Stalk Cold Tolerance of Commercial and Candidate Varieties During the 2010-2011 Harvest Season

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Variety trials for estimating stalk cold tolerance by measuring post-freeze deterioration of stalks of commercial and candidate varieties in the field are routinely planted at the USDA-ARS Ardoyne Research Farm, Schriever, LA. Commercial varieties of known cold tolerance are grown as controls. They include, but are not limited to, the following varieties: LCP 85-384 for "good" stalk cold tolerance and TucCP 77-42 for "poor" cold tolerance. Good stalk cold tolerance generally means that it will be possible to crystallize sugar from the juice of a variety at four weeks following a freeze event where the temperature drops to 24 to 26°F. Poor stalk cold tolerance generally means that it will not be possible to crystallize sugar from the juice of a variety after a four-week period. In the current experiment, ten commercial and one candidate varieties were planted at the Ardoyne Farm during the late summer 2009 for the purpose of testing varieties for stalk cold tolerance following a freeze event. The commercial varieties included in the study were as follows: LCP 85-384, HoCP 96-540, L 97-128, L 99-226, L 99-233, HoCP 00-950, L 01-283, L 01-299, L 03-371 and TucCP 77-42 (Argentina). The candidate variety included in the study was HoCP 04-838. Freezing temperatures that impacted the Louisiana sugar industry during the 2010-2011 harvest season occurred the nights of December 13 and 26, 2010, when the temperatures at the field site at the Ardoyne Farm dipped to 23.7°F and 22.9°F, respectively.

Ten-stalk samples were taken from each plot the mornings of December 14, 20 and 28, 2010, and January 4 and 11, 2011. Data were collected for sucrose % cane, purity % cane, yield of theoretical recoverable sugar per ton cane (TRS/TC), pH and titratable acidity (ml 0.1 N NaOH/10 ml juice to raise pH to 8.3). Data were also collected for Brix % cane and fiber % cane but will not be discussed here. Analyses for total soluble polysaccharides, mannitol and dextran are incomplete and will be reported later. Considering all the data collected for sucrose % cane, purity % cane, TRS/TC, pH and titratable acidity, the preliminary reaction (ratings) for the 11 varieties were as follows: HoCP 04-838 has significantly better stalk cold tolerance than any of the other varieties in the test and was rated as "Resistant or Very Good". LCP 85-384, HoCP 96-540, L 97-128, HoCP 00-950, L 01-283 and L 01-299 were rated as "Intermediate or Good" while L 99-226, L 99-233, L 03-371 and TucCP 77-42 were rated as "Susceptible or Poor". These ratings are mostly comparable to those given to the varieties last year following a freeze event of similar magnitude and duration. However, the rating of one variety, HoCP 00-950, was switched from Resistant to Intermediate with additional data. The ratings for the 2010-2011 harvest season are subject to change with data on total soluble polysaccharide, mannitol and dextran which are considered more sensitive criteria for determining stalk cold tolerance.

FCC Prospective on December 2010 Freezes—Part 1 Field Side

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Three freezes affected the Florida 2010-11 sugarcane crop. The first occurred on December 7 and 8 with frost and killed the growing points of most sugarcane away from Lake Okeechobee. The second freeze with occurred on December 14 and 15 with December 14 being windy and the lowest temperatures occurring on December 15 when the wind stopped blowing (radiation freeze). A third event occurred on December 28 which had temperatures similar to December 14. Only small areas of sugarcane near Lake Okeechobee remained undamaged. This presentation will cover damage assessments and FCC harvesting response to the severe freeze damage.

On December 16, damage assessments were started to evaluate about 3 million tons of standing cane at FCC for the severity of freeze damage. Most of this assessment work was completed by Saturday, December 18. Ratings based on a 0-4 scale were assigned to each field of cane with 4 being the highest damage level. These ratings were mapped and entered into cane bank files for harvesting to use as guidance to get the most damaged cane out first. The sheer amount of heavily damaged cane meant that some of it would still be in the field after 6 weeks. Operations were successful in harvesting all the cane rather than abandoning any cane. In normal Florida freezes, most heavily damaged cane is harvested within 3 weeks. We found that cane exposed to temperatures lower than 23°F showed more rapid sucrose losses than normally experienced in Florida freezes. Variety did not have much effect as cold tolerant varieties declined at about the same rate as more susceptible varieties.

FCC Perspective on December 2010 Freezes – Part 2 Processing

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The severe freezes of December 2010 significantly impacted both the quality and quantity of cane received by the mills. All aspects of operations were impacted and this presentation summarizes these impacts and the operating responses applied to ensure continued operation and completion of the crop. The routine analytical procedures for evaluation of cane quality produced a much wider range of data than expected for fresh cane. The online NIR system for incoming cane crusher juice analysis required a wider range of calibration analyses, and results were confirmed using HPLC data, even when the standard clarification procedure for pol measurement failed. Dextran (by the haze test) and starch levels were low for the freeze damaged cane. Titratable acidity data for juice were very variable, and the pH profiles for clarification through evaporation were quite different from normal. Increased lime was required for juice neutralization, at times supplemented with soda ash. Pan boiling schemes had to be

varied in response to the changing juice purities – it was not possible to operate the boiling house on cruise control. Strategies such as maintaining the quality of B-magma were essential to maximizing sugar recovery under these conditions.

