass (*Sorghum almum*) reacted positively. Presence of a virus close or identical to SCYLV was confirmed by Reverse Transcription-Polymerase Chain Reaction (RT-PCR) in five samples of Columbus grass using primers YLS111 and YLS462 targeting the coat protein of SCYLV. The RT-PCR product will be sequenced shortly to determine the percentage of identity between the virus found in Columbus grass and the one existing in sugarcane in Florida. Additionally, transmission of the virus from Columbus grass to sugarcane needs to be verified in order to investigate the importance of this potential secondary host of SCYLV in epidemiology and control of sugarcane yellow leaf.
Effect of Sugarcane Mosaic Caused by *Sorghum Mosaic Virus* on Sugarcane in Louisiana

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Sugarcane mosaic is caused by two viruses, *Sugarcane mosaic virus* (SCVM) or *Sorghum mosaic virus* (SrMV). In Louisiana, SrMV is the predominant mosaic pathogen affecting sugarcane. In a field experiment established in 2012, plots were planted with seed cane with or without mosaic symptoms. The mosaic was determined to be caused by SrMV. The experiment included one released (Ho 05-961) and four near-release sugarcane varieties (Ho 09-832, HoCP 09-804, L 08-88, and L 09-117). Percent shoots with mosaic symptoms was determined in the spring, while the number of millable stalks and average stalk heights were determined in the late summer for each plot. Stalk heights were also measured in late summer. The plant-cane and first-ratoon crops of the experiment were harvested with a single-row, chopper harvester in 2013 and 2014, respectively; and the total plot weight determined with a single-axle wagon equipped with load cells. A billet sample was collected from each plot for juice quality analysis. Cane and sucrose yields were calculated using plot weights and theoretically recoverable sucrose (TRS). The average cane yield was numerically lower among all treatment plots planted with virus-infected seed cane in plant-cane and first-ratoon crops except for those in the first-ratoon crop of Ho 05-961. On the other hand, average TRS was numerically higher in all treatment plots planted with virus-infected seed cane. Average sucrose yield was lower in plots planted with virus-infected seed cane compared to those planted with symptom-free seed cane in plant-cane (24%) and first-ratoon (27%) crops of L 08-88, respectively. Sucrose yield reduction in other cultivars was less than 5% except for a reduction of 16% in the first-ratoon crop of HoCP 09-804. In plant cane, the average percent shoots with mosaic symptoms among plots of the five cultivars planted with mosaic symptomatic seed cane ranged from 28% for HoCP 09-804 to 97% for L 08-88 in the plant-cane crop, and from 4-32% among the plots planted with symptom-free seed cane. Natural spread of the mosaic viruses is common, particularly in the spring. Slight to moderate increases in percent shoots with mosaic symptoms was noted in the first-ratoon crop for both disease treatments except in L 09-117 where the incidence was less in the first-ratoon crop. In previous research, recovery of mosaic virus infection was observed among some cultivars. Mosaic continues to be a disease with the potential to cause economic losses in sugarcane.

**Discovery of Uncharacterized Sugarcane Viruses by Next Generation Sequencing Technology: The Case of Ramu Stunt**

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Ramu stunt disease of sugarcane was first reported in Papua New Guinea in the mid 1980's. The disease can reduce sugarcane yields significantly and causes severe stunting and mortality in highly susceptible cultivars. The causal agent of Ramu stunt has been investigated but its characterization has not been completed. Sugarcane cv. Ragnar plant material, with symptoms of Ramu stunt, was received from Papua New Guinea through the USDA APHIS PPQ Plant Germplasm Quarantine Program and used in this study. Total RNA was extracted and subjected to next generation sequencing (NGS) using whole transcriptome shotgun sequencing method on the Illumina platform. Approximately forty million reads with an average length of 100 bp were obtained. More than eighteen thousand contigs were assembled and subjected to BLASTX analysis. Twenty-one contigs were virus related and five were associated with plant viruses. The BLAST algorithms revealed sequence similarity to Tenuiviruses, a genus of viruses whose members contain genomes consisting of four to six RNA segments. The five contigs derived from the RNA sequencing data correspond to the five RNAs that compose the Ramu stunt virus genome. Primers were designed for each of the five RNAs and RT-PCR amplicons were obtained only from the symptomatic sugarcane. There was concordance between the sequence data of the contigs obtained from the NGS and that of the amplicons obtained by RT-PCR. The NGS approach allowed us to determine the complete genomic sequence of Ramu stunt virus. It is likely that this virus is the causal agent of Ramu stunt disease. Characterizing the genomic organization and developing improved diagnostic methods for Ramu stunt virus will aid in quarantine and disease management efforts.

Expression Profile of Candidate Genes Involved in the Resistance Response of Sugarcane to Leaf Scald

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Leaf scald, caused by \textit{Xanthomonas albilineans}, is one of the major diseases of sugarcane worldwide. The disease is managed primarily with resistant varieties; however, rating the resistance reaction of clones is difficult because of erratic symptom expression. Identification of genes and linked markers for resistance to leaf scald has the potential to improve sugarcane breeding for resistance to this important but erratic disease. Using the suppression subtractive hybridization strategy, 166 and 165 genes were identified from a leaf scald resistant variety, LCP 85-384, and a susceptible variety, HoCP 89-846, respectively, to be induced in response to inoculation with the bacterial pathogen. Functional annotation indicated that genes involved in signal perception and transduction, DNA binding, and related to photosynthesis were highly expressed in the resistant compared to the susceptible variety. Twenty-two and nine simple sequence repeat markers were detected in LCP 85-384 and HoCP 89-846, respectively, that are being used to genotype 200 progeny from a cross between LCP 85-384 and susceptible L 99-226. Marker-assisted selection using the markers identified from the genes/genomic regions will
allow more informed crosses and increase the efficiency of breeding for leaf scald resistant varieties.

