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1997 OUTSTANDING PRESENTATION AWARDS

Harold Birkett and Jeanie Stein. Summary of Milling Studies in Louisiana (1992-1996).

David G. Hall. Seasonal Activity of Adult Lesser Cornstalk Borers (*Elasmopalpus lignosellus)* and Sugarcane Borers *{Diatraea saccharalis)* Based on Pheromone Trapping in Florida.

B. L. Legendre and E. P. Richard, Jr. Post-Harvest Management of Billeted Cane for Optimal Cane and Juice Quality.

P. A. Clay, J. L. Griffm, C. F. Grymes, and J. Cabiness. Spray Droplet Size of Herbicides and Herbicide/Adjuvant Combinations.

TABLE OF CONTENTS

President's Message - Louisiana Division
Duane Legendre . . . 1

President's Message - Florida Division

Modesto F. Ulloa . . . 3

PEER REFEREED JOURNAL ARTICLES Agricultural Section . . . 7

Estimates of Heritability in a Backcross Population of Interspecific and Intergeneric Hybrids in Sugarcane . . . 8
Q.W. Li, P.Y.P. Tai, F.H. Xiao, and J. D. Miller

Bermudagrass *(Cynodon dactylon)* and Johnsongrass *(Sorghum halepense)* Control Programs in Succession-Planted Sugarcane . . . 18
Donnie K. Miller, Edward P. Richard, Jr., and James L. Griffin

PEER REFEREED JOURNAL ARTICLES Manufacturing Section . . . 31

Impact of the Clean Air Act on Florida Sugar Mills . . . 32
Hector J. Cardentey

A Preliminary Study on the Effect of Sugarcane Leaves and Mud on Color in Sugarcane Juice . . . 39
Benjamin L. Legendre, Mary An Godshall, and Xavier M. Miranda

AGRICULTURAL ABSTRACTS . . . 45

Widespread Occurrence of Yellow Leaf Syndrome in Sugarcane Clones at Canal Point, Florida . . . 45
J.C. Comstock, Z.K. Wang, J.D. Miller, M.S. Irey, and B.E.L. Lockhart

Polymerase Chain Reaction (PCR) Protocols for Detecting the Bacteria that cause Leaf Scald and Ratoon Stunting Diseases of Sugarcane . . . 46
Y.-B. Pan, M.P. Grisham, D.M. Burner, B.L. Legendre, Q. Wei, and K.E. Damann, Jr.

Multiplex Polymerase Chain Reaction (PCR) for Diagnosis of Leaf Scald and Ratoon Stunting Diseases . . . 46
Michael J. Davis, Philippe Rott, and Gustavo Astua-Monge

Impact of Nematodes on Sugarcane in Louisiana 47
J.P. Bond, E.G. McGawley, and J.W. Hoy

Mortality Induced by *Bacilllus popilliae* in *Cyclocephala parallela* (Coleoptera: Scarabaeidae) Held Under Simulated Field Temperatures 48
R.H. Cherry and M.G. Klein

Seasonal Activity of Adult Lesser Cornstalk Borers *(Elasmopalpus lignosellus)* and Sugarcane Borers (*Diatraea saccharalis)* Based on Pheromone Trapping in Florida 48
David G. Hall

Precision Farming Applications for Sugarcane in South Florida *49*
Mike Lockhart and Travis Murray

Effect of Composted Municipal Waste and Sugarmill Waste on Sugarcane Yields and Nitrogen Fertilizer Requirements 49
W.B. Hallmark, L.P. Brown, and G.L. Hawkins

Variability of Leaf Posphoras Among Sugarcane Genotypes Grown on Everglades Histosols 50
Barry Glaz, Christopher W. Deren, and George H. Snyder

Mechanical Planting of Wholestalk Sugarcane in Louisiana 50
Herman Waguespack, Jr., Charley Richard, Windell Jackson, and Dalton Landry

Soybeans in Rotation with Sugarcane 51
Howard P. Viator

Green Cane Trash Blanket Effects on Weed and Sugarcane Development in Louisiana 51
E.P. Richard, Jr.

