

## AGRICULTURAL ABSTRACTS

### **Effect of Glyphosate Formulation on Sugarcane Ripening**

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Glyphosate is commonly used as a ripener in last ratoon Florida sugarcane. Natural ripening in Florida is often limited during the early portion of sugarcane harvest due to high temperature, plentiful soil moisture, and high levels of plant available nitrogen. The use of a ripener speeds maturity, resulting in higher sucrose content earlier in the growing season. Until the fall of 2002, the only labeled ripener was Polado L, an isopropylamine salt of glyphosate. However, Syngenta labeled a diammonium salt of glyphosate in fall 2002, and other new salts of glyphosate may soon become available.

This study was designed to compare the ripening effect of the isopropylamine salt of glyphosate to diammonium and potassium salts of glyphosate. All glyphosate formulations were applied to 6 by 15 meter plots at two locations using a tractor mounted sprayer. Applications were made at a volume of 47 l/ha. The common rate used for all formulations was 176 g ae/ha. Plots were sampled every two weeks beginning 3 weeks after application.

Initial analysis indicates few differences between glyphosate formulations 3, 5, and 7 weeks after application at either location. All glyphosate formulations increased sucrose and sugar/ton over the untreated control at both locations. Complete results will be presented at the meetings.

### **The Effect of Harvesting and Replanting on Arthropod Ground Predators in Florida Sugarcane**

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Four sugarcane fields in southern Florida were sampled starting in June, 2000. Two of the fields were 18 months old at the start of sampling. These fields were left in production after harvest (ratooned) and were used to measure the effect of harvest on activity of arthropod ground predators. In this paper, I consider arthropods to be predaceous if they belong to a taxonomic group in which most members are predaceous. Two of the fields were 3.5 years old at the start of sampling. These older fields were replanted to sugarcane (successive planting) after harvest and were used to measure the effect of replanting on activity of arthropod ground predators. The two ratooned fields were harvested during February, 2001. Harvesting consisted of burning the sugarcane to remove litter and removal of sugarcane stalks by mechanical harvesting. The two successively planted fields were harvested and replanted during November 2000. Harvesting was as described for ratooned fields. Replanting consisted of fields being disced,

sugarcane seedpieces placed in furrows, Thimet 20G (AI = phorate) placed in furrows on cane at 4.55 kg AI/hectare, and then seedpieces covered with soil. Pitfall trap sampling in all four fields started June, 2000 and continued until June, 2001.

A total of 4,255 arthropod ground predators were caught in pitfall traps during the one year study. Of these, the vast majority were ants being 67.6% of the total catch. Among ants, the imported fire ant, *Solenopsis invicta* Buren, was clearly the dominant ant species being 79.2% of all ants found in traps. Sugarcane harvesting did not affect pitfall trap catches of arthropod ground predators. However, replanting reduced arthropod catches for 5 to 6 months. These data show that for most of its 3 to 5 year crop cycle, Florida sugarcane is a stable ecosystem at ground level for arthropod ground predators.

### **Development of a Serological Diagnostic Probe to Detect the Sugarcane Yellow Leaf Luteovirus (SCYLV) Using Phage Display Technology**

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The SCYLV coat protein gene was amplified by RT-PCR from total RNA from SCYLV infected sugarcane leaves. The PCR product was ligated into the vector pGEM-T and used for transformation of *E. coli* JM109. The coat protein gene was then subcloned into pET27b and expressed in *E. coli* BL21 (DE3). The expressed SCYLV protein was purified using a nickel column. The antigenicity of the expressed protein was tested using a HSV-tag monoclonal antibody and a polyclonal antibody for SCYLV. A naive human single chain antibody (VH+VL ScFv) library, provided by the Centre for Protein Engineering, MRC Centre, Cambridge, England, was screened against the expressed protein. After three rounds of biopanning, several clones producing ScFvs specific to SCYLV were identified. Six clones from the third biopan were selected for soluble expression of the antibody using *E. coli* HB2151 cells. Antibodies expressed from these clones are being tested.

### **HoCP 96-540, a Chip Off the Old Block?**

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The Agricultural Research Service of the United States Department of Agriculture, The Louisiana Agricultural Experiment Station of the Louisiana State University Agricultural Center, and the American Sugarcane League of the U.S.A., Inc., working cooperatively to develop improved sugarcane cultivars, have jointly evaluated and released the new cultivar, HoCP 96-540, for commercial planting in the spring of 2003. HoCP 96-540 is a progeny of the cross LCP 86-454 x LCP 85-384 made at Canal Point (CP) Florida in 1991 and selected at Houma (Ho), Louisiana, in 1993. The cultivar has a moderate to high population of medium-sized stalks that turn amber when exposed to sunlight. Similar to LCP 85-384, HoCP 96-540 is an exceptionally

good ratooning variety. HoCP 96-540 is erect in growth habit, and well suited to mechanical harvesting. HoCP 96-540 is a mid-maturing high sucrose cultivar that produces levels of recoverable sugar per ton of cane and fiber content comparable to those of LCP 85-384. Yield data from a total of 58 mechanically harvested, replicated yield trials on both light- and heavy textured soils indicate that HoCP 96-540 consistently produces cane per hectare and sugar per hectare that are 10-15% greater than LCP 85-384 in plant, first-ratoon and second-ratoon crops. With greater stalk erectness and lower sheath adherence to the stalk at harvest than LCP 85-384, yield losses associated with mechanical harvesting HoCP 96-540 are expected to be reduced. HoCP 96-504 appears to be as cold tolerant and as responsive to the ripener Polado as LCP85-384. HoCP 96-540 is resistant to sugarcane mosaic virus (strains A, B, and D) and sorghum mosaic virus (strains H, I, and M). The cultivar is resistant to smut (*Ustilago scitaminea* Sydow), rust (*Puccinia melanocephala* H. And P. Syd.), and leaf scald [*Xanthomonas albilineans* (Ashby) Dowson] diseases under natural field infection conditions. Similar to essentially all sugarcane cultivars released in Louisiana, HoCP 96-540 may sustain significant reductions in yields of total recoverable sugar and cane in ratoon crops from ratoon stunting disease (*Clavibacter xyli* subsp. *xyli*). Based on field observations where it has been increased, HoCP 96-540 does not appear to be any more susceptible to the sugarcane yellowleaf virus and commonly used herbicides than current commercially grown cultivars. HoCP 96-540 is susceptible to the sugarcane borer [*Diatraea saccharalis* (F.)] and should not be grown in areas where insecticides cannot be applied.

### **Research to Evaluate Surface + Shallow Ditch Drainage as a BMP in Sugarcane Fields to Reduce N Losses**

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Research conducted at various locations in the humid region of the U.S. has shown that depth of drains, whether subsurface drain pipes or open ditches, has a significant effect on the amount of nitrate-nitrogen loss from the soil profile in subsurface flow to the drain pipes or ditches. In most soils, the deeper the drains or ditches the greater the N loss in drainage flow. Thus, shallow drainage practices using shallow open ditches, outlet controls on deeper ditches, shallow drainpipes, or controlled outlets on deeper drainpipes, are receiving much focus throughout the humid regions of the U.S. (especially the Midwestern States) and Southern Canada to implement water management practices that reduce nitrate losses in drainage flows.