**Identification and Expression Analysis of Genes Induced in Response to Brown Rust in Sugarcane**

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The lack of durability of resistance to brown rust caused by *Puccinia melanocephala* in sugarcane warrants an understanding of the expression and the genetic basis of resistance in order to develop varieties with broad-spectrum resistance. Although natural infection is useful in assessing resistance, it is not always efficient in identifying resistant cultivars due to variable environmental conditions and uneven inoculum exposure. Gene-based molecular markers would allow more effective breeding and selection of brown rust resistant sugarcane varieties. Genes induced in response to the fungal pathogen were identified through suppression subtractive hybridization from a variety L 99-233 that showed quantitative resistance to multiple spore collections. Of the 215 genes isolated, 144 transcripts coded for proteins of unknown function. Among the genes with known function, 33% were involved in signal transduction and transcriptional regulation, while others were involved in response of plants to biotic and abiotic stresses. Simple sequence repeat markers have been identified from these genes that are currently being mapped onto the linkage groups of L 99-233 to identify novel QTL for brown rust resistance. The markers linked to these QTL will facilitate combining these novel genes with known resistance gene *Bru1* to develop varieties with durable and effective resistance against brown rust.

**Identifying Markers for Resistance to Orange Rust (Puccinia kuehnii) via Selective Genotyping and Capture Sequencing**

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Sugarcane orange rust, caused by the fungus *Puccinia kuehnii*, is a serious disease of sugarcane in many parts of the world. The most effective strategy to combat the disease is to develop resistant sugarcane cultivars. Phenotypic screening for resistance to orange rust is a laborious and time-consuming process, and breeders would greatly benefit from molecular markers linked to resistance. The objective of this research was to identify, via association mapping, markers linked to resistance to orange rust. From the germplasm available in the breeding nursery at Canal Point, 726 genotypes were screened for orange rust resistance via artificial inoculation of
field-grown plants. A frequency distribution was generated from the disease reaction scores, and 39 susceptible and 37 resistant genotypes, comprising the lower and upper 5 percent of scores, respectively, were chosen for marker analysis. This technique, known as selective genotyping, can be an effective method to identify markers of interest, and is less expensive than genotyping the entire population for a large number of markers. These individuals were genotyped via capture sequencing using approximately 32,500 sugarcane probes anchored to the sorghum genome. A total of 148,603 SNPs were initially identified in the dataset. Filtering to eliminate SNPs with excessive missing data and/or low minor allele frequencies reduced this number to 46,946. In addition, five individuals were eliminated due to excessive identity by state (IBS). Principal components analysis of the genomic kinship matrix suggested some degree of population structure in the dataset. Several methods were used to account for population structure as part of the association analysis. The most appropriate methods (determined by the slopes of Q-Q plots) were mixed model analysis, structured association analysis, and inclusion of principal components. Amongst the 75 most significant markers identified by the three methods (the top 25 from each method), 27 were identified by at least two methods. Of the 48 unique SNPs, 13 were found on chromosome 5 (based on the sorghum reference genome). Significant markers were also found on all other chromosomes, except chromosome 7. The 48 unique SNPs are currently being validated on the remaining population, using high resolution melting of small PCR amplicons. This will test whether the SNPs identified via selective genotyping are indeed associated with orange rust, and provide estimates on the effect of each SNP on the trait.

Fluorescence- and Capillary Electrophoresis (CE)-based SSR DNA Fingerprinting and A Molecular Identity Database for the Louisiana Sugarcane Industry

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A database of Louisiana sugarcane molecular identity has been constructed and is being updated annually using FAM or HEX or NED fluorescence- and capillary electrophoresis (CE)-based microsatellite (SSR) fingerprinting information. The fingerprints are PCR-amplified from leaf DNA samples of current Louisiana cultivars and newly assigned breeding lines with a panel of 21 SSR primer pairs. The fluorescent SSR fragments are separated according to their sizes through CE on a DNA Sequencer. A panel of 16 ROX fluorescence-labeled DNA size markers is mixed with every sugarcane genotyping sample for accurate fragment size determination. The fluorescence- and CE-based SSR fingerprints are visualized with sizes indicated using genotyping software. One hundred forty-four distinctive DNA fingerprints from the 21 SSR primer pairs are targeted through manual checking. The molecular identity of any Louisiana sugarcane clone is represented by how many of 144 fingerprints are detected and the order of their appearance. Since 2005, approximately 2,000 molecular identities have been constructed and are available from the database. The molecular identity database has been utilized to: 1) provide molecular descriptor information for newly released cultivars’ registration articles; 2) identify in a timely fashion any mislabeled or unidentifiable clones from cross parents and
evaluation field plots; 3) provide clone-specific fingerprint information for assessing cross quality and paternity of polycross; 4) provide information for molecular marker inheritance studies. The integration of fluorescence- and CE-based SSR genotyping and the molecular identity database into the Louisiana sugarcane breeding program improves the overall efficacy of cultivar development and commercialization in Louisiana.