Spray Droplet Size of Herbicides and Herbicide/Adjuvant Combinations 52
P.A. Clay, J.L. Griffin, C.F. Grymes, and J. Cabiness

Bermudagrass Control in Sugarcane with Roundup and a Hodded Sprayer 53
James L. Griffin, Patrick A. Clay, Dannie K. Miller, Charles F. Grymes and James E. Hanks

Azafenidin: A New Broad-Spectrum Herbicide for Sugarcane 54
E. P. Richard, Jr., E.P. Castner, and R.G. Turner

Negative Relationship Between Sucrose and Tonnage in Sugarcane: Implications for a Breeding Program 55
J. Alvarez, C.W. Deren, and B. Glaz

Intrarow Plant Spacing and Family By Environment Interaction Effects on Sugarcane Cross Evaluation . . . 55
Orlando DeSousa and Scott B. Milligan

Breeding Studies of the Dwarf, Multiple Bud, and Red Leaf Mutants of Sugarcane . . . 56
D.M. Burner and B.L. Legendre

MANUFACTURING ABSTRACTS . . . 57

Fast-Track to Milling Control . . . 57
Luis R. Zarraluqui

Computers in the Sugar Factory . . . 58
Rogelio M. Ulibarri

Summary of Milling Studies in Louisiana (1992-1996) . . . 58
Harold Birkett and Jeanie Stein

Mill Improvement Program at St. James Sugar Coop., Inc., an Update . . . 58
Manolo A. Garcia

The Barandalla Trashplate: The Minimal Friction Spiral . . . 58
Luis R. Zarraluqui

Improving Gear Box Durability . . . 59
Saul Herscovici and John G. Proven

Detection of Sugar in Multiple Effect Evaporator Condensate Systems Using Fluorescence . . . 59
Terry McGillivray, Sheldon Seaborn, Binu S. Bedford, David P. Grueneich, David O. Larson, and Christine M. Stuart

Improved Clarification Through Increased Inorganic Phosphate Concentrations with a Novel Enzyme . . . 60
Willem H. Kampen

The Freeze of 1997: the Good, the Bad, and the Ugly (A General Manager's View) . . . 60
John A. Fanjul, Luis Entrialgo, Jr., Adalberto Pacheco, Miguel Lama, and Hector J. Cardentey

Losses of Sucrose in Billet Cane from Wash Water . . . 60
Edward W. Milner

Post-Harvest Management of Billeted Cane for Optimal Cane and Juice Quality . . . 61
B.L. Legendre and E.P. Richard, Jr.

Editorial Policy 63

Rules for Preparing Papers to be Printed in the Journal of the American Society of Sugar Cane Technologists 65

Guidelines for Preparing Papers for Journal of ASSCT 67

Constitution of the American Society of Sugar Cane Technologists 68

Author Index 74

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PRESIDENT'S MESSAGE
LOUISIANA DIVISION

Duane Legendre
Raceland Raw Sugar Corp.

From where have we come; to where are we going? These were the questions uppermost in the minds of those of us in the Louisiana sugarcane industry as we celebrated our 200^{th} anniversary. In reflecting on the history of the Louisiana sugar industry, we realize we have made great strides in the production and processing of sugar since the time Etienne de Bore first learned to make sugar from the extracted juice of the sugarcane plant in Louisiana.

We have learned much about improved varieties of cane that are suited to various soil types and weather conditions and those varieties less susceptible to diseases and insects. Variety development has always been, and continues to be, a top priority for industry research efforts.

Research priorities have resulted in the development of higher yielding varieties. This was reflected in the state's industry records for 1996. Louisiana farmers produced an average yield of 31.3 tonnes of cane per acre, resulting in the production of 6,250 pounds of sugar per acre. This can be attributed to the rapid expansion in the use of sugarcane variety LCP 85-384. This currently is the highest yielding variety known to the Louisiana industry.

Increased use of this variety has also resulted in the introduction of the combine harvester in Louisiana. During 1996, approximately 15 percent of the state's tonnage was harvested by combine harvesters. It is anticipated that this will increase to over 35 percent of the crop in 1997. So, where do we go from here?