The current common practice in sugarcane production of precision land grading for good surface drainage, plus shallow open ditches in the fields to carry the surface runoff from the fields to larger (wider) channels, is perhaps a Best Management Practice (BMP). This is because the shallow field ditch channels do not provide deep drainage of the soil profile, and thus leaching and transport of mobile N offsite does not occur. A new research project has been initiated at the LSU Ben Hur Research Farm to evaluate and compare the effectiveness of the shallow drainage ditch system with both shallow and conventional depth drainpipes. The deeper drainpipes will have the outlets controlled, however, to prevent water table draw down by the drains deeper than the depth of the shallow ditches or shallow drain pipes. Some of the research plots will be surface drained only, and will not include shallow field ditches. Runoff and

drainage flows will be measured and sampled to determine and compare nitrate loss between the various drainage and drainage control methods. It is expected that the shallow ditch system will cause less nitrate loss from the soil profile, thus it can perhaps be classified as a BMP.

The field project will also include a deep soil tillage variable, where some of the plots will be deep chisel plowed in the fall or prior to planting. Corn will be the initial crop so that treatments can be repeated each year, thus speeding up comparative results. Initial results will be obtained in the 2003 growing season. The presentation of this paper will provide sugarcane growers and industry officials the opportunity to make suggestions to the researchers on other treatments or comparisons they would like to see from the research.

### **The Effect of Location, Cultivar and Time of Harvest on Sugarcane Yields in South Florida**

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Sugarcane (interspecific hybrids of *Saccharum* spp.) is harvested over a 6-month (October – March) period in Florida, as well as in different growing environments. While many studies have examined the interaction of genotype x environment and its implication for breeding program design, knowledge is limited on the interaction of genotype, location and time of harvest and the implications of these interactions for growers. Three non-confounded data sets (“cases”) were analyzed to determine the effects of these factors on kilograms of sugar per ton (KST), tons of cane per hectare (TCH) and tons of sugar per hectare (TSH) of recently-released clones in south Florida. Location, cultivar, time of harvest and their interactions had significant effects on KST, TCH and TSH. Sugarcane KST and TSH were reduced by 28 and 29%, respectively, when harvested in mid-October compared to optimum harvest dates. The Lakeview “warmland” site near Lake Okeechobee had significantly higher TCH and TSH than the other sites, with CP88-1508 and CP88-1834 having higher relative yields at Lakeview. CP89-2143 had significantly higher KST than other cultivars in all 21 pairwise comparisons in the three cases, and a remarkably high, stable KST ranking across locations. CP89-2143 should be planted by growers throughout the EAA interested in improving sucrose concentration of their sugarcane crop. However, significant G x E interactions for other cultivars support continued multi-locational evaluation of sugarcane germplasm both during the breeding program and following cultivar release.

### **Sugarcane Genotype Emergence after Rain-Caused Flood**

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Sugarcane (*Saccharum* spp.), the primary crop on the Histosols of the Everglades Agricultural Area, increasingly is exposed to periodic floods or undesirably high water tables. Short-duration floods soon after sugarcane is planted can be particularly damaging. The purposes of this study were to quantify the effects on emergence of floods of 0, 1, 2, 4, and 6

days, and determine if emergence percentages of five genotypes differed in response to these flood durations. Two experiments, each with five replications, were conducted in 2002, one planted in August and one in October. Three or four stalk sections about 50 cm in length were planted in flats 10 cm deep and 35 cm wide, and covered with soil. Genotypes were chosen based on range of emergence response under flood in commercial fields. Effect of flood duration on emergence was best described as linear ( $r^2 = 0.93$ ) in the first experiment and quadratic ( $r^2 = 0.99$ ) in the second experiment. Emergence declined by 7.5% due to each additional day under flood in the first experiment. In the second experiment, the 1- and 2-day floods did not affect emergence, the 4-day flood reduced emergence by 11%, and the 6-day flood reduced emergence by 30%. CP 72-2086 had extremely low emergence when exposed to the 6-day flood. Four unreleased genotypes were tested, and none had more emergence than CP 89-2376 under the 6-day flood. Identifying genotypes with improved emergence after exposure to floods greater than 4 days would reduce losses due to flood at planting caused by heavy rains.

### **A Potential New Strain of Sorghum Mosaic Virus in Louisiana**

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Ten strains of sugarcane mosaic virus (SCMV) and three strains of sorghum mosaic virus (SrMV) have been shown to cause sugarcane mosaic in Louisiana; however, surveys conducted between the 1970s and 1995 identified strains of SrMV only. In 2002, plants of an advanced breeding cultivar, HoCP 98-743, from an off-station test nursery were found to have severe symptoms of mosaic. The results of reverse transcriptase-polymerase chain reaction (RT-PCR) designed to distinguish between SCMV and SrMV indicated that a SrMV isolate was associated with the diseased cultivar. A restriction fragment length polymorphism (RFLP) analysis of the RT-PCR product was performed in an attempt to identify the strain of the virus isolate. The RFLP banding pattern, however, did not match any known strain of SrMV. The virus isolate was successfully transmitted by mechanical inoculation to 'Rio' sweet sorghum on which severe mosaic symptoms developed. Healthy plants of HoCP 98-743, of LCP 85-384 and CP 70-321 (the two most widely planted cultivars Louisiana), of HoCP 96-540 (released in 2003), and six former commercial Louisiana cultivars, including three historic cultivars known to be susceptible to SCMV and SrMV, were mechanically inoculated with the infected juice from diseased sweet sorghum leaves. Fortunately, no inoculated plant of LCP 85-384 or HoCP 96-540 developed symptoms, and only one of 12 plants of CP 70-321 became infected. Approximately 10% of the plants of HoCP 98-743 and two former commercial cultivars, CP 72-370 and CP 79-318, became infected, while no plant of former cultivar, LHo 83-153, developed symptoms. The older historic cultivars known to be susceptible to SCMV and SrMV appeared to be the most highly susceptible among the cultivars tested with over 60% of plants becoming infected. The pathogenicity tests conducted with the virus isolate from HoCP 98-743 does not indicate that the new strain is an immediate threat to the leading cultivars of sugarcane in Louisiana. However, the discovery of an isolate with different molecular and pathological characteristics emphasizes the potential for new strains of the mosaic-causing viruses to develop, and in an industry such as Louisiana that is dependent on a single cultivar, LCP 85-384, for 85% of its production, a new strain of virus can pose a serious threat. Monitoring of virus strain development will continue.

**Laboratory Screening of Insecticides for Preventing Injury by the Wireworm *Melanotus communis* (Coleoptera: Elateridae) to Germinating Sugarcane**