**Ploidy Level Estimation of 300 Accessions in a Core Collection of *Saccharum* spp.**

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Sugarcane (*Saccharum* spp.) is a highly polyploid and aneuploid grass. Modern sugarcane cultivars were derived from inter-specific hybrids mostly between *S. officinarum* (2n=8x=80) and *S. spontaneum* (2n=5x-16x=40-128) with a basic chromosome number of x=10 and x=8, respectively, thus sugarcane is one of the most genetically complex crops. A core collection of 300 accessions was selected from the World Collection of Sugarcane and Related Grasses (WCSRG) maintained at the USDA Subtropical Horticulture Research Station and captured most of the genetic diversity in the WCSRG. The ploidy levels of most accessions within the core collection were unknown. Determining the ploidy level and chromosome numbers (2n) in these accessions is important for further genetic and genomic studies and the utilization of genetic diversity within breeding programs. In this study, flow cytometry was used to assess the genome size variation and to estimate the ploidy level and chromosome number for each accession in the core collection. The variation of genome size in the core collection varies widely and ranges from 3.08 to 15.45 Gb. The ploidy level and chromosome numbers vary among accessions ranging from 6 to 14, 2n=48 to 2n=140, respectively. Seventy-two accessions from *S. officinarum* have 80 chromosomes with genome sizes ranging from 7.71 to 8.32 Gb/2C. The *S. spontaneum* accessions had a wider range of chromosome number ranging from 2n=48-112 with genome size ranging from 3.65 to 12.74 Gb. The chromosome number was correlated with the genome size. The investigation of ploidy level and chromosome number of each accession in core collection will enhance our understanding of inheritance and the relationship between dosage effect and vigor in this highly polyploidy crop.

**Mapping orange rust resistance genes in sugarcane (*Saccharum* spp.)**

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Orange rust disease of sugarcane has impacted the Florida Sugarcane Industry since its introduction in 2007. Marker assistant selection for resistant cultivars is the most efficient way to control the disease, which depends on development of genetic map and identification of makers linked to the disease resistance genes. Though efforts have been made towards sugarcane map construction for over a decade, the existing genetic maps are still far from saturated due to the features of large genome size, polyploidy, and heterozygosity of sugarcane. So far, no makers linked to orange rust resistance have been reported. The objectives of this research are 1) to establish a high density genetic map in sugarcane and 2) to identify makers linked to sugarcane orange rust resistance genes. To establish the genetic map, we used a genotyping by sequencing (GBS) approach to genotype a biparental population derived from a single cross between resistant cultivar ‘CP95-1039’ and susceptible cultivar ‘CP88-1762’, which is segregating in orange rust resistance. The high quality single nucleotide polymorphisms (SNPs) were called through four SNP-calling pipelines and then used to construct genetic maps of sugarcane with JoinMap. The phenotypic reaction to rust of the population was determined in the field and greenhouse through 2010 to 2014. Considering disease symptoms without rust sporulation as resistant reaction and with rust sporulation as susceptible reaction, the population was characterized containing 90 resistant progenies and 40 susceptible ones. Linkage analysis between SNPs and resistance to orange rust disease were conducted using MapQTL to identify the makers linked to the disease resistance. The high density genetic map and linked SNPs makers will greatly facilitate the sugarcane breeding program for disease resistant cultivar development.

Near Infrared Spectroscopy (NIR) and its Potential Benefits to Sugarcane Breeding Programs and Sugar Mills

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Near Infrared Spectroscopy (NIRs) is a relatively new technique that has the potential to benefit Louisiana’s sugarcane industry. Recently, the USDA-ARS in Houma, LA purchased a NIR Cane Presentation System from Bruker Optics™. A modified version of this system is used for cane payments in South Africa. It is a self-contained sampling system, with a cane shredder connected to a conveyor. The cane is moved by conveyor, then “fluffed” using metal fingers, and subsequently passed through a window with a NIR detector. The NIR detector measures light reflected off the shredded cane. The machine is calibrated based on the light spectra and, with the right calibrations, can instantaneously determine sucrose, pol, fiber, moisture, and other parameters such as color and mannitol/dextran (sugarcane deterioration compounds). The equipment has the potential to be calibrated for other parameters such as conductivity ash, reducing sugars, starch, and trash which could provide valuable processing information to the factory staff. The machine was tested in December 2014 using samples from the basic breeding program. After only one day of use, the average sample took between 1.0 and 1.33 minutes to process. The system is simple to use, with minimal software controls, and the operator simply
feeds the cane into the shredder, enters the sample ID, and presses the “start” button. This type of system has the potential to minimize laboratory errors and discrepancies. Furthermore, the speed in which samples can be processed ultimately will increase the number of samples the laboratory can handle, thus reducing sub-sampling error.