Mechanization research has been deemed vital to determine whether processors and/or producers should make changes to handle the alternative harvesting techniques. Various research projects are being conducted by Louisiana State University, by the Agricultural Research Service of the United States Department of Agriculture, and by the American Sugarcane League scientists to determine profitability of the combine system.

Leaders in the research area are also focusing their efforts on more effective production as well as harvesting techniques. Studies are underway to determine the feasibility of planting billeted cane which, if effective, could reduce planting cost dramatically.

With the introduction of combine harvesting of cane to Louisiana, both the grower and the processor are faced with the added expense of the transition to the newer combine harvesters. Further, with combine cane comes problems, both in the field and in the factory. Billeted cane deteriorates faster and hastens the formation of dextran. Intensive management is the key to preventing this problem. Further, the effects of repeated combine harvesting on stubbling is unknown as well as the effects of combine cane on processing.

Increased efficiency in other aspects of cane and sugar production continues to be emphasized. Industry support of biotechnology research continues in an effort to improve productivity. The objective is for future varieties to increase overall industry productivity. Gene mapping is currently being undertaken through cooperative research with other sugar industries. Genetically engineered plants have been produced and are being tested in an effort to incorporate these technologies into the conventional breeding programs.

Leaders in the industry recognize that we are at important crossroads. Higher yields and increased efficiency are definitely necessary if we are to remain globally competitive. Not only the producers but the processors must continue to work to improve the efficiency of their operations.

All of the research projects that are being conducted require funding for their respective efforts. The sugar industry meets the challenge through the Dedicated Research Funding Program funded by the growers and processors of the state coordinated by the American Sugarcane League and the Louisiana Farm Bureau.

During last year, as in past years, there were legislative attempts to destroy or dismantle the domestic sugar program. Louisiana sugar leaders again took an active role in bringing about the defeat of these attempts. It is Louisiana's intent to continue to work for the best interest of the domestic sugar program.

Industry personnel have also worked in areas of environmental concerns. They were particularly concerned with regulations and policies regarding open field burning of sugarcane, sugar mill air emissions, factory waste water discharge, and factory solid waste disposal.

There are those who may think the sugar industry is on the way out. Records from 1996 indicate otherwise. In fact, for the third consecutive year, Louisiana produced over one million tonnes of sugar.

Sugar recovery at the mills averaged above 10 percent for the 6th time in the past ten years.

Acreage for 1997 is expected to be an all-time high, probably near 400,000 acres, although harvested acreage was down in 1996 due largely to winter freezes.

For the first time since the turn of the century, sugar production will take place in the western portion of the state. It is anticipated that expansion in that area will exceed 100,000 acres by the year 2000.

On the manufacturing end, innovative ideas were and are being incorporated into several Louisiana sugar mills to improve their operations. This technology includes the installation of hydraulic mill drives, planetary gears for mill drivers, and the beginning of construction on a 10,000 tonne per day sugarcane diffuser.

Does this sound like a dying industry? I think not. The cooperative effort of all who work both in and for the sugar industry, or even those outside the industry, is what makes this industry viable. It is this continuing cooperative effort that allows the Louisiana sugar industry to continue to grow and compete in the global marketplace of the future.

PRESIDENT'S MESSAGE
FLORIDA DIVISION

Modesto F, Ulloa
Sugar Farms Coop.

Let me begin by thanking the Louisiana Division of the American Society of Sugar Cane Technologist for hosting the 27th Annual Joint Meeting in Fort Walton Beach, Florida.

In summary, my address will begin with a briefing on the production results from 1996-97 crop. In addition I will outline some events of importance to Florida producers, and what role I feel we need to establish in order to regain control of our future in the Everglades Agricultural Area (EAA). I will try to cover the events and contributions from the industry that in general were important in characterizing 1996.