Response of Giant Reed to Postemergence Sugarcane Grass Herbicides

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Increasing energy demand, rising energy costs, and environmental concerns have led to a surge in research on bioenergy sources. Giant reed (*Arundo donax* L.) has been proposed as a potential feedstock for bioenergy production in the marginal sugarcane (*Saccharum* spp. hybrids) production region of south Florida. Giant reed is a non-food based feedstock with rapid growth, high productivity, low input requirements, and resistance to biotic and abiotic stresses. However, giant reed has a high invasive potential where cultivation is proposed. In an effort to curtail future invasion of giant reed in sugarcane, there is need to screen currently available sugarcane grass herbicides for its control. A dose-response study was conducted in the greenhouse to determine the response of giant reed to postemergence sugarcane grass herbicides. Giant reed plants were treated with asulam at 460, 920, 1850, 3700, 7400, and 14800 g ai/ha, and trifloxysulfuron-sodium at 2, 4, 8, 16, 32, and 64 g ai/ha. Plants were harvested at 21 days after treatment, dried and weighed to obtain relative dry weight. Overall, giant reed relative dry weight decreased as rates of either asulam or trifloxysulfuron-sodium increased. Relative dry weight reduction was greater for asulam compared to trifloxysulfuron-sodium treated plants. The rates required to cause 50% response (ED50) for relative dry weight was 1780 and 4 g ai/ha for asulam and trifloxysulfuron-sodium, respectively. The probability of giant reed regrowth following asulam treatment decreased at rates above 3700 g ai/ha. In contrast, the probability of regrowth following trifloxysulfuron-sodium treatment decreased at 64 g ai/ha. These results suggest that asulam shows a better potential for use in control of giant reed in sugarcane. Additional field studies will be conducted to corroborate these results.

Efficacy and Economics of Bermudagrass Control Programs in Fallowed Sugarcane Fields

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In a typical fallow program, sugarcane stubble from the last harvest is destroyed in the spring or early summer, and fields are prepared for replanting in August and September. The fallow period in the sugarcane production cycle allows producers the most flexibility or options in terms of specific tillage practices and weed control programs. Many different combinations of tillage practices are currently being used by producers, and a wide array of herbicides are available for

use to control problem weeds in fallowed fields. The choice of specific tillage operations and herbicide has a direct impact on the variable cost per acre of the fallow program. Previous research has been conducted to evaluate tillage and herbicide programs for control of bermudagrass, the major weed problem in Louisiana sugarcane, with little attention given to economics. A collaborative effort between weed scientists and agricultural economists has resulted in development of the *Sugarcane Fallow Weed Control Program - Producer Decision Aid*. This Excel-based spreadsheet model can be used as a farm planning tool for producers to determine costs of current fallow programs and to compare costs for alternative fallow programs. Total variable cost per acre for a fallow program is estimated based upon data entered. Total variable cost includes charges for fuel, labor, and herbicide materials for operations performed as part of a fallow program. Sugarcane producers can use this model to determine the specific combination of tillage operations and herbicide applications to meet the goal of obtaining the desired level of weed control at the lowest cost per acre. The *Sugarcane Fallow Weed Control Program - Producer Decision Aid* model and users guide is available on the sugarcane crop page of the LSU AgCenter web page (www.lsuagcenter.com). The spreadsheet model also includes a blank worksheet for entry by the user of a specific fallow program. Two additional worksheets provide examples of model data entry for two alternative fallow programs. In addition to an explanation of how the model can be used, the report also includes the portion of the LSU AgCenter Sugarcane Weed Management Guide which relates to sugarcane fallow weed control.

Soybean Response to Off-Target Movement of Dicamba Applied in Sugarcane

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In Louisiana sugarcane production, dicamba containing herbicides, Weedmaster/Brash/others (dicamba + 2,4-D) and Clarity/Vision/others (dicamba), are labeled for use both in-crop, during the fallow period, and on ditchbanks. Planting of soybean in fallowed sugarcane fields has become more common. The close proximity of soybean to sugarcane increases the potential for off-target movement of dicamba and subsequent soybean injury. Field studies were conducted over three years and at three locations in Louisiana to evaluate soybean growth and yield response to postemergence application of dicamba. Clarity was applied to soybean at V3-V4 (2 to 3 fully expanded trifoliate leaves) at 8, 4, 2, 1, 0.5, 0.25, and 0.125 oz/A (1/2 to 1/128 of the labeled use rate in sugarcane of 16 oz/A). In a separate study, soybean at R1 (first flower) was treated with Clarity at 2, 1, 0.5, 0.25, 0.125, 0.063, and 0.031 oz/A (1/8 to 1/512 of the labeled use rate). In both studies a non-treated control was included for comparison. At 14 to 21 days after application, soybean injury for the V3-V4 application was 97% at 8 oz/A Clarity and 36% at 0.125 oz/A. Soybean injury for the R1 application 14 to 21 days after application was 67% at 2 oz/A Clarity and 19% at 0.031 oz/A. Injury ranged from cupping and crinkling of uppermost leaves to plants turned down with growing points near the soil surface. At higher rates stem swelling and cracking were observed. For the V3-V4 application mature soybean height compared with the non-treated was reduced 71% at 8 oz/A Clarity and 6% at 0.125 oz/A.

Mature height following the R1 application was reduced 57% at 2 oz/A Clarity and 26% at 0.031 oz/A. Soybean yield compared with the non-treated for the V3-V4 application was reduced 92% at 8 oz/A Clarity and 8% at 0.25 oz/A. When Clarity was applied at 0.125 oz/A, soybean yield was equivalent to the non-treated (46.6 Bu/A). For the R1 application, soybean yield was reduced 79% at 2 oz/A Clarity and 17% at 0.031 oz/A. When Clarity was applied at 0.25 oz/A (1/64 of the use rate and which can be expected with herbicide drift), soybean yield was reduced 8% with Clarity applied at V3-V4 and 43% when applied at R1.