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Sugarcane and energy cane (complex hybrids of *Saccharum* spp.) cultivar development requires diverse germplasm, such as that of the World Collection of Sugarcane and Related Grasses (WCSRG) maintained in Miami, Florida. To evaluate this germplasm for breeding purposes, a representative diversity panel selected from the WCSRG of approximately 300 accessions was planted at Canal Point, FL in three replications with 10 checks. In the plant crop the accessions were measured for stalk height and stalk number multiple times throughout the growing season and Brix and fresh biomass during harvest. In the ratoon crop, stalk height, stalk number, stalk diameter, internode length, Brix and fresh and dry biomasses were measured. The highest correlations were between the early measurements of stalk number and stalk height and harvest traits like Brix and fresh weight. Hybrids had higher fresh mass and Brix than the other species while Saccharum spontaneum had higher stalk number and dry mass. The heritability of hybrid fresh mass was greater in the ratoon crop and hybrids had the lowest dry mass heritability. According to the principal component analysis, the collection was divided between accessions with high stalk number and high dry biomass such as *S. spontaneum* and accessions with higher Brix and fresh biomass such as *S. officinarum*. There were 61 *S. spontaneum* accessions not significantly different in Brix from the sugarcane checks in the plant crop, and there were six accessions with significantly higher biomass than the commercial sugarcane checks. We identified the breeding potential of different traits expressed by accessions within the World Collection to aid in energy cane and sugarcane cultivar development.

Progress of Rust Severity Varies According to the Sugarcane Cultivar and the Planting Date

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Seven sugarcane cultivars differing in resistance to orange rust (caused by *Puccinia kuehni*) and to brown rust (caused by *P. melanoccephala*) were planted in October, November and December 2013 in a replicated trial at University of Florida in Belle Glade. Disease severity, expressed as plant reaction (from no symptoms to more than 50 sporulating pustules per leaf) and leaf surface affected by rust, was recorded every 2-4 weeks on leaf +1 (top visible dewlap leaf or TVD) and leaf +5 (fourth leaf below TVD). Sporulating pustules of both diseases were initially observed in
January 2014 on leaves +1 and +5, especially on sugarcane planted in October 2013. From January to May-June 2014, disease severity on the four cultivars susceptible to orange rust (CP89-2143, CP88-1762, CP80-1743, and CL85-1040), and grown since October 2013, was higher than disease severity on the same cultivars planted in November and December 2013. This difference in disease severity between plants of different ages was only observed from January to mid-March-mid-April 2014 for the three cultivars susceptible to brown rust (CP78-1628, CP96-1252, and CL90-4725). Once plants with different ages of a given cultivar reached the same disease severity level, disease severity was largely similar for the remainder of the crop, although some differences were observed. Based on these data, it would be preferable to plant rust susceptible cultivars as late as possible during the planting season. Observation in February-March 2015 of severe brown and orange rust symptoms in commercial fields of sugarcane cultivars planted in October 2014 supports this recommendation. The impact of planting date on sugarcane yields remains, however, to be investigated.

Sugarcane Yield Response to Elemental Sulfur on Organic Soils in Florida

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Elemental sulfur is applied in the furrow at planting for Florida sugarcane (Saccharum spp.) when soil pH is extremely high to increase micronutrient availability. Current sulfur recommendations suggest an application of 500 lb S/acre with pH > 6.6, but this is not considered cost-effective. A field study at six locations was conducted to (1) determine sugarcane yield response to different sulfur rates and formulations and to (2) relate soil pH or other soil properties with sugarcane yield response so that recommendations can be updated. The trials were all on organic soils (five muck soils and one sandy muck soil) with average soil depth ranging from 14 to 38 inches. Sulfur materials used in the study were 90% S, 62% S + micronutrients, and STM5 (80% S + 5% Mn). Differences in yield response among sulfur formulations were minor, with some trends suggesting that when soil Mn content is low, STM5 may perform better than 90% S. No additional benefit was determined with the additional micronutrients in 62% S (Mn, Zn, Fe, and Cu) compared to only Mn in STM5. Soil pH related well to relative sugar yield at the two locations with strongest yield response, with substantial yield reductions with pH > 7.5. Proposed recommendations are 250-500 lb S/acre with pH > 7.5 and 100-250 lb S/acre with pH 7.2-7.4. Proposed recommendations also suggest application of 100 lb STM5/acre with pH 6.6-7.1 and Mehlich 3-extractable Mn < 5.0 g/m3.

Effect of CaSiO₃ Slag Applied at Different Rates and Time on Sugarcane Yield, Soil pH and Nutrients Availability