From the field side, let me say that despite freezing weather experienced during the week of January 18th, the Florida sugar industry completed a successful crop on March 23rd. This season's mid January freeze was well managed, through both a harvesting strategy and cold tolerant varieties. The strength of United States Sugar Corporation (CL) and USDA (CP) varieties made it possible for us to finish the 1996-97 Crop without significant declines in juice quality. The campaign lasted a total of 153 days from the start of the first to the finish of the last mill, and yielded 1,679,179 short tons of 96 sugar. The average sugar recovery per gross ton of cane was 220.8 pounds versus 221.4 for last year. Per acre cane production was lower on the marginal mucks affected by the freezing weather in February of 1996, and in the mineral soils due to periods of prolonged drought last summer. Weather conditions during this harvest and planting season were nearly ideal, and the 1997-98 crop is off to very good start. Official acreage figures have not been audited yet so at this time I am unable to generate per acre production trends.

In the environmental and political arena, the State and Federal Political Agenda and the negative attitudes fueled by environmental advocates have set an unfavorable climate for a scientific problem solving method. The narrow margin of 54.5% that voted "NO" on Amendment 4 is indicative of an urban community that does not strongly sympathize with the Florida Sugar Producer. This political battle was won thanks to strategist that designed an uncomplicated campaign that voters could well relate to. The major emphasis of the message dealt with the loss of jobs, the inefficient use of tax dollars, the potential for additional taxation, and the recognition that the Florida sugar producers were making, and had made significant monetary contributions toward restoration of the environment. This brief and clear campaign together with the sacrifices and the support from all sugar related businesses and families in the area was enough to turn the vote in our favor. I thank you on behalf of the Executive Committee for your efforts.

This victory does not vaccinate us from future attacks. It does, however, buy us time to rally, and with educational and public awareness programs, help our urban neighbors clearly understand the value and environmental friendliness of the Florida Sugar Industry. Sugar production is an environmentally friendly cropping and manufacturing alternative, because of its suitability to the EAA. The principal cropping and harvesting operations are carried out during the fall and winter months. This period is typically dryer than the summer. Therefore we can say that sugarcane culture is in tune with the South Florida climate. In addition, industrial sugar production is energy efficient, and none of its processes involve the use of hazardous or environmentally undesirable materials. Our factories operate on renewable fuel and bum well within EPA air quality standards. We have a good story to share, and it is our responsibility, as sugar technologists, to make sure that it is well told, and understood.

Currently, the executive committee of this Florida society is discussing possible direct involvement in educational programs with high schools in the area. Members of the ASSCT Florida Division should volunteer to serve as friends and science project mentors to future generations in order to forge good and lasting relationships between the urban and agricultural sectors. In addition to our efforts, private sugar corporations are opening their doors to visitors and special interest groups for outsiders to see first hand, that qualified and well intentioned persons operate this industry in the best interest of South Florida. Other Florida private sugar businesses are launching a farming and environmental television campaign. These and other individual and joint efforts are what makes the difference. We will be here, and stronger, well into the 21 st century, because our industry makes good sense to the economy and to the environment.

Farmers within the EAA contributed $12.8 million to the Agricultural Privilege Tax during the first year of the Everglades Forever Act (EFA). In addition, they sponsored approximately $ 3 million of research at the Everglades Protection District designated to improve water quality in Lake Okeechobee and the Everglades. All EAA farmers have implemented an array of farm Best Management Practices (BMP's), with associated water flow and phosphorous monitoring, at drainage pump locations. There was a 68% reduction of phosphorous for the EAA last year with a three year average of 47%, thus greatly exceeding the 25% regulatory requirement.

The construction of storm water treatment areas (STA's) by the South Florida Water Management District (SFWMD) are continuing on schedule despite poor fiscal planning and controls by the District. The SFWMD presented potential project short falls of as great as $180 million which upon further scrutiny by the Florida Legislature, were reduced to $29 million with much analysis still being needed. Another threat to constructing the STA's is the recent dredge and fill permit by U.S. Army Corps which does not agree with the EFA. However construction contracts are proceeding with STA #6 and "inflow works" to STA #1. Negotiations will continue regarding these issues.