Trinexapac-Ethyl: An Alternative to Glyphosate as a Sugarcane Ripener

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In Louisiana, all commercially cultivated sugarcane is relatively immature during the first several weeks of the harvest season, with theoretical recoverable sugar (TRS) levels at or below 90 g/kg. To increase early season TRS, chemical ripeners are used. Since 1980 in Louisiana, the herbicide glyphosate has been applied at sub-lethal rates to increase early season sucrose. However, in recent years farmers have been more reluctant to use glyphosate as a ripener due to less than desirable stubble regrowth in treated fields. An alternative ripener that would increase yield of theoretical recoverable sugar per ton of sugarcane (TRS/TC) and overall sugar yield per acre as well as glyphosate and with little or no impact on subsequent stubble crop(s) ratooning ability would be desirable. Palisade (trinexapac-ethyl), manufactured by Syngenta Crop Protection, is currently used as a sugarcane ripener in Brazil and other Latin American countries. In 2009, a study was initiated to evaluate the response of five commercial Louisiana sugarcane cultivars to trinexapac-ethyl. The experiment was designed as a randomized complete block and factors included sugarcane cultivars: HoCP96-540, L99-226, L99-233, HoCP00-950, and L01-283 and ripener treatments: glyphosate (0.46 g ae/ha) and trinexapac-ethyl (310 and 350 g ai/ha). Trinexapac-ethyl application numerically increased TRS for all cultivars eight weeks after application, but increases were significant for only three cultivars. Although differences were not detected for sugarcane yield eight weeks after treatment (α=0.05 significance level), yield of sugarcane per acre was numerically reduced for both trinexapac-ethyl and glyphosate treatments compared with the non-treated. Data suggests that trinexapac-ethyl can increase TRS/TC in some Louisiana sugarcane cultivars. Although sugarcane yield was negatively affected with both trinexapac-ethyl and glyphosate, yield loss was numerically less for trinexapac-ethyl compared with glyphosate.

Amphibian Communities and Habitat Use in Sugarcane Fields of Florida

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Frogs and toads (anurans) can be found in habitats in and near sugarcane fields in the Everglades Agricultural Area. We conducted quarterly surveys for anurans in 2010 and 2011 in sugarcane, rice and leafy greens fields, and included field edge, road, ditch and canal in our point counts. We established transects at the edges of fields with sugarcane, leafy greens and rice with comparison points in natural habitat. Our surveys were conducted at night and were primarily auditory but we also searched vegetation for individuals. We recorded the number of individuals or the relative size of anuran choruses and the location of each individual or chorus, i.e. field, edge, canal, or ditch. We did not measure abundance or reproductive success. Anurans are wetland dependent but some, like toads, are also found in dry habitats near water. In the EAA anurans are found along canals and ditches but also in and near sugarcane and flooded areas like rice fields. Ten species of frog or toad were observed in agricultural habitats, and communities were different in different agricultural types. Ten species were also observed in natural habitat but species composition was different.

Effects of Cultivation Frequency on Sugarcane Yields

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Reducing the number of cultivations during one or more years of a four year crop cycle reduces production expenses and could increase profitability if yields ae not adversely affected. This study was initiated to determine the effects of cultivation on yields of sugarcane grown on a clay soil both on an annual basis and throughout a cane-cropping cycle. Whole-plot treatments in plant-cane were either no or conventional cultivation. Conventional cultivation consisted of a total of four cultivations with two inter-row cultivations before fertilization, one cultivation immediately after fertilization, and a lay-by cultivation. For the no cultivation treatment, rows were left undisturbed except for knifing fertilizer on both sides of the planted line of sugarcane in April each year of the crop cycle. For every subsequent ratoon crop, the whole plots established in the previous crop were split with split-plot treatments being no or conventional cultivation. Thus, split, split-split, and split-split-split treatments were initiated in the first-, second-, and third-ratoons, respectively. Conventional cultivation increased sucrose yields by 700 and 600 kg ha^{-1} in the plant-cane and first-ratoon crops. Cultivation treatments resulted in equivalent yields in the second-ratoon crops. In the third-ratoon, the no cultivation treatment increased sucrose yields by 700 to 1000 kg ha^{-1} only if the cane had been conventionally cultivated in either the prior plant-cane or second-ratoon crops. Over the three years where the treatments could be combined (plant-cane, first-, and second- ratoons) conventional tillage increased sucrose yields by 1400 kg ha^{-1}, which equates to a $525 and $475 USD increase in gross and net revenue per hectare. Conventional cultivation in plant-cane is necessary to increase yield throughout a crop cycle, but Louisiana producers may consider minimum cultivation in the last two years of the crop cycle.

Diaprepes abbreviatus a New Pest of Florida Sugarcane?

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The Diaprepes root weevil, *Diaprepes abbreviatus*, was first reported in Florida in 1964 at a citrus nursery near Apopka. Since then it has spread over a large area of central and southern Florida where it is damaging citrus, ornamental plants, and some other crops. Since *D. abbreviatus* is an important pest of sugarcane in the Caribbean, Florida sugarcane growers have been on the lookout for infestations since its introduction. Although found near Florida sugarcane fields since the 1990's no sugarcane damage has been reported. Now two infestations of *D. abbreviatus* have been confirmed in Florida sugarcane. A single *D abbreviatus* female may lay 5,000 eggs in her life. Eggs are laid in clusters between two leaves that are glued together or one leaf that is folded and glued. Eggs hatch in seven to eight days, and the neonate larva fall to the ground, enter the soil, and begin feeding on sugarcane roots and sometimes tunnel into the base of the cane stalk. Because of *D. Abbreviatus* long larval period, extensive feeding damage may occur. After a period of feeding, they pupate in the soil, emerging later as adults. Because the time spent in the larval and pupal stage is so variable, the total life cycle of any single weevil may last from six to 15 months resulting in multiple overlapping generations.
Sugarcane damage was severe in the two locations found in 2010. Currently, we do not understand why it took so long for Diaprepes to infest Florida sugarcane since the insect has been present in Florida for many years. Also, we don't know if Diaprepes will become more of a pest in Florida sugarcane in the future. However if the weevil spreads it will be difficult to control because of it's location in the soil under sugarcane stools. In the 1960 persistent chlorinated hydrocarbons such as aldrin and chlordane were used in the Caribbean, but these compounds are no longer available. In Florida insecticides to control the adults and flooding to control larvae in the soil may hold some potential. Maintaining fields free of weed species used by adults as food may be a first line of defense against larval infestations in sugarcane.

A LCP 85-384 Genetic Linkage Map Enriched with Polymorphic SSR Markers

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Sugarcane (*Saccharum* spp. hybrids) cultivars, such as Q165, R570 and LCP 85-384, have been used to construct genetic segregation populations for the development of genetic linkage maps.