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In Louisiana sugarcane production system, granular fertilizer is commonly applied in spring. The application of a more manageable rate of CaSiO$_3$ containing material and concurrent with other granular fertilizer commonly applied to sugarcane are economically attractive to producers. A sugarcane study was established in September, 2012, in St. Gabriel, LA, and conducted for two years, with treatments including different application rates of CaSiO$_3$ (12% total silicon (Si)) applied either once at planting (2.0 t CaSiO$_3$ slag acre$^{-1}$), split at planting and annual spring application (0.5 + 0.25 and 1.0 + 0.5 t CaSiO$_3$ slag acre$^{-1}$), or only in spring, annually (0.25, 0.5, 0.75 and 1.0 t CaSiO$_3$ slag acre$^{-1}$). Treatments were imposed on plots containing three 6-ft wide x 40-ft long rows with a total area 720 ft$^2$, replicated four times and arranged in a randomized complete block design. The study was established on a Commerce silt loam soil with an initial 0.5 M acetic acid extractable Si of 40 µg g$^{-1}$. One-time, at planting application of CaSiO$_3$ was made in September 2012 by hand on opened rows just prior to planting, while the annual spring application was done around March and April of 2013 and 2014 by hand, 6 inches from the middle of the row, in both sides. After application, the rows were pulled up. Nitrogen, phosphorus and potassium fertilizer were applied based on the current LSU AgCenter fertilizer recommendation. The results for plant cane, harvested in December 2013, show that the application of 0.5 t CaSiO$_3$ slag acre$^{-1}$ at planting and an addition of 0.25 t CaSiO$_3$ slag acre$^{-1}$ in spring tended to obtain the largest amount of millable stalks. The largest increase in pH was achieved by the application of 2.0 t CaSiO$_3$ slag acre$^{-1}$ at planting, but the higher increased in the amount of extractable Si was attained by spring application even at minimal rates of CaSiO$_3$ slag (0.5 to 1.0 t acre$^{-1}$). For the first ratoon cane, harvested in November 2014, the annual application of 0.75 t CaSiO$_3$ slag acre$^{-1}$ in spring resulted in the highest sugar yield, what can be partly attributed to higher amount of millable stalks produced and was around 1000 lbs acre$^{-1}$ higher than the yield of treatments that received 0.25 or 1.0 t CaSiO$_3$ slag acre$^{-1}$ annually in spring or 0.5 t CaSiO$_3$ slag acre$^{-1}$ at planting + 0.25 t CaSiO$_3$ slag acre$^{-1}$ annually. There was an evident increased in soil Si across rates and time of application of CaSiO$_3$ showing that plots which received 2.0 t CaSiO$_3$ slag acre$^{-1}$ at planting remained elevated compared to control plots and those plots receiving spring application. Similarly, the effect on pH was maintained at higher level compared to control plots. Among the nutrients quantified in the soil, only magnesium was significantly increased while soil calcium and zinc tended to increase with increasing application rate wherein higher level were observed on those plots receiving annual application in spring. Our findings demonstrate the potential of annual application of CaSiO$_3$ at modest rates as an alternative to traditional large application rate at planting in sugarcane production system.

**Thermopotash: An Alternative for Sugarcane Crop Production**

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Potassium chloride is a highly soluble product while thermopotash is slightly soluble, similar to slow release fertilizers. The use of thermopotash on the sugarcane crop reduces chloride levels and potassium soil leaching, and its high residual effect leads to high agronomic performance. This study was carried out to evaluate the immediate and residual effect of thermopotash fertilizer relative to potassium chloride on the sugarcane crop during two growing seasons and three different sites. A randomized complete block experiment in a factorial design was used with two potassium sources (KCl and thermopotash) and five potassium rates applied in the furrow at planting (0, 50, 100, 150 and 200 kg ha\(^{-1}\) K\(_2\)O). The variables studied were: K, Ca, Mg and Si content in the leaf and soil (0-20 and 20-40 cm depth), soil pH, cane height, Brix, Pol, stalk and sugar yield. The quantitative data was submitted to a regression analysis and the qualitative variables were compared using a Tukey test at the 5% significance level. In addition to K, the thermopotash fertilizer was able to increase Ca, Mg, Si and pH in the soil and the sugarcane plant. There were no significant differences among the potassium sources for height, Brix, Pol, and ATR. The results showed that thermopotash had a positive impact on sugarcane yield ha\(^{-1}\). In order to achieve maximum yield, it was necessary to apply between 121 and 153 kg ha\(^{-1}\) of K\(_2\)O depending on the experiment site. Thus, the calculated Relative Agronomic Efficiency (RAE) showed that thermopotash can be more efficient than KCl not only for the plant cane crop but also for ratoon crops due to the residual effect.

**Productivity of Sugarcane with Thermopotash in Two Harvests**

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Verdete is a silicate rock rich in glauconite and its K\(_2\)O percentage is between 7 and 11%. Mixing Verdete with CaCO\(_3\) and heating to 1100°C produces the thermopotash, a source of potassium (K) that is insoluble in water. This study evaluated the effect of thermopotash in sugar cane production. An experiment with cultivar SP832847, was installed in June 2011 in Energy Cia Vale do São Lourenço, Minas Gerais, Brazil. The soil was classified as Rhodic Acrustox, with the following characteristics: pH 4.4; 15 mg dm\(^{-3}\) K; ECC 3.4 mmol\(_c\) dm\(^{-3}\). The experimental design was a randomized block with 10 treatments in a 2 x 5 factorial arrangement, with 5 replications. The sources of K used were potassium chloride (KCl) with 60% K\(_2\)O, and thermopotash with 7.0% K\(_2\)O, 28.4% Si, 31% CaO and 6.9% MgO and the K\(_2\)O rates were: 0, 100, 150, 200 and 250 kg ha\(^{-1}\). Each plot was 5 x 20 (rows x length) spaced at 1.5 m with a total area of 150 m\(^2\). At planting 250 kg ha\(^{-1}\) of monoammonium phosphate was applied along with treatments at the bottom of the furrow. Both KCl and thermopotash increased productivity of sugar cane independent of K\(_2\)O rate used. The relationship between sugar cane yield and K\(_2\)O rates for the first harvest can be best described by the equation \(y = -0.0012x^2 + 0.2905x + 115.03\), \(R^2 = 78\%\). When the cane did not receive K fertilization the productivity was 113.3 t ha\(^{-1}\); in contrast, the addition of K, regardless of the source used, resulted in a maximum yield of 132.6 t ha\(^{-1}\), in response to 121 kg ha\(^{-1}\) of K\(_2\)O applied. For the second harvest, sugar cane yield had a linear relationship with K\(_2\)O rates (\(y = 0.070x + 110.5\), \(R^2 = 87\%\)). The average of the two harvests for the productivity using thermopotash showed an increase of 6.6 t ha\(^{-1}\) of cane.
differing significantly from KCl. The yield of the sugarcane fertilized with thermopotash was similar to KCl in the first harvest; however in the second harvest it was significantly higher than the KCl treatment. The cumulative average of sugarcane yield was significantly higher for thermopotash compared to KCl. Thermopotash can be used as a K source for sugarcane.