Sugarcane and rice production are the closest alternative to sawgrass that make good environmental sense with respect to land use management and economic development for the State of Florida. Farming is the ideal transitional buffer that benefits both the urban and wildlife management sectors.

On the research and technology front, our breeders are feeling the pressure. Sugarcane in Florida has been exposed to a flurry of new diseases reducing the effectiveness of conventional breeding programs and eliminating major commercial cultivars from our production system. Most of our commercial cultivars are susceptible but tolerant enough to allow for a transitional period. Additional resources will be needed for the USDA Canal Point Program to regain lost ground quicker. Conventional breeding systems rely on increased seedling numbers, and this equates to increased cost. As a field person, I believe that a good variety development program is the essence of sugar production. Like my predecessors, I too have learned that sugar is made in the fields and not in the factory.

But the future is promising. As an alternative, and in order to compliment current breeding methods, we now must turn the page to biotechnology. I am sure all of you have heard of the Green Revolution. It was responsible for averting starvation in many parts of the developing world. We have now entered the Biotechnology Revolution and some molecular biology techniques are now being applied to sugarcane.

In 1988, the first steps were taken to determine the feasibility to map the sugarcane genome. It was soon learned that this type of basic research is indeed very costly. In July 1991, seven research institutes representing four countries (Australia, Brazil, United States, and South Africa) signed a memorandum of understanding (MOU) and established the International Consortium on Sugarcane Biotechnology (ICSB). Since then, new member countries have agreed to fund projects through the Consortium (Colombia, Mauritius, Argentina, Philippines, and Reunion). From the U.S., four institutions are members: American Sugar Cane League, Florida Sugar Cane League, Texas A&M, and U.S.D.A.

Let me, in a brief moment, tell you about the progress made and the future prospects in sugarcane biotechnology. First, the basic research funded through the ICSB since 1989 has reached about $3.2 million by the end of 1997. Florida has contributed about 5.5% of that total. Second, during this time period fourteen projects have been funded by contract with third parties. Third, the research funded has been primarily in two areas: (1) sugarcane genome analysis (e.g.., molecular mapping marker associated to traits of interest like disease resistance and high sucrose content, and map-based cloning), and (2) genetic transformation, or the creation of a new, genetically different individual without the use of sexual reproduction. Regarding this aspect of transformation, sugarcane has already been genetically transformed for herbicide resistance in Texas, Hawaii, Australia, and South Africa. Potential application for other desirable transformation, like disease resistance to sugarcane mosaic virus, are currently being worked on. Laboratory and greenhouse data from the above mentioned locations are encouraging, however transformed plants need to be approved for release to the commercial environment, evaluated under field conditions, and licensing must be completed with companies owning genes and possibly the transformation techniques. Even though promising to the industry, I feel, that earliest application of this work is still a few years away.

One final area of interest that I would like to mention is that of employee standards, conservation practices, health, and environmental restrictions that are imposed upon U.S. farmers. These regulations, under which we work, far exceed those of most imported sugars. Therefore, our cost is higher. For example, Monsanto tested a new compound (SEMPRA) for control of a specific weed called nutsedge in Florida years ago. Nutsedge has become a uncontrollable nuisance for Florida sugarcane farmers but SEMPRA has not yet been registered for use in Florida sugarcane fields. Last year, while in Colombia and Brazil I found this same herbicide under the trade name SEMPRA in full commercial use. This is only one example of many that highlighted differences between U.S. and foreign producers. This difference in imposed standards has not been taken into consideration by supporters of so-called free trade. The field is not level based on the political, social, or scientific standards. In spite of the above the U.S. farmer/producer is still among the most competitive.

Sugar has not increased in price over the years and this has made us more innovative. We have crossed over from an industry fueled by offshore labor, with runaway costs, many liabilities, and much negative publicity, to 100% mechanization. This transition was accomplished in 5 years. The industry has looked for added value through the expansion of sugar refining capacity, cogeneration, specialty sugars, and rotation crops. Engineers are actively working to implement new techniques to increase recovery in the sugarhouse, and plant breeders have increased cane production trends through added disease resistance, cold tolerance, and increased juice quality. However there is still much to be learned. Developments in both agriculture and manufacturing in such countries as Australia, Brazil, South Africa, and others, must be reviewed and studied for potential implementation in mainland United States. The challenge is still there, let us pursue it.