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Candidate insecticides for preventing stand losses by the wireworm *Melanotus communis* (Gyllenhal) to germinating plant cane were screened in the laboratory for general efficacy using an assay previously described (Hall 2003). Single-eye billets treated with different rates (usually 100, 1,000, 10,000 or 50,000 ppm active ingredient, ai) of an insecticide were planted in containers of organic soil, and wireworms were subsequently introduced into the containers. The assay was a free-choice feeding experiment in that wireworms could either approach and attack a billet or remain some distance away from the billet. After a 4-week period, wireworm survival and damage caused during germination and early shoot development were assessed. Previous research indicated the following had some potential for wireworm control in Florida sugarcane: bifenthrin, thiamethoxam and tefluthrin 3G. Wireworms frequently survived in containers of billets protected with these materials yet did not damage eyes before germination, indicating the materials repelled wireworms. Research this year indicated the following had potential for wireworm control: bifenthrin (Capture 2EC) (1,000 ppm or more); carbofuran (Furadan 4F) (10,000 ppm or more); thiamethoxam (Platinum) (100 ppm or more); and zeta-cypermethrin (Fury 0.8 EC) (at rates of 10,000 ppm or more). Carbofuran and zeta-cypermethrin are currently labeled for use in sugarcane but not as seedpiece treatments. Ethoprop (Mocap 20G), an insecticide currently labeled and effective for controlling sugarcane wireworms, provided significant wireworm mortality and protection of germinating cane under the assay at rates equivalent to 112, 224 or 337 mg ai/m<sup>2</sup>. Carbofuran provided levels of control similar to or better than those provided by ethoprop with respect to preventing damage to germinating cane and killing or repelling wireworms. Thiamethoxam provided levels of control similar to or better than those provided by ethoprop with respect to preventing damage to germinating cane but not with respect to killing wireworms (the material appeared to be a strong repellent). High rates of zeta-cypermethrin provided protection of germinating cane apparently because wireworms simply chose not to feed on treated billets. Under all treatments studied except high rates of carbofuran or thiamethoxam, surviving wireworms which did not damage germinating eyes sometimes later damaged young developing shoots. Overall, thiamethoxam, carbofuran and bifenthrin were the best candidates for wireworm control. Some materials tested which showed relatively little or no promise for preventing stand losses to wireworms under the assay conditions included: Baythroid 2 (at rates of up to 10,000 ppm); esfenvalerate (Asana XL) (at rates of up to 50,000 ppm); lambda-cyhalothrin (Warrior) (at rates of up to 10,000 ppm); and azadirachtin (Bioneem) (1,500 and 3,000 ppm tested, probable phytotoxicity at 3,000 ppm).

## **Precision Agriculture Applications in Louisiana Sugarcane Productions Systems**

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Louisiana sugarcane producers, like most U.S. agricultural producers, have faced increased economic pressure in recent years. Low sugar prices and increased input costs have decreased profit margins significantly. To be successful, producers must find ways to decrease costs and maximize profits. The systems of precision agriculture may provide several important tools to accomplish this task. This study reports results from our evaluations of the spatial variability in sugarcane yield and quality in relation to variations in soil chemical and physical properties in selected sugarcane soils of Southern Louisiana. Sugarcane variety LCP 85-384 was harvested in two producers' fields for two consecutive years in Schriever and Patoutville, LA, respectively. The field in Schriever was a plant cane and first ratoon crop and the field in Patoutville was a fourth and fifth ratoon crop in 2001 and 2002, respectively. Each field was harvested in a grid cell pattern with cell dimensions of 10.6 x 15.2 m with a single row, chopper sugarcane harvester with weights determined using a weigh wagon. A random sample of cane billets was also obtained from each grid cell for sugar quality analysis. Soil samples (0-15 cm) were collected after harvest from each grid cell. Yield, quality and soils data were analyzed by both conventional statistics and geostatistical techniques. Maps of sugarcane yield, quality and soil properties were constructed and when utilized may prove useful in delineation of management zones for variable rate lime and fertilizer application.

### **Do Old Recommendations for N Fertilizer Fit a New Sugarcane Variety?**

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The sugarcane variety LCP85-384 was released for commercial production in 1993 and is now grown on over 85% of Louisiana sugarcane acreage. Robust stubbling, high tonnage and sugar production, and smaller but more numerous stalks are traits that have led to its wide acceptance, but are somewhat atypical to previous successful varieties. The industry has managed this variety using N fertilizer recommendations based on data collected prior to its introduction. Contrary to the conventional wisdom of recommended or higher rates, preliminary data indicated present recommendations may be higher than necessary, in some cases. We evaluated the response of LCP85-384 to five rates of N fertilizer, 45 to 224 kg/ha in 45 kg increments, in large, replicated trials in commercial fields representing a cross section of crop cycle and soil type. Cane yield in plant cane (PC) ranged from about 45 Mt/ha to over 94 Mt/ha with statistical differences among N rates for the only PC test on heavy soil but no treatment differences for PC on light or mixed soil (five locations). Using regression analysis on a relative basis, 95% or greater of maximum yield for each PC location on light or mixed soil was obtained using between  $\leq 45$  and 99 kg/ha of N, and the single PC test on heavy soil resulted in 95% of the maximum

obtained with 112 kg/ha of N. Stubble crops were more responsive to N application with significant differences among rates. Cane yield of stubble crops ranged from 43 to 112 Mt/ha. Regression analysis indicated stubble crops on light soil yielded 90% or better of maximum yield with 84 to 95 kg/ha N and stubble crops on heavy soil between 123-134 kg/ha N. Results for relative response of sugar/ ha to N input were slightly higher than those for cane yield. These results, though limited, suggest LCP85-384 does require slightly less N fertilization than presently recommended for sugarcane in Louisiana. Preliminary supporting data for this conclusion include a higher N-use-efficiency at a low (56 kg/ha) N rate compared to CP70-321 and increased lodging with increased N rate measured at one location of this study.

### **Sugarcane Resistance to the Sugarcane Borer: Performance Among Progeny Derived from Resistant and Susceptible Parents**

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Sugarcane, *Saccharum* spp., cultivar development programs routinely incorporate resistance to fungal and bacterial diseases that limit sugar yield, whereas there is comparatively little effort in breeding for insect resistance. Use of chemical control measures to alleviate insect pest problems can be limited by a number of factors including cost, real or perceived adverse environmental and health effects, and poor timing of application. Biological control and genetic control offer viable and environmentally friendly options available for season-long control of damaging borer infestations. In this study, parents and progeny derived from parents exhibiting a range of resistance levels were evaluated for sugarcane borer, *Diatraea saccharalis* (F.), damage across 2 years, in 1998 and 1999. The objective was to investigate if sugarcane borer resistance can be selected for in a breeding program. Borer damage was evaluated as percent borer-damaged internodes on two random stalks in a stool. Borer damage was highly correlated between the two stalk samples ( $r = 0.70$  in 1998 and  $r = 0.90$  in 1999); however, borer damage was considerably higher in the 1998 trial (average = 20.4%) compared to the 1999 trial (average = 5.8%). Mean percent borer-damaged internodes was higher among progeny derived from susceptible x susceptible crosses (22.8% in 1998 and 9.5% in 1999) compared to those derived from resistant x resistant crosses (20.8% in 1998 and 5.1% in 1999). Crossing a susceptible parent to a resistant parent also reduced mean percent borer-damaged internodes among the progeny compared to the susceptible parent or the susceptible x susceptible progeny and produced progeny showing transgressive segregation in both directions. The results support earlier studies that suggest it would be possible to breed sugarcane cultivars that are resistant to sugarcane borer. However, a concerted effort involving several rounds of screening and recurrent selection for resistance to borer damage is needed to develop germplasm that can withstand high levels of borer infestation. This work is currently underway.

## **Post-harvest Sugarcane Residue Management Effects in Reducing Soil Erosion from Quarter-drains on Alluvial Soils in Southern Louisiana**

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Intense rainstorm events can severely erode quarter-drains commonly used in sugarcane fields, and thus reduce their effectiveness in removing runoff from the alluvial soil, flat fields typical in southern Louisiana. A field experiment was conducted in the Spring of 2002 to evaluate two post-harvest residue management practices in terms of their effect on reducing soil erosion in the quarter-drain channels. One treatment was to remove the post-harvest residue with the conventional burning practice, and the second treatment was to leave the residue in the field, but to sweep it off the top of the cane rows and into the furrow between rows. Six relatively severe rainstorm events occurred in the Spring of 2002, and the results showed that leaving the residue in the field (swept to furrow between cane rows) reduced erosion in the quarter-drains by 64% compared to erosion where the residue was removed by burning. This simple cost-effective practice thus showed much promise. Therefore, the experiment has been repeated a second year during the 2003 growing season, and results will be available in the Fall of 2003.