Based on the genetic linkage map for a selfed-progeny population of R570, the French research group at CIRAD tagged a rust resistance gene that eventually led to map-based cloning of the '*Bru1*' gene. Louisiana sugarcane researchers at the USDA and the LSU AgCenter have taken a similar approach and constructed a preliminary genetic linkage map based upon a selfed-progeny population of LCP 85-384. The objective of this study was to enrich this linkage map with newly discovered polymorphic SSR markers. This enrichment process involved a total of 1,504 polymorphic markers with 64 AFLP, 12 TRAP, and 83 SSR primer pairs. Nine hundred and ninety-three single dose markers (Theoretical segregation ratio <= 6.7:1) were chosen for map construction. Of which 634, including 465 AFLP, 70 TRAP, and 99 SSR markers, fit the theoretical single dose markers segregation ratio of 3:1. The remaining 359 distorted single dose markers did not fit the 3:1 segregation ratio. Eight hundred and eighty-four out of 993 single dose markers were successfully assigned onto 108 co-segregation groups (CGs). These 884 markers included 615 AFLP (69.6%), 90 TRAP (10.2%), and 179 SSR (20.2%) markers. An additional eight AFLP, one TRAP, and 163 SSR markers were added to the 108 CGs when comparing with the preliminary genetic linkage map. Sixty-three of the 108 CGs were successfully assigned into 11 homologous groups (HGs) based on the SSR marker information. The number of CGs for each HGs ranged from as few as two to as many as 27. This enriched LCP 85-384 genetic linkage map will be useful for mapping QTLs associated with important agronomic traits in sugarcane, such as sugar and fiber content.

Microbial Ecophysiological Response of Sugarcane Soils to Sulfur Amendment

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The objective of this study was to assess the functional response of microbial communities to sulfur amendment of Histosols under sugarcane cultivation in the Everglades Agricultural Area (EAA) in Florida. The soil was amended with elemental S at four rates up to 448 kg S ha^{-1} to decrease pH and enhance nutrient availability. Soil samples were collected 2, 6, 9, and 13 months after S application and subjected to microbial, enzyme, and nutrient analysis. Application of S at rates up to 448 kg S ha^{-1} enhanced labile P availability by 103% compared to unamended soils. Nonetheless, stimulatory effects were limited and temporary due to the high buffering capacity of this organic soil (pH=6.3) against acidification. Activities of leucine aminopeptidase and sulfatase were not related to S application rate. Phosphatase activities were 115% higher and glucosidase activities 573% higher for soils receiving the highest S rates than unamended soils at 2 months, indicating a short-term enhancement of organic matter decomposition. Microbial biomass C and N were not affected by S amendment, but biomass P was 314% higher for soils amended with the highest S rates at 2 months than soils receiving the lowest rates, primarily as a result of increased P availability. The C, N, and P mineralization rates were not affected by S, though all rates varied seasonally, suggesting that S application did not stimulate soil oxidation over the long-term. Overall, application of S generally did not result

in a sustained pulse or flux of nutrients from this soil, suggesting that S application had minimal benefit for increasing nutrient availability to sugarcane for soils with pH around 6.3.

Genetic Diversity of Commercial Sugarcane Cultivars of Louisiana Analyzed Using SSR Markers

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With an objective to assess the diversity that can be exploited in selecting parents for commercial breeding program, and to obtain information about locus-specific alleles shared with ancestral genomes, genetic diversity was analyzed among 48 Louisiana sugarcane cultivars alongside two accessions of *Saccharum officinarum* and 14 diverse accessions of *S. spontaneum* using simple sequence repeat (SSR) markers. Cluster analysis based on 259 polymorphic loci separated the cultivars from *S. officinarum* and *S. spontaneum* at 0.35 and 0.28 similarity coefficient, respectively. The cluster consisting of cultivars formed multiple subclusters with similarity coefficients ranging from 0.43 to 0.78. A large subcluster included LCP85-384, a parent extensively used in crossing program, and its descendants. The cluster analysis was supported by the principal coordinate analysis where 19.4% of the variation was explained by the genotypes. The markers had an average polymorphic information content of 0.28 with an average bootstrap coefficient of variation of 11%. Analysis of molecular variance ($P < 0.001$) indicated that 27% of the variation was attributed to among the clusters while the remaining 73% to within a cluster. Our larger SSR data (in preparation) and previous results with other types of molecular markers will enable us to understand comprehensively the genetic structure of Louisiana commercial sugarcane cultivars. Further, correlation between molecular markers and pedigree data will yield valuable information with regard to inheritance of *S. spontaneum* alleles in the commercial germplasm.

Random Coefficient Model: A Statistical Tool for Family Selection in Sugarcane

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Whereas sugarcane is recognized as a clonally propagated crop, the first episode of selection in sugarcane breeding occurs among seedlings planted from true seed. Family selection at this stage involves the selection or rejection of whole families of seedlings based on family performance. Subsequent selection of individual seedlings is restricted to the selected families. All subsequent stages in the breeding program are planted from vegetatively propagated material and evaluated as clones. Confounding effects of 'seed type' can occur when the relative performance of families or individual seedlings differ between the seedling and clonal stages. Statistical methods that model simultaneously the potential and repeatability of performance between the seedling and clonal stages will help to mitigate possible adverse confounding effects to provide a more robust tool for family selection. The objectives of this study were to evaluate families for cane yield potential and repeatability using the random coefficient model (RCM) analysis, to identify model parameters that could be used to select elite families, and to compare the RCM analysis to the analyses of variance (ANOVA) and covariance (ANCOVA) methods of selection. Data collected from 17 families evaluated as seedlings (2002) and clones (2003) were used in the analyses. Unlike in the ANCOVA, the RCM analysis allows for simultaneous testing of the intercept (yield potential) and slope (repeatability) of each family against population parameters. The slope was the most discriminating parameter and was positively associated with within family variability in the seedling stage. The elite families selected by the RCM analysis produced higher cane yields in the seedling and clonal stages compared to those identified by the ANCOVA and ANOVA methods. Seedlings selected from these families were also associated with higher cane yield in the clonal stage. The RCM analysis can be implemented as a separate program to evaluate new families, and that information used to rank elite families as well as decide what proportion of seedlings from these elite families to plant in the core breeding program.