PEER

REFEREED

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ARTICLES

AGRICULTURAL

SECTION

ESTIMATES OF HERITABILITY IN A BACKCROSS POPULATION OF INTERSPECIFIC AND INTERGENERIC HYBRIDS IN SUGARCANE

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ABSTRACT

Saccharum spontaneum, Erianthus spp., and *Miscanthus* spp. have been used through interspecific and intergeneric hybridization to transfer their desired characters into cultivated sugarcane. However, genetic information needs to be established so that breeders can effectively use those characters in their breeding programs. The BC_2 populations produced by mating four BC_1 hybrids (one interspecific and three intergeneric) to three commercial cultivars as males were used to determine the relative effect of parents on morphological characters (stalk height, number, diameter and weight) and juice quality (Brix, sucrose content and purity). The results showed that the female effects were significant for all characters examined, but only the measurements of the juice quality showed significant male effect and male x female interaction. Genetic information obtained from this study should assist in establishing backcross and selection strategies for a sugarcane breeding program utilizing basic germplasm.

INTRODUCTION

The genus *Saccharum* consists of six species, *S. officinarum* L. (noble cane), *S. spontaneu* L., *S. barberi* Jesw., *S. sinense* Roxb., *S. robustum* Brandes and Jeswiet ex. Grassl, and *S. edule* Hassk. (Brandes, 1958). The genus *Saccharum* and its related genera including *Erianthus, Miscanthus, Sclerostachya,* and *Narenga* together have been called the *Saccharum* complex (Da

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and Roach, 1987). The high polyploidy in *Saccharum* helps overcome obstacles to hybridization with other genera within the complex (Janaki Ammal, 1941). Sugarcane and related grasses have been actively used in the basic breeding program at Canal Point, Florida (Grassl, 1963; Tai and Miller, 1988; Tai et al., 1991 and 1992). Reasons for using *S. spontaneum* and related genera in sugarcane breeding include expansion of the germplasm base of commercial sugarcane and breeding clones, the transfer of desired characteristics that do not exist to a satisfactory degree in *Saccharum*, and the heterotic effect for yield and sugar content (Grassl, 1963; Roach, 1984; Tai and Miller, 1988). Estimates of broad-sense heritability for morphological and juice-quality characters in biparental crosses between commercial cultivars have been obtained (Brown et al., 1968; Hogarth, 1971 and 1977; Hogarth et al., 1981; Kang et al., 1983). Heritability estimates in progeny derived from interspecific and intergeneric crosses between *S. officinarum* and *S, spontaneum,* between commercial cultivars and *S. spontaneum*, and between commercial cultivars and *Miscanthus* and/or *Erianthus* have been reported (Roach, 1969; Tai et a1, 1991 and 1992). Based on the performance of progeny, Jackson and Roach (1994) suggested that little or no immediate gain from heterosis may be achieved by crossing F_1 clones derived from diverse *S. spontaneum* sources. In order to more effectively use interspecific and intergeneric hybridizations to broaden the genetic base in sugarcane, information on the genetic behavior of characters of economic importance needs to be established. The objective of this study was to estimate the heritability of some morphological and juice-quality characters in a backcross population of interspecific and intergeneric hybrids in sugarcane.