## **A Comparison of Sugar Metabolism in Sugarcane Genotypes Adapted to Louisiana and Hawaii**

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Different strategies of sugarcane (*Saccharum* sp. hybrids) breeding programs in Hawaii and Louisiana produce very different genotypes. Hawaiian genotypes are adapted to 2-year production cycles and produce high cane tonnage in a tropical environment. Louisiana genotypes are adapted to a 9-month growing season and have early sucrose accumulation. We compared sugar concentration and enzymes of sucrose metabolism, cell wall acid invertase, soluble acid invertase, neutral invertase, sucrose synthase and sucrose-phosphate synthase, in internodes 2 and 18 from the top of four Hawaii (HI) and two Louisiana (LA) genotypes. Sucrose concentration in Internode 2, which was still expanding, was similar in all genotypes. Sucrose concentration in Internode 18 was significantly higher in LA than HI genotypes, and there was a significantly higher sucrose to total sugar ratio in LA genotypes. While soluble enzyme activities were different among genotypes, the differences were not consistent between LA and HI genotypes. Cell wall acid invertase activities in both internodes were significantly greater in LA than in HI internodes. This result suggests that the higher activity of cell wall acid invertase enhances sucrose unloading into the internode tissue. Thus, the cell wall invertase gene may be a good candidate for improving sucrose accumulation in sugarcane.

## **The Effect of Inter-row Competition on the Optimum Plot Arrangement**

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Competition among plots of different clones can affect the accuracy of yield determinations. To minimize the negative effects of competition, breeders commonly sample interior rows of multi-row plots. The downside of using buffered plots (multiple-row) compared to unbuffered plot arrangements is that the buffered plots may require more seed and land unless total plot size or replication number is modified. The third clonal selection stage of the US Sugar breeding program (CL varieties), evaluates 80 to 144 clones replicated at three locations. Prior to 2001 this stage used three replications of two-row, 10.6 m long plots at each location. Pairs of plots were planted side-by-side, and a 4.6 m alley was used on the ends and outside of each pair of plots. Stalk samples and plot weights were determined from the inside competing rows. Concerns about the effect of competition stimulated the question if three-row plots with two replications per location would be a more effective experimental design than the conventional design. In 2001, the 144 clones in stage three were planted in paired three-row plots using two replications per location. Yield determinations were collected from the competing interior rows and the buffered rows of 50 randomly selected clones. Three situations were compared: (1) competing, two-row plots at three locations and three replications using data from the interior competing row [termed 3L3RC], (2) single, buffered row from three-row plots at three locations and two replications [termed 3L2RB], and (3) the mean of the competing and buffered rows from a three location, two replication, three-row plot arrangement [termed 3L2RM]. The predicted response to selection using the 3L3RC arrangement was higher than the 3L2RB configuration with a 19.3% higher economic index [ $\$ \text{ha}^{-1}$ ], 28.1% higher sucrose production [ $\text{Mg ha}^{-1}$ ], 11.3% higher cane production [ $\text{Mg ha}^{-1}$ ], 0.8% higher sucrose content [sucrose % cane], 26.5% higher stalk number [stalks  $\text{m}^{-2}$ ] and 7.1% higher stalk weight [kg] response). The three-row plot configuration also enables using the mean of the competing and buffered row (3L2RM). Use of the two rows of data reduced the three replication advantage over the two replication arrangement but did not eliminate it. The predicted response to selection using the 3L3RC configuration was 1.2% more for the economic index, 5.1% more for the sucrose production, 8.5% for cane production, 4.2% less for sucrose content, 10.5% more for stalk number, and 5.6% more for stalk weight. Thus, it appears buffering plots at the expense of replication could not be justified.

### **Soil Organic Matter Decomposition Potentials in Organic Soils Under Different Tillage Methods**

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Soil conservation in the Everglades Agricultural Area (EAA) of south Florida is important because in many fields, there is not more than 60 cm of organic soil on top of

limestone bedrock. Tillage practices influence organic matter loss. When soils are tilled, they become aerated. This increases microbial activity, which increases organic matter decomposition. A field experiment was set up on an organic soil to determine the potentials for organic matter decomposition resulting from different tillage practices. Tillage treatments from lowest to highest soil disturbance consisted of: (1) no-till, (2) one tine implement scratching, (3) two tine implement scratchings, (4) one harrow discing, and (5) one switchplowing. Treatments were conducted on two fields (bare fallow and plant residue covered). Surface soil samples (0-6 inch) and all microbial measurements were taken on 0, 1, 4, 13, 28, and 42 d after tillage. The switchplow treatment had the greatest potential for soil loss using the  $^{14}\text{C}$  oxidation of benzoate (OP) and soil  $\text{CO}_2$  respiration (RESP) methods averaged over the 42-d period compared with the other treatments. Influence of tillage on organic matter decomposition can persist for longer than 42 days. No-till tended to have the lowest OP and RESP. Other tillage treatment effects were intermediate depending on field type. Potential for soil loss was greatest within the first few days after tillage. Short periods of flooding or low temperatures had little effect on OP and RESP. Utilizing conservation tillage practices on organic soils could reduce potential for soil loss. Further investigation for utilization in farm scale operations is warranted.

### **Evaluation of CP98 and CP99 Stage IV Genotypes for Susceptibility to Yellow Sugarcane Aphid**

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Damage caused by yellow sugarcane aphid (*Sipha flava*) feeding on sugarcane varies by genotype. Symptoms include red feeding spots to overall reddening or purpling of surrounding tissue, localized to general chlorosis followed by leaf necrosis, shorter and narrower internodes, reduced tillering and plant death. While only a few of the cultivars currently under commercial production in Florida are readily colonized and quickly damaged by *S. flava*, one of the most promising cultivars (i.e., CP89-2143) was found to be sensitive to such damage after it was released for commercial increase. Our goal was to provide information regarding yellow sugarcane aphid susceptibility in Stage IV genotypes to the sugarcane variety release committee for use in further selections toward commercialization. Canal Point genotypes advanced to Stage IV in late in 2001 (CP98) and 2002 (CP99) were evaluated in greenhouse trials for susceptibility to damage by *S. flava* feeding. Winged *S. flava* maintained on a sorghum-sudangrass hybrid were allowed to fly and settle for one week upon 3- to 4-leaf stage plants. Estimates of percentage necrotic leaf tissue, as well as ratings (0 to 4 scale) for chlorosis and reddening, were determined weekly beginning one week after aphids settled and began to reproduce on the plants. Genotypes CP98-1335, CP98-1457, CP98-1513, CP98-1569, CP99-1686, CP-1865, CP99-1889 and CP99-3027 were particularly sensitive to *S. flava* feeding and showed high levels of chlorosis and premature necrosis. Poorly colonized genotypes that were slow to show damage symptoms included CP98-1417, CP98-1481, CP98-1497 and CP99-1896.

## **Planting Rate Effects on Sugarcane Yield Trials**

**Albert J. Orgeron, Kenneth A. Gravois, and Keith P. Bishoff**

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New varieties are provided to the Louisiana sugarcane industry by researchers at Louisiana State University AgCenter, the United States Department of Agriculture-ARS, and the American Sugar Cane League of the USA, Inc. Currently, Louisiana farmers plant sugarcane at rates ranging from two to five or more whole stalks. The higher planting rates are used to compensate for damage with whole stalk mechanical planters. The higher planting rates also help insure optimal plant population and reduce the impact from winter freezes, disease and insect damage. A two-stalk planting rate is used to plant all stages of the LSU AgCenter's sugarcane variety development program. The objective of this study was to determine the effect of planting rate on sugarcane variety trial data and interpretation.