**Distributions of Carbon and Nitrogen in Soil Profiles Under Different Sugarcane Managements**

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Soil organic carbon (SOC) is an important component of the global carbon budget. The aim of this study was to assess the spatial variability of SOC and nitrogen (N) in a long-term study of continuous sugarcane cropping in Louisiana. Soil core sampling along two transects (1.8 m spacing and 1 m depth) was carried out; one on a burn treatment where the residue was burned after harvest, and the other on a no-burn where the residue was not removed. The soil cores were sectioned in 10 cm increments and analyzed for SOC and N, pH, bulk density and cation exchange capacity (CEC). Significant correlations were observed between CEC and SOC for both treatments. For individual soil depths, semivariogram analysis indicated that there was a lack of spatial variation for all properties measured. Semivariograms for the entire data set indicated extensive spatial structure for SOC, N and CEC. For the burn treatment, greatest spatial structure was observed for SOC and CEC. Vertical distribution results indicated that the no-burn treatment stored significantly more SOC and N than the burn treatment. This finding was inconsistent with measurements made one year later (2013) where SOC and N results indicated no significant differences between the burn and no-burn treatments. Results from a control area under bermudagrass indicated higher SOC and N near the soil surface compared to both the burn and no-burn treatments. Based on two years of data, the influence of no-burn management of sugarcane residue on carbon stock in the soil profile is inconclusive.

**Consequences of Trash Removal after Greencane Harvest on Sugarcane Yield and Weed Population**

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Thick trash (harvest residue) layer left in the field after greencane harvest could impact the subsequent ratooning of sugarcane in terms of microclimate, early season cane growth and weed population. This study evaluated various trash removal treatments (0, 33, 66, and 100% removal) to minimize the impact of trash layer on early season sugarcane growth and final yield. Data from first ratoon crop showed increase in soil temperature, increase in weed population and weed biomass, and minimum changes in sugarcane yield associated with trash removal. Results
indicated some potential of trash removal in minimizing negative consequences associated with trash layer after greencane harvest.

**Eastern Black Nightshade – A New Problematic Weed for Louisiana**

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For the past several years, growers and crop consultants have reported failures in controlling an unidentified broadleaf weed with postemergence herbicides in spring. In 2013, the weed was identified as Eastern Black Nightshade (*Solanum ptycanthum* Dun.) (EBN)). Three postemergence (POST) studies were conducted and seven herbicides were evaluated in the spring of 2014. Brash (2,4-D + dicamba) and Callisto (mesotrione) provided over 80% control of 2-3 inch EBN at 3, 4, and 6 weeks after treatment (WAT). As weed size increase to 4-8 inches, control ranged from 43 to 68%, 5WAT regardless of herbicide treatment. Control was further impeded when plant size increase to 8-12 inches, and ranged from 23 to 35%, 5WAT.

**2015 Agricultural Abstracts - Posters**

**Effect of Nitrogen Source and Rate on Yield, N Uptake and Quality Parameters of Sugarcane in Louisiana Production Systems**

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Sugarcane is a major industry in Louisiana and has the largest production area in the United States with an average acreage of ~420,000 acres. Using the right source of nitrogen (N) fertilizer is one of the four cornerstones of best N management practice. In Louisiana sugarcane production systems, urea-ammonium nitrate (UAN, 28-32% N) solution is a common source of N and little is known about the performance of other N sources. This study was established in 2013 at the LSU AgCenter Sugar Research Station in St. Gabriel, LA to evaluate the effect of different N sources (urea-46%N, ammonium nitrate-34%N, polymer-coated urea, and UAN solution- 32% N dribbled and knifed-in) applied at different rates (0, 40, 80, and 120 lbs N ac⁻¹) on sugarcane productivity. Each treatment was replicated four times and arranged in randomized complete block design. Soil samples at 0-6 and 6-12 inch depths were collected at different time for soil nitrate and ammonium monitoring. At harvest, ten stalks were manually collected per plot prior to plot harvesting. The collected stalks were shredded and analyzed using SpectraCane Near Infrared System for quality parameters: theoretical recoverable sugars (TRS), total soluble solids (Brix), purity, sucrose and fiber content. Grab samples of shredded stalks were collected, processed, and analyzed for total N content. The application of UAN (knife-in) at 80 lbs N ac⁻¹
tended to increase both cane tonnage and sugar yield. Similar cane tonnage and sugar yield were attained by plots which received ammonium nitrate and polymer-coated urea as sources but at a higher rate (120 lbs N ac\(^{-1}\)). Reduction in TRS was observed for plots which received higher N rates (80 or 120 lbs N ac\(^{-1}\)) using urea, ammonium nitrate and coated urea. For plots treated with coated urea at 120 lbs N ac\(^{-1}\), high cane tonnage did not offset the large reduction in TRS which resulted in lower sugar yield than UAN-knife in at 80 lbs N ac\(^{-1}\). In 2013, the amount of ammonium and nitrate measured from soil samples collected at 21 days and 3 months after N fertilization did not show any clear association with cane tonnage and sugar yield response. Thus far, the findings of this study validate the use of knife-in UAN as an effective N source and application scheme in sugarcane production in Louisiana.