MATERIALS AND METHODS

During the 1990/91 flowering season, four BC, clones (US 88-1014, US 90-1025, US 90-1027 and US 90-1028) derived from backcrosses of interspecific and intergeneric hybrids (Fig. 1) (Tai and Miller, 1988; Tai et al., 1991 and 1992) were used as female parents to produce BC_2 seed by crossing them to each of three commercial cultivars, CP 70-1133, CP 81-1135 and CP 81-1425. The BC_2 seedlings were transplanted to field plots in a randomized complete block design in five replications in June 1991. Both BC_1 and BC_2 were defined as the first and second backcrosses of the interspecific or intergeneric hybrids to commercial cultivars, respectively. Approximately 120 seedlings from each of the BC_2 families were planted in a two-row plot at 0.3 m intervals with 1.5 m between plots and rows. Data on stalk height (m), stalk number, and stalk diameter (mm) from 40 plants were selected at random from each plot in December 1991. Stalk height was measured from the base to the top visible dewlap, and stalk diameter was measured on five mature stalks per plant, at mid-internode, approximately 0.5 m above the ground. Stalk number was the number of mature stalks per seedling. All mature stalks were cut for determining stalk weight and milled for juice analysis in January 1992. Determination ofpercent sucrose was by polarimetry. Percent purity was calculated from the ratio of percent sucrose to Brix. Crossing, field evaluations and laboratory analyses were conducted at the USDA-ARS Sugarcane Field Station, Canal Point, Florida.

Analyses of variances were carried out for each of the characters examined using individual plant and plot mean data (Becker, 1985; Hogarth, 1971; Steel and Torrie, 1980). Duncan's Multiple Range Test (Steel and Torrie, 1980) was used to compare means of all characters among BC_2 populations. Variance components attributed to males(s_m^2), females (s_f^2), and male x female interaction (s_{mf}^2) were estimated. Estimates of additive genetic variance (s_A^2) were calculated as 4 s_m^2 and estimates of dominance genetic variance (s_D^2) were calculated as 4 s_{mf}^2.

Narrow-sense heritability (h^2) was estimated by three ways (Becker, 1985; Falconer, 1967):

$$h_m^2 = 4s_m^2/s_P^2$$
$$h_f^2 = 4s_f^2/s_P^2$$
$$h_{m+f}^2 = 2(s_m^2 + s_f^2)/s_P^2$$

Where s_P^2 (individual plant basis) was the total variance ($s_P^2 = s_m^2 + s_f^2 + s_{mf}^2 + s_w^2$), and s_w^2 was the variance component of within family or plant to plant within a plot.

RESULTS AND DISCUSSION

The means for all characters varied significantly among BC_2 populations (Table 1). However, there was no notable trend of showing high or low means produced by specific male or female parent or by a group of backcrosses.

An analysis of variance indicated that the female effect was significant for all characters examined, but only stalk height, Brix, percent sucrose and percent purity showed significant male and male x female interaction effects (Table 2). Variance components show that s_f^2 was greater than s_m^2 for all characters except percent purity (Table 2). The o_f^2 component contains additive genetic variance plus variances of dominance and common environment (Falconer, 1967). The differences between female parents (interspecific and intergeneric hybrids) were greater than the differences between male parents (commercial cultivars). The interaction variance components between male and female parents were small for most characters examined. Estimates of the variance components for juice-quality characters of this study ($s_m^2 < s_f^2$) differed from those of BCj progeny derived from backcrosses between commercial sugarcane and *S. spontaneum* ($s_m^2 > s_f^2$) (Tai et al., 1992). The difference could be due to materials with which genetic variances were estimated. The materials used for the present study were derived from both intergeneric and interspecific hybrids of three genera, *Erianthus, Saccharum, and Sclerostachya,* while the materials used by Tai et al. (1992) were derived from interspecific hybrids of *Saccharum.* This difference in a genetic variance might warrant further investigation. Among genetic variances, additive genetic variance (s_A^2) was greater and more important than dominance genetic variance (s_D^2) for stalk diameter, stalk weight, sucrose, and purity. Therefore, the average performance of progeny for these four characters would be determined by the mean performance of parental clones. The ratios of non-additive to additive genetic variance (s_D^2:s_A^2) showed that there was little or no dominance for genes controlling these four characters. There was some degree of overdominance for genes controlling stalk height, stalk number, and Brix. Information on the genetic manipulation on these quantitative characters should be useful to the selection practice in backcross progeny.