A planting rate by variety experiment was conducted during 2000 through 2002 at the Sugar Research Station in St. Gabriel, Louisiana. The experimental test was planted in a Commerce silt loam (*Fine-silty, mixed, nonacid, thermic Aeric Fluvaquent*) soil. Two commercial varieties, LCP 85-384 and HoCP 91-555, and six experimental varieties, L 97-105, L 97-126, L 97-128, L 97-129, L 97-137, and L 97-147, were hand harvested and hand planted. A randomized complete block design was used for the experiment with three replications. The three treatments consisted of planting rates of two, three, and four hand-cut whole stalks.

Increasing planting rate from two to four stalks significantly ( $P \leq 0.01$ ) increased sugar yield by 11 to 15% depending on crop and year. Cane yield and stalk population significantly increased when planting rate increased from two stalks to either three or four stalks in the 2001 plant cane crop. Stalk population and stalk weight were negatively correlated, thus the lower stalk populations tended to compensate with greater stalk weight. Stalk weight was significantly greater for the two-stalk rate vs. the three- or four-stalk rates in 2001, but stalk weight was only numerically greater for the two-stalk rate in 2002. Theoretical recoverable sugar was not significantly different regardless of planting rate. As expected, varieties differed for sugar yield and its components. More importantly, the planting rate by variety interaction was not significant for any trait in any of the experiments. Thus, increasing the planting rate from two stalks to three or four stalks did not change varietal ranking. Using a two-stalk planting rate does not introduce a bias into the interpretation of variety trials.

Other work from the study focused on yield estimation. Sugar yield and cane yield were both weighed and estimated for 2001 and 2002. One hurricane (Lily) and one tropical storm (Isidore) occurred in 2002, causing the sugarcane crop to lodge severely. The coefficient of variation (CV) was lower for estimated sugar yields and estimated cane yields in 2002 compared to weighed sugar yields and weighed cane yields. In 2001, the CV was lower for weighed yields as one may expect with more erect crop conditions. These results show that using estimated yields are more precise when sugarcane is severely lodged.

## **An Assessment of Genetic Relatedness Among Louisiana Sugarcane Clones using Microsatellite DNA Fingerprints**

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Microsatellites, also known as simple sequence repeats (SSRs) or short tandem repeats (STRs), are inheritable DNA markers that contain various numbers of tandem repeat units of di-, tri-, or tetra-nucleotide motifs. In this study, 25 Louisiana sugarcane clones, a Reunion clone, R570, and an Australian clone, Q124 were fingerprinted with nine sugarcane microsatellites using a capillary electrophoresis system. In total, 52 molecular alleles were identified. Eleven were common alleles found in all 27 clones. The remaining 41 alleles were, however, found in some but not all clones. There were eight alleles for the microsatellite SMC286CS, five for SMC334BS, eight for SMC336BS, four for SMC713BS, five for mSSCIR5, five for mSSCIR33, five for MCSA042E08, four for MCSA053C10, and eight for MCSA068G08. Presence or absence of these 52 alleles from a clone constituted a DNA fingerprint or genotype for that clone. The genetic relatedness among these clones was assessed according to their microsatellite fingerprints. There were three groups of clones that shared at least 73% pairwise identity between their microsatellite fingerprints. Group I included HoCP 96-509, HoCP 97-609, HoCP 98-718, HoCP 98-741, HoCP 96-540, HoCP 98-771, L 98-209, LCP 85-384, HoCP 98-778, L 97-128, HoCP 98-776, HoCP 85-845, HoCP 97-606, CP 72-370, L 98-207, LCP 86-454, and HoCP 98-734. Group II included HoCP 91-555, L 95-462, LCP 82-89, HoCP 98-781, and R570. Group III included CP 70-321, CP 65-357 and LHo 83-153. Two clones, L 97-137 and Q124, were clustered outside the three major groups. The results from this study indicate that a narrow genetic background is shared among the current Louisiana clones illustrating the need to broaden their genetic base.

## **Mitigating the Mexican Rice Borer Threat to Rice and Sugarcane Crops in Louisiana and Texas**

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As the Mexican rice borer, *Eoreuma loftini* (Dyar), infestations approach the Louisiana sugarcane area, varietal resistance seems to provide the greatest potential for management. A 2-yr study at two locations in Texas indicated that CP 70-321 was the most resistant cultivar evaluated, based both on reduced injury and the production of fewer adult rice borer moths. Sugarcane variety HoCP 85-845, though resistant under low to moderate pressure, appeared to be less resistant under heavy infestation pressure. When rice and sugarcane are produced in the same area, borer management may be particularly difficult because area wide moth production from varieties such as Priscilla may be as much as 70-fold in comparison to populations from

sugarcane. Additionally, early data indicates that rice borer infestation damage levels in sugarcane may be substantially lower than in the rice crops.

### **Evaluation of Hexazinone Plus Diuron Mixtures for Grass Control in Sugarcane**

**E. P. Richard, Jr.**

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The number of soil-active herbicides available to selectively control johnsongrass [*Sorghum halepense* (L.) Pers.], itchgrass [*Rottboellia cochinchinensis* (Lour.) W. Clayton], and other weeds common in Louisiana sugarcane fields is limited. Field studies were initiated in 2000 to evaluate the possible enhanced efficacy of hexazinone when applied at reduced rates in tank-mixture with diuron (DuPont K4<sup>®</sup>) at planting and during the spring. Seedling johnsongrass control following at-planting and spring applications of hexazinone + diuron was greater than either herbicide applied alone and appeared to be additive. However, control was lower than the seedling johnsongrass control obtained with standard at-planting followed by spring applications of pendimethalin plus atrazine at 3.36 + 3.36 kg ai/ha and clomazone plus diuron at 1.4 and 2.24 kg ai/ha. Of the treatments evaluated, only hexazinone alone at 0.56 and 1.2 kg/ha and diuron at 2.0 kg/ha did not result in an increase in sugar yields when compared to the non-treated check. The hexazinone plus diuron mixture provided some early season control of itchgrass, but control was equivalent to the application of hexazinone alone at 0.56 and 1.2 kg/ha and was not as good as the control observed with the standard application of pendimethalin plus atrazine. In a varietal tolerance study where weed pressures were minimal, sugar yields with at-planting followed by spring applications of hexazinone plus diuron were equivalent to the non-treated check for LCP 85-384, HoCP 85-845, and HoCP 91-555; the three predominant varieties currently grown in Louisiana. Results suggest that a mixture of hexazinone plus diuron will provide an acceptable level of preemergence control of seedling johnsongrass, but preemergence control of itchgrass beyond 45 days after treatment may be questionable.

### **Nitrogen Effects On Sugarcane Bull Shoot Production**

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Sugarcane bull shoots, otherwise known as suckers, water sprouts or late maturing tillers have been reported as a problem in south Louisiana sugarcane. Research has shown that bull shoots tend to be physiologically immature and accumulate less sucrose compared to mature shoots at time of harvest. Therefore, bull shoots may affect productivity by increasing biomass while contributing little to sucrose content. A good understanding of the environmental and cultural factors responsible for sugarcane bull shoot production in south Louisiana may be helpful in designing strategies to minimize the impact of bull shoots on Louisiana's sugar industry. The objective of this study was to investigate the effects of nitrogen application rates and timing of applications to bull shoot production in the cultivar HoCP 85-845. This cultivar had been previously identified as having a high propensity to produce bull shoots.