**Yield, Quality Parameters, Biomass Chemical Composition and Nutrient Uptake of Different Cane Varieties Planted as Whole Stalks and Billets**

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Planting is the most expensive operation in sugarcane production system. The estimated planting cost per acre of plant cane is around $800 depending on region. The type of planting materials and seeding rate can influence early cane stand population, number of millable stalk, and overall cane yield. Sugarcane grown in Louisiana is traditionally planted as whole stalk seed-cane. The high labor and equipment cost of whole stalk planting means that they are becoming less popular. Thus, the ease in billet harvesting made a big shift for industry to adopt billet planting method under Louisiana conditions. A field experiment was initiated in 2012 at the LSU AgCenter Sugar Research Station in St. Gabriel, Louisiana to evaluate the influence of type of planting materials on energy cane yield, quality, biomass composition and nutrient uptake. Treatments were arranged in a split plot in randomized complete block design with four replications. Two planting schemes were designated as the main plot (whole stalk and billet) and six varieties as sub-plot (Ho 02-113, US 72-114, Ho 06-9001, Ho 06-9002, and two reference varieties L 01-299 and L 03-371). Fifteen stalks were collected at harvest and were separated (into leaves and stalks), weighed, processed, and analyzed for biomass composition (ANKOM\(^{2000}\)), sugar quality parameters and nutrient uptake. Millable stalks were cut using combine harvester and loaded to wagon with load cell to determine plot weight. Yield was not significantly affected by planting scheme but variety L 01-299 showed the highest yield of 16 ton acre\(^{-1}\) and 18 ton acre\(^{-1}\) for whole stalk and billet planting, respectively. Lowest yield of 5 ton acre\(^{-1}\) was observed with variety Ho 06-9001 for the two planting scheme. Similarly, other measured parameters like nitrogen uptake, Brix, theoretical recoverable sugar (TRS), sucrose, fiber, hemicellulose, cellulose and lignin were not significantly influenced by different planting scheme. However, it was very evident that the sugarcane varieties L 01-299 and L 03-371 showed significantly higher nitrogen uptake, Brix, TRS, sucrose and fiber content than the
energy cane varieties ($P<0.05$). However in terms of biomass chemical composition, energy cane varieties had higher hemicellulose (16%), cellulose (30%) and lignin (20%) content than L 01-299 and L 03-371. The initial results of this study suggest that billets can be used as planting material in cane production without compromising cane yield, sugar quality parameters and biomass lignocellulosic composition.

**Estimating Yield Loss from Mexican Rice Borer (Lepidoptera: Crambidae) Injury in Energycane and Sugarcane**

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The Mexican rice borer, *Eoreuma loftini* (Dyar) (Lepidoptera: Crambidae) is an invasive pest of sugarcane, *Saccharum* spp., and poses a threat against the production of dedicated bioenergy feedstocks in the U. S. Gulf Coast region. A 2-yr field study was conducted in Jefferson County, TX to evaluate yield losses associated with *E. loftini* feeding on bioenergy and conventional cultivars of sugarcane under natural and artificially-established *E. loftini* infestations. In 2012, bioenergy sugarcane (energycane) cultivars L 79-1002 and Ho 02-113 exhibited reduced *E. loftini* injury; however, these cultivars sustained greater losses in fresh stalk weight and sugar concentration per percent bored internode when compared to conventional sugarcane. In 2013, *E. loftini* injury was greater in L 79-1002, although reductions in yield per percent bored internode were similar to results in 2012. Of the cultivars in this experiment, Ho 02-113 and L 79-1002 hold the greatest potential as dedicated bioenergy crops for production of ethanol in the Gulf Coast region; however, *E. loftini* management practices will need to be continued to mitigate yield losses.

**Microbial and Physicochemical Properties of Sugarcane Bagasse for Potential Conversion to Value-Added Products**

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Sugarcane bagasse is a potential source for commercially-viable products such as animal feed, mulch or fuel. The applications will be determined by the levels of moisture, ash and beneficial chemicals. Generating value-added products will be impacted, and may require conversion of the substrate, by microbes. Microbes present in bagasse have potential for optimal conversion to beneficial products because they have the ability to metabolize fibrous cane, and to survive the environmental conditions in bagasse. An analysis of both microbes and chemicals present in
bagasse will be necessary to determine the most viable potential applications. This study evaluates the microbial and physicochemical properties in bagasse samples from three individual cultivars and one sample of mixed cultivars which were collected in south Louisiana. The individual cultivars were either shredded or passed through a roller mill. The mixed sample was collected from the final tandem mill at a factory. Samples for microbial analysis were grown on two types of media. One medium, MRS, selects for *Leuconostoc* and *Lactobacillus*, microbes that metabolize sugars. The second medium, NA, allows growth of a broad range of microbes which are present in the cane growing environment. Microbial counts and type were compared across cultivars and processing method and were correlated with physicochemical analyses.