Relationships among Leaf Area Index, Visual Growth Ratings, and Biomass Yield in Sugarcane

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Subjective visual growth ratings (VGR) are often used in sugarcane breeding programs to compare genotype performance quickly and economically. However the relationship between these VGR as well as quantitative growth measurements with final yield measurements is not well understood. Data on Leaf Area Index (LAI) and VGR obtained from a 3-yr study were used to determine the relationships among LAI, VGR, and sugarcane (*Saccharum* spp.) yield (TCH), and also to estimate crop growth stage at which LAI and VGR were most closely related to the yield. Mean LAI increased linearly with crop growth stage. The relationship between r^2 values

(LAI vs TCH) and crop growth stage indicated that LAI was poorly related to TCH (r^2 = 0.09-0.18) early in the growing season and there was a rapid improvement in this relationship by mid-season (r^2 = 0.66-0.76), which was maintained through late-season (r^2 = 0.66-0.87). The relationship between VGR and TCH was strongest in mid-season (r^2 = 0.72-0.88) and relatively poorer early and late in the growing season (r^2 = 0.38-0.53). Similarly, there was good agreement between subjective VGR ratings and objective LAI measurements in the middle of the growing season (r^2 = 0.65-0.77). However, r^2 values between VGR and LAI (r^2 = 0.54-0.57) deteriorated later in the growing season. Overall, our results indicate that LAI and VGR measurements from the middle of the growing season have stronger relationships with each other and also with sugarcane yield than measurements taken early or late in the growing season.

Effect of Residue Management on Sugarcane Yield

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We investigated the effect of sugarcane residue (mulch cover) management, using residue deposited during harvest operations, on sugarcane yield (biomass and sugar). Three residue management practices were implemented on two sites at the Sugar Research Station in St. Gabriel, Louisiana. The three treatments were; (i) burning the mulch after harvest , off-barring and cultivating in the spring; (ii) sweeping the mulch off the top of the row after harvest, off-barring and cultivating in the spring; (iii) leaving the mulch on the field after harvest, off-barring and cultivating in the spring. The last treatment where mulch was not removed may best regarded as a no-till treatment which is a commonly used soil conservation measure. Three cycles of sugarcane were used to compare the treatments. Sugarcane variety HoCP91-555 was planted on September 19, 2001 on a Commerce silt loam soil. Sugarcane variety HoCP91-555 was planted on October 21, 2003 on a Sharkey clay soil. Sugarcane variety L97-128 was planted on August 15, 2006 on a Commerce silt loam soil. Sugarcane population and yield were measured for each treatment. Highest yield over the average of nine years was that for the burn treatment which with 10 % increase in sugar when compared to the no-till treatment. Sugar yields from the sweep treatment were consistent with yields from no-till.

Improved Efficiency from Mechanical Planter Modifications

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In 2007, funding from the American Sugar Cane League was directed toward modifications to a front end drum planter. A field scale experiment was initiated during the 2007 planting season. The test was designed to evaluate the performance and yield of three mechanical planters that were compared to hand planting. The planters were identified as a modified, partially modified and unmodified mechanical planter. The modified planter was raised 10 inches and the discharge chute was adapted to help direct the cane into the furrow better. Additionally, a 5 foot diameter, open drum and a rubber belt with raised cleats were installed in the planter. The partially modified planter was similar, but did not have the large, open drum or a rubber belt. In a randomized block design, five replications of each treatment were monitored for performance and yield over the three year crop cycle. Piles (10 or more stalks), gaps (an unplanted space of three or more feet) and tons of seedcane used were measured at the time of planting. The modified planter used 15.6% more seed cane than the hand planted check, while the partially modified planter and the unmodified planter used 41.9% and 36.5% more seed cane, respectively. The modified planter distributed an average of 12 piles and 2.5 gaps per 1000 row feet. The partially modified planter distributed an average of 24 piles and 1.2 gaps, and the unmodified planter distributed an average of 27.5 piles and 2.2 gaps per 1000 row feet. An economic analysis, using 2007 costs, showed that in this test the modified planter operated at 39.5% less cost per acre than the hand planted check while the partially modified and the unmodified planter had 45.5% and 35.2% more cost per acre than the hand planted check. Total crop cycle yields were similar for all treatments. The modified planter was the most efficient since it had the lowest planting expense without any loss in yield. The modified planter generated the highest net returns compared to the hand planted check.

Feasibility of Using Remote Sensing Technology in Nitrogen Management in Sugarcane Production

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The development of effective decision tools for managing agricultural resources like nitrogen fertilizer is considered as one of the major goals of integrating remote sensing technology in crop production. However the adoption pattern of precision farming by agricultural communities more specifically by the sugarcane producers is slow. This study was initiated in 2009: 1) to establish a knowledge base about the use of remote sensor to characterize sugarcane biophysical properties, and 2) to obtain insights on the current state of knowledge of sugarcane producers about remote sensing technology and its application on nitrogen fertilizer management. Sugarcane trials were established at two sites with four nitrogen rates (0, 40, 80, and 120 lbs/A) with three of the most prevalent cane varieties in Louisiana (HoCP 96-540, L99-226 and L01-283) as treatments. Field data including biomass clippings, tiller counts, and sensor readings were collected on a weekly basis for four weeks starting at two weeks after nitrogen fertilization. Cane and sugar yields, nitrogen concentrations in biomass, and nitrogen uptake by cane were also determined. These data were used to evaluate the relationships of canopy reflectance at specific wavelengths in the visible and near infrared regions of the spectrum and different vegetation indices with sugarcane

agronomic variables. Based on nonlinear regression analyses, two of the vegetation indices tested showed potential use for non-destructive biomass estimation for sugarcane. Both normalized difference vegetation index (NDVI) and simple ratio (SR) computed from sugarcane canopy reflectance had strong logarithmic relationships with biomass at 5 weeks after N fertilization. A survey was conducted to determine the criteria used by sugarcane producers for production technology adoption. An assured increase of 5 tons ac^{-1} in cane tonnage and/or 1000 lbs ac^{-1} in sugar yield and cost of investment were among the criteria identified. The information generated from this study is essential to ensure that future research efforts in remote sensing will yield field-oriented and valuable nitrogen management decision tools for sugarcane producers.