A field study was conducted in 2000 (Experiment 1; only first ratoon cane data available) and 2001 (Experiment 2; plant cane) at the Sugar Research Station in St. Gabriel, LA on a commerce silt loam soil (fine-silty, mixed, nonacid, thermic aeris fluvaquent). The experimental design was a Randomized Complete Block Design with four replicates. A plot consisted of three rows 1.8 m wide and 12.2 m long. Treatments consisted of nitrogen applied at the rates of 56 kg/ha, 112 kg/ha, 168 kg/ha, and 224 kg/ha in April and an additional (split application) 56 kg/ha applied in July to the 112 kg/ha and 168 kg/ha plots. Analyses were based on data collected from the middle row.

Significant differences ( $P < 0.05$ ) in number of bull shoots were found among treatments in Experiment 1 in mid-September before tropical storm Isidore and hurricane Lili. The highest number of bull shoots was recorded from the 224 kg N/ha treatment, while the 168 kg N/ha treatment yielded the lowest number of bull shoots. Orthogonal contrasts revealed that applying additional nitrogen (112 kg/ha + 56 Kg/ha) in July significantly increased the number of bull shoots compared to the 168 kg/ha treatment, but there were no significant differences between the 224 kg/ha treatment and the 168 + 56 kg/ha treatment. Severe lodging prevented counts to be made in Experiment 2. No significant differences were found among treatments for number of bull shoots at time of harvest (mid-December) for both experiments. Significant differences were found for cane yield, sucrose content, TRS and sugar yield at time of harvest (mid-December) in both experiments. These results are not conclusive because of the high amounts of rainfall and severe lodging experienced in these trials. On average, bull shoots contributed 1.6% and 0.93% to total cane yield in Experiments 1 and 2, respectively, and 9.4% and 2.2% to total sugar yield in Experiments 1 and 2, respectively. However, regression analyses revealed that bull shoots contributed very little to total sugar yield relative to their contribution to total cane yield. Given the added costs of transportation and milling, bull shoots are likely to have an overall negative effect on sugar production.

### **Microbial Communities in Soil with and without a Sugarcane Cropping History**

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Yield decline of sugarcane is a complex problem associated with poor root health that results in loss of productive capacity of soils with a long-term sugarcane cropping history. Numerous studies have provided evidence that soilborne biological factors contribute to this problem in sugarcane. This research investigated whether there are differences in microbial communities associated with sugarcane roots in soil with and without a sugarcane cropping history. Results demonstrated that differences exist between culturable organisms in microbial communities associated with sugarcane roots in Louisiana soils with and without a recent sugarcane cropping history. In addition, sole carbon source utilization profile results showed that differences exist in community functional capability in soils with and without a long-term sugarcane cropping history.

**The Sonoran Group Project: Developing a Diverse California Sugarcane Industry by Implementing the Tilby System for "Total Cane Utilization"**

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And

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Since 1997, research regarding the cultivation and production of sugarcane has been conducted at the University of California Desert Research and Extension Center (El Centro, CA). Research has focused on germplasm collection and its preliminary evaluation, cane and sugar yields, irrigation management, and most recently salinity screening. The original intent was to augment local sugar beet production and processing with sugarcane. With the elimination of Methyl Tertiary Butyl Ether (MTBE) as a gasoline additive in California and thus the need for close to 1 billion gallons of ethanol, the focus has shifted from sugarcane-to-sugar to sugarcane-to-renewable energy. A number of firms have indicated a desire to develop renewable energy projects in the Imperial Valley utilizing sugarcane as the primary feedstocks. The Sonoran Group is one such firm. Utilizing the Tilby Separation System, the Sonoran Group Project will process all of the above-ground portions of the sugar cane plant into a number of value-added products including building products, beverage, food-grade fiber, industrial wax, fuel-ethanol and electricity – a process referred to as “Total Cane Utilization.” This paper will describe the specifics of the Sonoran Group Project.

**Electrolyte Leakage Test for Evaluating Sugarcane Freezing Tolerance**

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Measurement of electrolyte leakage was used to evaluate freezing injury of sugarcane foliage. Two *Saccharum* species, *S. officinarum* and *S. spontaneum*, five commercial cultivars and four commercial cultivar x *S. spontaneum* hybrids were exposed to 4 °C for 6 days in a growth chamber. Leaf segment samples (about 7.5 cm long) from the first complete leaves (top, middle and base of each leaf blade) were cut to determine if any leaf segment by genotype interaction occurred. After being washed with deionized water, two to four pieces per leaf segment were placed in a glass tube and submerged for 1 hour in a -2 °C ethylene glycol cooling bath and then a small ice cube was added into the tube to induce freezing. The samples were again immersed in the bath at -2 °C for one more hour followed by immersing at -3 °C and -4 °C for 1 hour each. The samples were thawed in a refrigerator overnight and incubated in 10 ml of deionized water with shaking at room temperature for 4 hours. Electrolyte leakage from leaf segments was measured with a conductivity meter. The leaf segments were removed from the glass tubes and frozen at -80 °C for 1 hour. The frozen leaf segments were returned to the glass tubes and incubated for 4 hours to obtain a measurement of total electrolyte leakage. The percent leakage (%) was expressed by (electrolyte leakage after freeze test/total electrolyte leakage) x 100. A test using top leaf segments only was conducted to determine lethal temperature LT<sub>50</sub> (50% leaching) under a range of sub-freezing temperatures that were cooled in a gradual

decrease of 1 °C each hour from -2 °C to -11 °C. Results indicated that there was no significant interaction between leaf segment and genotype, but there were significant differences among three leaf segments with the top being the highest % leaching and the base being the lowest. Based on the results from electrolyte leakage measurements, freezing tolerance varied among genotypes, with *S. officinarum* clones from tropical regions having the least resistance to freezing injury and the *S. spontaneum* clones from the higher latitudes having the most resistance. The freezing tolerance of the hybrid clones tested was intermediate to the two parent groups. The correlation between the visual rating on green leaf tissue after being exposed to natural frost injury and the measurement of electrolyte leakage was significant and negative ( $r = -0.67^*$ ). The electrolyte leakage test can be used as an objective measurement of freezing tolerance in genetic and breeding studies in sugarcane.

### **Development of a Sugarcane Pedigree Database**

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With a sharply increased worldwide level of interest in family history resulting from the explosion of genealogical information available on the Internet, pedigree software has become much more powerful, user friendly, and adaptable over the past few years. Using *Personal Ancestral File*, a pedigree software package that is free to download, the author developed a sugarcane pedigree database, and from it, two sub-databases, one of worldwide scope and one focused on breeding clones of current interest in Florida, Louisiana, and Texas. The sub-databases are available as GEDCOM files (\*.ged), and, as such, can be loaded into a multitude of pedigree software packages available in the marketplace. The author will demonstrate 1) how already-existing pedigree data is merged in the process of preparing pedigrees of new varieties, 2) use of the feature, 'relationship calculator,' that shows the relatedness of two potential parents, and 3) effective application of the following printout charts that can be electronically previewed: pedigree, ancestry, family group, and descendants. Also, the 'sources,' 'notes' and 'media' features in the software will be illustrated. These features can be used to provide documentation, background information, and visual images of varieties included in the database.