**Economic Products Derived From Sugarcane Trash and Bagasse**

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There are two potential untapped resources associated with the harvesting and processing of sugarcane, the trash left in the field and the sugarcane bagasse as surplus from the mills. Burning of sugarcane trash in the field has been under scrutiny in recent years due to urban encroachment and air-quality concerns and excess trash left in the field can also reduce ratoon crop yields due to lower soil temperatures and higher soil moisture. Sugarcane mills produce excess bagasse during the grinding season which is left unused for the remainder of the year. These two organic feedstocks can be thermo-chemically converted into biochars that can be brought back to the field to be used as a soil amendment to enhance soil health, water holding capacity and improve sugarcane yields. Biochars from sugarcane leaf residue (HoCP 96-540) and sugarcane bagasse were applied at three application rates, 0, 4 and 8% with and without commercial fertilizer. Biochars were applied both in a greenhouse setting as well as in the field. Biochars and feedstocks were chemically characterized for their nutrient content, several physico-chemical and adsorptive properties. Sugarcane biomass and theoretical recoverable sucrose (TRS) content were measured and compared across the different treatments. Possible benefits of biochar include an increase in soil carbon content, improvement of soil drainage and aeration, and addition of nutrients to the growing sugarcane crop. Benefits are expected to both sugarcane growers and processors through the production of valued by-products from pyrolysis of sugarcane trash and bagasse as well as enhancing the sugarcane industry’s role in renewable energy markets.

**Sugarcane Borer Damage to Energy Cane versus Sugarcane Cultivars**

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Energy cane and sugarcane are from the same genus, *Saccharum*; energy cane, however, has higher fiber: sugar ratios, thinner stalks and higher plant populations than sugarcane. Energy
cane is developed for its potential use in lignocellulosic ethanol production. Sugarcane borer, *Diatraea saccharalis* (Fabricius) is one of the major pests of sugarcane, but there are no reports available on damage to energy cane cultivars in Florida. Small larvae are typically leaf feeders before boring into stalks when larger. The objective of this test was to determine if small larvae exhibited any feeding preference for leaves and large larvae exhibited any preference for boring into stalks of the energy cane versus sugarcane cultivars. This information can be helpful in parental selection while making crosses for sugarcane or energy cane in a breeding program. Free choice tests were conducted with small and large larvae using leaves and stalks of three energy cane cultivars (UFCP 78-1013, UFCP 82-1655 and UFCP 84-1047) and three sugarcane cultivars (CP 88-1762, CP 89-2143, and CP 00-1101). Tests with small larvae were conducted in 15 cm diameter petri dishes, and with large larvae in large circular aluminum pans (pizza pans) measuring 35 cm in diameter with 4 cm high walls around their circumference. In small larvae test, a 2x1 cm leaf section from each variety was placed adaxial side up in each of the 6 equally sized radial sectors. After 48 h, the feeding damage was ranked on all leaf sections from 0 (no feeding) to 5 (heavy feeding). Each dish was one replication and 50 replications were conducted with small larvae and 10 with large larvae. In large larvae test, a 14-cm long section of stalk was taken from the middle in each cultivar and placed into each radial sector. After 48 h, the holes bored into the stalks were counted using a microscope. Feeding damage between the six cultivars was analyzed using the Least Significant Difference (LSD) test. Single degree orthogonal contrast was used in SAS to compare overall feeding damage in the three energy cane versus three sugarcane cultivars. Contrast analysis showed no significant difference either in feeding damage or holes bored in energy cane versus sugarcane cultivars, which indicates sugarcane borer’s equal preference for energy cane and sugarcane cultivars. Ongoing research on no-choice tests will provide information on larval survival in energy cane versus sugarcane cultivars.

**Identification of Candidate Markers Associated with Sucrose-related Traits in Elite Sugarcane Clones of Louisiana**

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Sugarcane, being a complex aneupolyploid, poses unique challenges to fine mapping of quantitative trait loci (QTL) controlling agronomic traits of interest. Due to high linkage disequilibrium in sugarcane, genome-wide association studies (GWAS) could be a better alternative to identify molecular markers associated with specific traits. We analyzed the association of markers with three sucrose related traits, Brix, total recoverable sugar (TRS), and percent sucrose, using 48 elite Louisiana breeding clones, including released commercial varieties, and a total of 1062 alleles generated using 50 SSR and 64 ALFP primer combinations. The population was grouped into four clusters that were subsequently used to model the three traits. The correlations among these three traits were all higher than 96%. A comparative association analysis was performed using TASSEL and JMP Genomics with identity by state
(IBS) K-matrix obtained from each program. Four different Q-matrices were paired with the K-matrices for a total of eight models that were run in both TASSEL and JMP. The Q-matrix contributed to the majority of the variation in the results. Across the two platforms, three markers were found to be associated for Brix and percent sucrose, each with $R^2$ values ranging from 0.17 to 0.2 (Brix) and 0.18-0.2 (percent sucrose) at a P value of <0.01. Four markers were associated with TRS with $R^2$ between 0.17-0.2. As expected, three markers were common to all three traits, and these markers will be validated in a larger population for their use in marker-assisted breeding.