Sugarcane Yield Responses to Mill Mud and Compost Application on Mineral Soils in Florida

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There are approximately 80,000 acres of sugarcane (*Saccharum* spp.) grown on mineral soils in south Florida. This comprises approximately 20% of the sugarcane acreage in Florida. Any expansion in acreage of sugarcane or energy cane will be on these sands which have very low organic matter content and low capacity to hold water and nutrients. Soil incorporation of organic amendments has potential for increasing sugarcane yields on these soils. Three small-plot experiments were conducted on mineral soils to evaluate sugarcane tonnage and sucrose yield responses to furrow and broadcast applications of mill mud and compost. In a comparison of furrow and broadcast applications of mill mud and yard waste compost, broadcast application of mill mud (120 yd^3/acre) resulted in the most consistent increase in tons sugar/acre (TSA) (20% over two years). In another experiment comparing furrow applications of mill mud and yard waste compost, there were significant responses in TSA in the ratoon crops to mill mud application (30 yd^3/acre) (9% increase in TSA over 3 years). In a third factorial experiment with N rates and broadcast application of yard waste compost mixed with sewage sludge (60 yd^3/acre), there was a 41% increase in TSA over two years with compost/sludge across N rates 0 to 240 lb N/acre/yr. In that experiment there was a 17% increase in TSA over two years with compost/sludge across N rates 180 and 240 lb N/acre/yr. The most consistent sugarcane yield responses to organic amendments in the study were determined with broadcast applications of mill mud and compost/sewage sludge.

New Findings on Factors Affecting Mexican Rice Borer, *Eoreuma loftini* Dyar, Infestation of Sugarcane: Leaf Characteristics, Drought Stress, Soil Fertility, and Alternate Host Plants

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The Mexican rice borer, *Eoreuma loftini* Dyar, was first detected in the United States in sugarcane during the 1980s. It has since become the predominant pest of sugarcane in Texas, and it affects rice production as well. Studies on the ecology of this pest have revealed leaf characteristics that are highly preferred by the moth for oviposition, some of which might be capitalized upon for development of resistance varieties. Drought stress to sugarcane has been associated with greater levels of damage from Mexican rice borers than on well-watered plants, and enhanced soil fertility has also been shown to significantly increase injury to sugarcane. Varietal resistance based on drought tolerant sugarcane cultivars is being assessed, and studies on methods for improving soil fertility without increasing Mexican rice borer damage are underway. Oviposition on selected weed and crop hosts have revealed for the first time that, while the Mexican rice borer is well-known as a pest of rice and sugarcane, these new findings show that it is more strongly attracted to corn, which may have large ramifications on corn pest management as well as for rice and sugarcane. Biochemical analyses of host plants and sugarcane under various stresses have identified mechanisms related to the attraction of the pest to plants grown under certain conditions, and to host plants.

Developing an Aerial Application Insecticide Program for Control of the Mexican Rice Borer

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A 2-year aerial application study conducted in five commercial sugarcane fields (35-85 acres) each in the Lower Rio Grande Valley showed that chemical control of the Mexican rice borer (MRB) with one carefully timed application could achieve adequate season-long control. The insect growth regulation Diamond® (novaluron) averaged 7.1% (±2.2 SE) bored internodes versus 24.7% (±6.1 SE) bored as means from five 10-acre plots for each treatment. Using adult pheromone traps to facilitate infestation determination, sugar yield increased 14% to average 8.03 tons of sugar per acre, an increase greater than $300 per acre. Because more than half of the larvae bore into the plant within one day of hatch, pheromone trap assisted monitoring enhances management.

Biological Nitrogen Fixation in Louisiana Sugarcane

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Nitrogen (N) is a major input for sugarcane with crops in Louisiana receiving between 90 and 180 kg/ha with the cost of N increasing 75% in the last decade. Biological N fixation (BNF) may be a viable alternative to fertilizer N. The process relies on endophytic bacteria (bacteria that live among the cells of plant tissues) converting atmospheric N into plant-available N. In 2010, endophytic bacteria were isolated from field-grown commercial sugarcane (HoCP 96-540, L 99-233, L 01-283, Ho 00-950, L 97-128, and LCP 85-384) at four locations. The isolations were made on N-deleted media indicating that they must generate their own N to grow. Members of three genera (*Gluconacetobacter*, *Burkholderia*, and *Herbaspirillum*) known to contain nitrogen-fixing bacteria were identified among the many bacterial isolates. Fifty-nine bacterial isolates were selected for further study. The N-fixation capacity of *Gluconacetobacter diazotrophicus* isolated from Ho 00-950 has been demonstrated using the acetylene reduction assay. Determining the N-fixation capacity of other isolates has been initiated. If these bacteria are found to be beneficial and provide the sugarcane plant with moderate, dependable levels of N, lower fertilizer rates could be recommended.

Yield Response by Rust Susceptible Cultivars to Foliar Fungicide Applications Applied to Commercial Sugarcane Fields

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Brown rust, caused by *Puccina melanocephala* (H. & P. Sydow), and orange rust, incited by *P. Kuehnii* (E. J. Butler) are two of the most important diseases of sugarcane in Florida. For many years, host plant resistance was the only way to feasibly manage rust diseases. However, as with rust diseases on other crops, resistance in sugarcane has not always been durable. The development of rust variants capable of overcoming host plant resistance has been a reoccurring problem. Small plot fungicide trials had demonstrated the efficacy of chemical control, particularly by fungicides in the strobilurin and triazole classes, but without registrations, these compounds could not be tested on a larger scale without total crop destruction. In the spring of 2008, a Section 18C registration was granted for the use of the fungicides pyraclostrobin (Headline) and metconazole (Caramba) in Florida. These registrations allowed for the completion of commercial scale comparisons of fields left untreated, with those receiving fungicides. During 2010, comparisons were made on five cultivars at six different locations.