### **Genetic Diversity for Tolerance to Freeze Injury Among F<sub>1</sub> Hybrids Between *S. spontaneum* and Commercial-type Sugarcane**

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Wild relatives of sugarcane evolving from cold climates, for example, clones of *Saccharum spontaneum* from the foothills of the Himalayas, have been important in sugarcane breeding because of the hardiness and vigor they frequently impart in the development of elite germplasm. Current basic breeding strategies at the Sugarcane Research Unit at Houma include: 1) evaluating parents and progenies for resistance traits, such as cold tolerance, in breeding containers and under field conditions in early spring and winter, and 2) systematically

backcrossing and recombining progeny in a manner that will concentrate genes associated with those traits. In the spring of 2002, 2169 progeny from 11 interspecific crosses between 10 *S. spontaneum* clones and six commercial-type sugarcane clones were transplanted into a genetic nursery for evaluation studies. In February 2003, we identified 10 hybrids from SES234 X LCP85-384 as expressing cold tolerance after a 3-hour 23 F (-5 °C) freeze in January 2003. The 10 cold tolerant selections were biologically different within the cross; the cross, in general, had less freeze injury than other crosses. All other progeny from 11 crosses were classified as susceptible to cold damage with the majority of hybrids having 100 % dead leaf tissue, dead terminal buds, and evidence of stalk tissue deterioration. The 10 selections expressed minimum levels of dead leaf tissue, few dead terminal buds and no stalk damage. We verified them as interspecific hybrids using microsatellite DNA markers, included them on our breeding carts for breeding utilization in 2003, and replanted them in a replicated test in the field.

### **Evaluation of Potassium-based Ripeners as an Alternative to Glyphosate and the Effects of 2,4-D on Herbicidal Cane Ripening**

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Glyphosate (Polado<sup>®</sup>) is the only registered ripener for use in Louisiana. Past research has proven it to be effective as a cane ripener, but growers are restricted to a harvest window of 35 to 49 days after treatment (DAT). The delayed emergence of glyphosate-treated cane the following spring is an undesirable side effect of glyphosate. Recent research from Ecuador indicated foliar applied potassium nitrate increased sugar per ton of cane similar to glyphosate with no reduction in cane growth at 43 DAT. A second product, potassium carbonate (Kayphol<sup>®</sup>), has been sold in Louisiana as a non-herbicidal ripener. No studies have been conducted to evaluate the potential effectiveness of these products under Louisiana conditions. Additionally, situations occur where 2,4-D could be tank-mixed with glyphosate to provide cane ripening and morningglory control in one application. Much research in weed control has indicated that the addition of 2,4-D may antagonize the activity of glyphosate on certain plant species. Because there is no data available on the antagonistic potential of 2,4-D on glyphosate's ripening capabilities, this tank-mix is not recommended.

Treatments were aerially applied at 5 GPA to second ratoon LCP 85-384 at Rebel V Farms in New Iberia, LA on August 27, 2002. Each plot consisted of two 6-row swaths, was 2.1 acres in size, and was replicated four times in a randomized complete block design. The treatments applied were glyphosate @ 0.19 lbs ai/A (6 oz Polado 4L), glyphosate @ 0.19 lbs ai/A + 2,4-D @ 0.95 lbs ai/A (1 qt/A Hi Yield<sup>®</sup> 2,4-D 3.8 L), potassium nitrate @ 6.60 lbs/A (46% K<sub>2</sub>O; 13.75% N), potassium carbonate @ 2.09 lbs K<sub>2</sub>O/A (2 qt/A Kayphol), and a nontreated check. Beginning 14 DAT, Brix measurements from 20 stalks in each plot were taken weekly until harvest. Stalk and leaf samples were collected for sucrose and tissue analysis at 21 and 49 DAT. Sugarcane was combine harvested 49 DAT with theoretical recoverable sugar (TRS) being determined at a commercial core lab.

Treatments of glyphosate, glyphosate + 2,4-D, potassium carbonate, and potassium nitrate were also included in a small plot experiment conducted at the USDA-ARS Ardoyne Research Farm at Schriever, LA. Treatments were replicated four times in a randomized complete block design. The rates of these treatments and date of application were consistent with the large plot experiment. Treatments were applied using a CO<sub>2</sub>-pressurized backpack sprayer calibrated to deliver 10.5 gallons per acre. Hand-cut stalk samples cut from each plot were processed for sucrose analysis at 28, 35, and 42 DAT.

Commercial core sample data and field measurements from the large plot experiment indicated a 34 lb/ton increase in TRS and a 912 lb/A increase in sugar yield for the glyphosate treatment compared to the nontreated check. Results from the tissue analysis of leaves in the canopy showed a significant increase in concentrations of magnesium and calcium levels at 21 DAT for glyphosate-treated cane versus the nontreated check.

For the large plot experiment, percent Brix of the glyphosate-treated cane was consistently higher than potassium nitrate, potassium carbonate, and the nontreated cane throughout the monitoring period. The potassium nitrate and potassium carbonate treatments were not statistically higher than the nontreated in most weeks, with the exception of the final measurements at 49 DAT in which juice Brix of the potassium nitrate treatment was greater than the nontreated, but less than the glyphosate treatment. Analysis of the hand cleaned, 20-stalk samples showed significantly higher TRS for potassium nitrate over the check at harvest; however, this was not detected in the commercial core samples. Potassium nitrate and potassium carbonate did not increase core sample TRS or sugar yield compared to the nontreated check. The slight increase in TRS at 49 DAT evident in the hand samples could indicate that the potassium nitrate was just beginning to induce ripening, but not enough to be detected commercially. The small plot experiment did not show an increase in TRS at 28, 35, and 42 DAT for either potassium nitrate or potassium carbonate. Since data was not taken after 42 DAT, it is not known if TRS increased for the potassium nitrate treatment at 49 DAT as in the large plot experiment.

2,4-D at a rate of 0.95 lbs ai/acre did not adversely affect the activity of glyphosate throughout the ripening period in both large and small plot experiments.

### **Irrigation Scheduling for Sugarcane Production in South Texas**

**Bob Wiedenfeld**

Texas Agricultural Experiment Station, Weslaco, TX

Sugarcane water requirements exceed rainfall in South Texas, thus supplemental irrigation is required. However, water availability is becoming increasingly limited and therefore must be used as efficiently as possible. Among the methods used to schedule irrigation, the water balance method has proven to be the most accurate and reliable for determining both amount and frequency of irrigation. Reference evapotranspiration (ET<sub>o</sub>) is becoming widely available for this purpose, but local calibration is necessary; including identification of crop growth stages, rooting depth and available soil water holding capacity. To accomplish this,

various soil, plant and water parameters have been monitored over a 2-year period on a 59 acre block of sugarcane grown under an overhead sprinkler irrigation system. FAO crop coefficients accurately reflect sugarcane water use. Cumulative heat units have been found to reliably indicate when the sugarcane crop moves from the initial to the development stage. Leaf area index can be used as an indicator of when the crop moves from the development to the mid-season stage of growth. Soil moisture monitoring has indicated both the level of soil water depletion and root depth. Water requirements for irrigating sugarcane can be reduced by about 30% without causing any stress during crop growth. Irrigation water available in South Texas contains salt ( $1.3 \text{ dS m}^{-1}$ ) and soils are heavy (20 - 30% clay), therefore salt build-up is anticipated as water use is reduced. Thus far, however, this has not been a problem.

## MANUFACTURING ABSTRACTS

### **Changing the Heating Surface to Volume Ratio on a Low Head Batch Vacuum Pan**

**Stephen Bergeron and Greg Carline**

Lula Sugar Factory, Lula Westfield, Corp., Belle Rose, LA

This paper will present data obtained during the 2002 crop on Pan No. 1 at Lula Sugar Factory. The pan is primarily used for low grade strikes. Data presented reflects the increased productivity of the pan as a result of increasing the heating surface to volume ratio. These results as well as the scope of work involved in making the design changes are outlined.

A similar design change is presently being undertaken on No. 3 Pan and will be operational for the 2003 crop. The impetus for modifying this pan will be outlined as well. This modification should allow the high grade side to operate with greater efficiency in terms of productivity. It will complement the other pans with respect to volume and heating surface.

### **Glucooligosaccharides from *Leuconostoc mesenteroides* B-742, a New Prebiotic**

**Donal F. Day and Changho Chung**

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The use of oligosaccharides in functional foods is a rapidly growing market. The technology for the production of these polymers has been limited to acid or enzymatic hydrolysis of polysaccharides or *de novo* synthesis by transglycosylation reactions. Modifying the *Leuconostoc* dextran fermentation by limiting the dextransucrase reaction, produces large amounts of branched iso-oligosaccharides. These oligomers stimulated *Bifidobacterium* and *Lactobacillus* growth but were not as readily utilized by *Salmonella*. Utilization of this GOS by microbial isolates from chicken ceca were compared to utilization of commercial fructooligosaccharides (FOS), and generally, the lactobacilli showed higher growth rates with GOS than with FOS. In mixed cultures of cecal bacteria and *Salmonella*, the cecal bacteria outgrew the *Salmonella*, eliminating this organism from the culture. The simplicity of the process and the absolute requirement for sucrose for production, as well as greater effectiveness than existing oligosaccharides, make this a potential value-added process/product for the sugar industry.

### **Preliminary Factory Study on the Performance of a Plate Evaporator and Roberts-Type Evaporators with Emphasis on Sucrose Losses**

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At the latter end of the 2001 grinding season, a full-scale Alfa Laval EC 700 plate evaporator was installed at Raceland factory, LA, as a booster to the second effect Roberts-type calandria evaporator. A factory study was conducted to determine the effects of time between evaporator wash-outs on overall performance of the plate evaporator and the Roberts-type evaporators, with an emphasis on sucrose losses. The factory evaporator station consisted of Roberts-type calandria evaporators in series, with one pre-evaporator (25,000 ft<sup>2</sup>), followed by a first (21,000 ft<sup>2</sup>), second (17,000 ft<sup>2</sup>), third (12,000 ft<sup>2</sup>) and fourth (12,000 ft<sup>2</sup>) effect evaporator. Calculated retention times were 2.9 min in the pre-evaporator, and increased from 2.7 to 8.9 min across the other evaporators; retention time across the plate evaporator was only 1.1 min. Numerous samples entering and exiting each evaporator were taken across two adjacent cleaning cycles (between Nov 20 and Dec 4). Gas chromatography was used to determine glucose, fructose, and sucrose concentrations. Changes in pH, Brix, and color were also monitored. Most sucrose losses to inversion occurred in the pre-evaporator where temperature and heating surface were the highest. The plate evaporator improved the performance of the evaporator station and allowed the factory to increase their grinding rate. Generally, the plate increased Brix by ~ 4.5 Brix units, and % evaporation rate (equivalent to a % Brix increase) across the plate evaporator was ~ 11.5%. The plate evaporator, like the Roberts-type evaporators, was still susceptible to scaling, which caused sucrose losses to occur generally ~ 4 days after the last wash-out and became worse with prolonged use of the plate. Sucrose losses were consistently measured in the last evaporator at this factory, even just after a wash-out, which is a phenomenon that was not observed at another Louisiana factory.

### **Clarification improvements at Raceland during the 2002 crop**

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During the 2002 crop, a new design flash tank and a hot liming system were installed at Raceland. This was done as the existing flash tanks were undersized and experiences in other countries supported hot liming of juice. In spite of elevated dextran and mud levels and lower phosphate in cane experienced during the 2002 crop, the clarity of juice improved by 40% and sugar color by 20%, over the 2001 crop. Additional benefits were noted in juice heater and evaporator cleaning intervals, which were extended by 20%, condensate pH and sugar recovery.

### **Online Bagasse Moisture Measurement**

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Three online moisture analyzers were tested to measure final bagasse moisture in a range from 48% to 58% with less than 1% error. The instruments consisted of two Near Infra-Red (NIR) analyzers and a microwave analyzer with density compensation. The NIR instruments reported moisture values with 0.8% and 0.5% standard error, respectively, while the microwave correlated final bagasse moisture with 2.8% error. Moisture in bagasse was also found to be very variable under normal mill conditions. Some tests were performed in the lab to handle one

kilogram samples instead of the standard 100 grams. A comparison between a domestic clothes dryer and the lab oven yielded that the former dried a one kilogram sample in 3.5 hours instead of more than 24 hours. The drier showed an average difference of 0.4% higher in the sample moisture when compared with the oven and was capable of drying samples up to ten times larger. Air drying rates were also studied and determined to be affected by bagasse temperature, air flow, moisture and temperature. The air drying rate at 70°F averaged 20 grams per minute following an almost linear trend. The two NIR instruments were found very reliable and precise compared to the microwave unit. Easiness of the calibration procedure, maintenance requirements, licenses and permits were also a strong handicap for the microwave unit.

### **Pol-Dextran Effects**

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The change from lead acetate to more environmentally acceptable juice clarification agents (such as Octapol) has added a new error to pol-sucrose calculations. The bulk of dextran in solution is removed by lead acetate but not by the newer clarification agents. As juice quality declines, the error due to the dextran increases. Dextran was found to increase the optical rotation of pure sucrose by 0.10 °Z per 100 ug/ml. In Louisiana, in the 2001 sugar season, there was an average overestimate of sugar arriving at the mill of 0.5 %. An equation was developed that could be used to correct pol readings for dextran error. The corrected values correlated well ( $r^2=0.94$ ) with both theoretical and actual sucrose concentrations in juice.

### **Dextran Test Method Provides Versatility for Sugar Factory Process Monitoring**

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A monoclonal antibody method for rapid measurement of dextran in sugar processing operations has been developed. The value of such a process control test has been questioned by the industry. However, the monoclonal antibody method proved its worth many times over during the 2002 Louisiana crushing season by tracking dextran throughout the factory and allowing controlled application of process chemicals to reduce the deleterious effects of dextran. The monoclonal antibody test method is a rapid test that can be used on any process stream in the factory from wash water to molasses to final sugar. Severe weather in Louisiana during the 2002 season caused the proliferation of conditions favorable to dextran formation throughout the entire crop. Numerous tests for dextran in several different process streams were conducted at various Louisiana factories during the grinding season. Streams sampled included crusher, dilute and clarified juice, as well as filtrate, syrup, and 'C' sugar remelt. Data collected from these tests provided instant information on the location and severity of dextran problems and allowed the factories to take immediate actions using process chemicals and mill cleaning more efficiently

and in a timely manner. A means by which dextran travels through the factory and is reintroduced into the process through the reuse of low grade remelt sugar was also documented.

### **Circulation in Vacuum Pans**

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The crystallization of sucrose involves complex processes that require the correct design of vacuum pans and precise operation. Numerous parameters, such as tube dimensions, downtake size and pan geometry, determine the quality of the sugar produced and the throughput, which results in certain vacuum pans giving better performance than others. A particularly important factor is the circulation, which is strongly interrelated with the convective-boiling heat transfer in the calandria, and determines to a large extent the velocity of crystallization and the uniformity of the conditions inside the vessel. In this paper, several factors that affect boiling and circulation in vacuum pans are identified. The use of Computational Fluid Dynamics in the analysis of circulation and alternatives for hydrodynamic optimization is discussed. Options for making changes to batch pans to improve the characteristics of the pan are identified, either to change the geometry or assist circulation. Some results with steam-assisted circulation (steam jiggers) are given, which show that boiling times can be substantially reduced.