Two cultivars (CP78-1628 and CP96-1252) were brown rust susceptible, while three cultivars (CP80-1743, CP88-1762, and CP89-2143) were orange rust susceptible. CP96-1252 was compared on both sand and muck soils. All fields receiving fungicides received two sequential pyraclostrobin applications, rotated with a metconazole application (for fungicide resistance management), followed by a third pyraclostrobin application. A 12 fluid ounce per acre rate was used for both compounds. In all cases, fungicide applications were initiated in early June, with the first three being separated by approximately one month intervals. The last application was made about 2 months following the third, when there appeared to be a resurgence of orange rust in late Sept. Field sizes varied, ranging from 12.5 acres to 40 acres, so yields were expressed on a per acre basis. Cane yield ranged from 3.53 to 10.45% higher in blocks receiving fungicide than in fields that were left untreated. Averaged across all six locations, cane yields (T/A) in treated fields were improved by 5.66% over their respective untreated checks. Additionally, sucrose levels in cane from treated blocks were consistently higher than those in cane from untreated fields, although in some instances, differences were slight. Based upon fungicide and application costs and an average price of sugar set at 25 cents per pound, fungicide applications produced positive economic returns in six of six cases, with returns ranging from $33.40 to $265.84 per acre. These results verify earlier efficacy data generated from small plot experiments and demonstrate the potential for fungicidal control of sugarcane rusts in commercial sugarcane production.

Yield Loss Incited by Orange Rust (*Puccinia kuehnii*) on a Highly Susceptible Sugarcane Cultivar in Florida

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Sugarcane orange rust, incited by *Puccinia kuehnii*, was initially reported in the Western Hemisphere in 2007, when it was first observed in Florida. Since that time, it has affected several commercial cultivars, notably CP80-1743, CP72-2086, and CL85-1040. Experiments were conducted during 2008 and 2009 to quantify yield losses on the latter, the most susceptible of these cultivars. Varying levels of orange rust were established at the Everglades Research and Education Center in Belle Glade, FL by applying the fungicide pyraclostrobin at 7, 14, 21, and 28 day intervals. Experimental units measured five rows by 15 m and were arranged in a randomized complete block design with eight replications. Non-sprayed plots served as controls. Rust severities were visibly estimated on the top-visible-dewlap leaf minus four using established assessment keys. The 2008 orange rust epidemic began in May and persisted through the remainder of the growing season, while the 2009 epidemic began in August and persisted through the remainder of the growing season. The major difference in the two years was a late January freeze during 2009 which drastically reduced primary inoculum levels. No such freeze occurred during 2008. During both years, fungicide applications continued only into Sept, ceasing due to the height of the crop. Disease severities ranged from near zero in the 7-day treatments to over 35% in the controls when assessed on the terminal third of the fourth leaf below the top visible dewlap. During 2008, millable stalk populations were reduced by 12% and

stalk biomass by 32% when controls were compared with the 7-day treatments. Together, these accounted for reductions of 43% in tons of cane per hectare. Sucrose concentrations were significantly reduced by nearly 18% on this cultivar in 2008. During 2009, differences in millable stalk populations were less than 2%, this difference (12% vs 2%) from year–to-year presumably being due to the relatively late epidemic in 2009. Stalk biomass, in contrast was reduced by 33% during 2009, and cane tonnage by 32%. Cumulative losses in terms of sugar per unit area of cane measured 53% and 43% for 2008 and 2009, respectively. These findings demonstrate the highly destructive nature of this disease under favorable conditions and underscore the urgency to breed for host plant resistance.

Update on the Status of Sugarcane Rust Mite in the Americas

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The sugarcane rust mite, *Abacarus sacchari*, was found on sugarcane in southern Florida in September 2007. Previously known only from Asia, it has since been found in sugarcane growing areas throughout the Americas, most recently in Guatemala and Panama. The mitocide Envidor was effective at greatly reducing populations of the mite for >3 wk in 2010 field trials. The orange discoloration on lower leaf tissue caused by mite feeding appears to be the most prominent on the commercially released variety CP89-2143. Damage ratings on cultivars in stage III and IV trials conducted in southern Florida from 2007 through 2010 will be discussed in relation to predicting resistant parental lines.

Physiological Responses of Sugarcane to Orange Rust Infection

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Sugarcane orange rust, caused by *Puccinia kuehnii*, is a relatively new disease in the United States that substantially reduces yields in susceptible sugarcane cultivars in Florida. The objective of this study was to determine physiological responses of sugarcane to orange rust infection by quantifying effects of the disease on leaf chlorophyll level (SPAD index), net photosynthetic rate, dark respiration, stomatal conductance, intercellular CO_2 concentration, and the relationships between these leaf physiological traits and rust disease ratings. Treatments included four sugarcane cultivars (CP 72-2086, CP 88-1762, CP 89-2143, and CPCL 99-4455) and two rust inoculations (not inoculated and inoculated). Spores of orange rust were collected from infected leaves of field-grown sugarcane prior to inoculation. Plants growing in pots were inoculated with these field-collected orange rust spores using a leaf whorl inoculation method at the 5-leaf stage. A disease rating was assigned weekly using a scale from 0 to 4. At the same dates of rust assessment, SPAD index and photosynthetic components of the top visible dewlap (TVD) leaves were measured. About 4 weeks after inoculation, these measurements were taken

on the rust infected and uninfected portions of inoculated leaves. No significant differences were detected between the non-inoculated and inoculated plants for any physiological variable, when measurements were taken on TVD leaves or uninfected portions of inoculated leaves. However, the rust infected portions of inoculated leaves showed significant reductions in SPAD index, stomatal conductance, leaf transpiration rate, and net photosynthetic rate at disease ratings$\geq$ 2. The infected leaf portions with rust ratings of 4 had 43-47% less leaf SPAD index and net photosynthetic rate compared with the non-inoculated control. The rust infected portion of the inoculated leaves had increased intercellular CO_2 concentration and dark respiration rate. Although leaf SPAD index, photosynthetic rate, stomatal conductance, and transpiration rate at the rust infected portion of the leaves decreased linearly with increased rust rating, the effect of orange rust on net photosynthetic rate was much greater than that on stomatal conductance and transpiration. Reduction in leaf photosynthesis by orange rust under low light was greater than that under high light intensity. These results help improve our understanding of orange rust etiology and the physiological bases of sugarcane yield loss caused by orange rust. The quantitative relationships between orange rust ratings and photosynthesis components could be used for modeling the impact of orange rust on leaf photosynthesis and plant growth in sugarcane.

Alternative Use of sugarcane Residue and Bagasse as Biochar Precursors for Soil Amendment Applications

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In recent years there has been a reduction in the burning of postharvest sugarcane trash in the field due to urban encroachment and air-quality concerns. The trash – mulch layer left on the soil surface reduces yields of ratoon crops due to lower soil temperatures and higher soil moisture, and allelochemicals. Sugarcane mills occasionally produce excess bagasse during the grinding season. It is possible to thermochemically convert these two organic feedstocks (sugarcane trash and sugarcane bagasse) into biochars that can be brought back to the field to be used as a soil amendment to enhance soil health and water holding capacity and to improve sugarcane yields. This is the first study in a multiple-year study where several biochars from sugarcane leaf residue (variety HoCP 96-540), whole plant (variety L79-1002) and sugarcane bagasse are produced, characterized and applied back to the soil. These feedstocks will be chemically characterized for their nutrient content, several physico-chemical and adsorptive properties, and some of them used in greenhouse experiments with untreated and commercial fertilizer controls included. Plant height as well as sugarcane yields are measured every two weeks. In subsequent years, theoretical recoverable sucrose and cane yield will also be determined. 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 byproducts from pyrolysis of sugarcane trash and bagasse as well as enhancing the sugarcane industry's role in renewable energy markets.

Seasonal Timing of Glyphosate Ripener Application Affects Sugarcane's Response in Louisiana

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Glyphosate is applied as a ripener to ratoon sugarcane in Louisiana to increase theoretically recoverable sugar (TRS) in harvested sugarcane. While glyphosate is applied as a ripener throughout the harvest season, recommendations for these applications have been based primarily on the response of sugarcane to ripener applied early in the harvest season (August or September). In order to improve recommendations for these ripener applications, experiments were conducted in 2006, 2007, and 2009 to measure the response of sugarcane to ripener applications throughout the harvest season. Beginning in mid-August, glyphosate (0.2 kg/ha) was applied to a commercial sugarcane field four times during the harvest season, with applications at four-week intervals and were compared to non-treated sugarcane. Plot size was two 1.8m wide rows and 15 m long with six replications of each treatment and were arranged in a split-plot design. Sugarcane 'HoCP 96-540' was hand-harvested at four, five, six, and seven weeks after treatment (WAT). Fifteen consecutive stalks were cut from a random location within each plot and weighed to determine average stalk weight. Five of these stalks were randomly selected to determine whole stalk response to ripener application. The remaining 10 stalks were divided into thirds to measure response based on location within stalk. These divisions are termed bottom (the four basal nodes of each stalk), middle (the next four internodes), and top (the remaining internodes). At 7 WAT, plots were harvested using a chopper harvester to determine plot weights and stalk piece (billet) samples were collected from each plot. All samples were processed using the core/press method, with TRS being determined from Brix, Pol, and fiber measurements.

Averaged for the three years of this study, glyphosate applied in mid-August increased whole-stalk TRS by 21% compared to the non-treated control. Glyphosate applied four weeks later (early-September) increased whole-stalk TRS by 11%. Applications made another four weeks later (early-October) increased TRS 8%. There was no increase in TRS when the final glyphosate application was made in either late-October or early-November. The greatest increases in TRS were observed in the top of the stalk with increases as much as 50% when glyphosate was applied in mid-August. While there was no significant increase in whole-stalk TRS for the last glyphosate application, there was a 3% increase in TRS in the tops of these stalks. Even while the greatest increases in TRS were seen in the top portion of the sugarcane stalk, increases were also observed in the middle and bottom of the stalk where internodes were generally considered to be mature. For applications made in mid-August, TRS increased 13 and 19%, respectively, for the bottom and middle stalk portions. Treatment to harvest intervals did not affect the percent increase in TRS appreciably. Glyphosate applied in mid-August increased TRS 20, 24, 20, and 21%, respectively, for harvests at 4, 5, 6, and 7 WAT.

Stalk weights were reduced by 8 and 9%, respectively, at the 6 and 7 WAT harvest dates when glyphosate was applied in mid-August, but not at earlier harvest dates. When glyphosate was applied in early-September, stalk weight was reduced 11% only at the 7 WAT harvest. Stalk

weight was not reduced at the later glyphosate application dates. Gross cane yields at 7 WAT were reduced 7 and 12%, respectively, when glyphosate was applied in mid-August or early-September, but yield was not reduced with later applications. Glyphosate increased sugar yields 13% when applied in mid-August and 8% when applied in early-October, but neither increased nor decreased sugar yields when applied in either early-September of early-November. For applications made in early-September, all gains in TRS were offset by losses in tonnage.

This study showed that glyphosate can be used to effectively increase TRS levels in harvested sugarcane through three-quarters of the harvest season. While the increase in TRS was greatest early in the harvest season, applications made in the middle of the season also increased TRS. As sugarcane is still actively growing in August and September, and the percent increase in TRS is similar when harvested at 4 or 7 WAT, perhaps utilizing a treatment to harvest interval of 4 or 5 weeks would further increase sugar yields for cane harvested in the first third of the harvest season. This would allow the sugarcane to increase in tonnage and maturation prior to glyphosate application. With no response to glyphosate applications made in late-October or early-November to cane scheduled for harvest in the latter third of the harvest season, it would not be recommended to continue applications beyond the middle of October.