The estimates of heritability varied considerably between estimating methods and between characters (Table 3). Based on estimation from variance components, three estimates (h_m^2, h_f^2 and

h_{m+f}^2) showed the heritability of stalk weight was very low and the heritability of percent sucrose was moderate. Heritability of other characters varied among methods. Female genetic variance, s_f^2, tended to give higher estimates for nearly all characters than did the other two estimates, s_m^2 and o $_{mf}^2$. The female variance component was greater than the male variance component and was inflated by non-additive (dominance variance) and common environment effects. Therefore, the two estimates of the heritability, h_f^2 and h_{m+f}^2, from the female component and male-female combination may be
biased upward. The estimate of the heritability from male variance components would be more reliable than that from female variance component.

The present heritability analysis was based on the variability associated with individual plants, This information should be useful to sugarcane breeders who practice seedling selection on an individual plant basis. The heritability of both Brix and percent sucrose was fairly consistent and of a moderate magnitude, but the estimates of heritability for the other five characters varied widely. Selection of clones for high sugar content within the BC_2 population of the interspecific and intergeneric hybrids of sugarcane would be more successful than selection of clones for other characters examined. Genetic gain from selection for stalk weight, stalk height, stalk number, stalk diameter, or percent purity in BC_2 population of interspecific and intergeneric hybrids would be uncertain.

Our information on a genetic variance, degree of dominance, and heritability of morphological and juice-quality characters obtained from a backcross population of interspecific and intergeneric hybrids should assist us in establishing more effective backcross and selection strategies for the breeding program. This study involved a limited number of parents and backcrosses. Further investigations on variation in heritability from one population to another involving more parents and backcrosses could provide us with additional knowledge about genetic gains through the procedure of nobilization. Increased replications and family selection for some characters with low heritability would improve our progress. Elite clones with superior performance in some of the important characters should be used as parents in backcrosses. This information also should increase germplasm utilization of wild sugarcane and related genera by using clones with superior agronomic characters for hybridization.

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Table 1. Means of morphologic and juice-quality characteristics of the progeny derived from backcrosses of interspecific and intergeneric hybrids of sugarcane.

Cross	Stalk height	Stalk number	Stalk diameter	Stalk weight
	m	#	mm	Kg
US88-1014 x CP70-1133	2.28 a*	3.3 def	21.87 ab	1.08 ab
US88-1014 X CP81-1135	2.11 bc	3.7 def	22.76 a	1.28 a
US88-1014 X CP81-1425	2.02 cd	4.2 abc	22.82 a	1.32 a
US90-1025 X CP70-1133	1.83 e	3.9 bcd	20.48 cde	1.05 ab
US90-1025 X CP81-1135	1.93 de	4.7 a	21.26 bc	1.08 ab
US90-1025 X CP81-1425	1.92 de	4.5 ab	20.41 cde	1.18 ab
US90-1027 X CP70-1133	2.20 ab	3.7 cde	19.58 e	0.98 bc
US90-1027 X CP81-1135	2.10bc	3.4 def	19.91 ed	1.08 ab
US90-1027 X CP81-1425	1.93 de	3.3 ef	19.42 e	0.82 d
US90-1028 X CP70-1133	2.12 be	2.8 f	20.86 bcd	0.82 d
US90-1028 X CP81-1135	1.92 de	2.8 f	21.16 bc	0.99 bc
US90-1028 X CP81-1425	1,98 cde	3.2 ef	21.78 ab	0.83 d
Grand mean	2.24	3.7	20.97	0.96
	Brix	Sucrose %	Purity	
US88-1014 X CP70-1133	13.82 ab	9.89 bc	71.28a	
US88-1014 X CP81-1135	13.77 ab	9.54 bc	68.64 abc	
US88-1014 X CP81-1425	14.13 a	10.10 ab	71.00 ab	
US90-1025 X CP70-1133	11.96c	8.19 d	67.38 bc	
US90-1025 X CP81-1135	12.15 bc	8.19d	66.91 bc	
US90-1025 X CP81-1425	12.75 bc	8.48 cd	65.91 bc	
US90-1027 X CP70-1133	11.58 c	10.09 ab	67.46 bc	
US90-1027 X CP81-1135	12.96 bc	8.73 c	72.77 a	
US90-1027 X CP81-1425	13.77 ab	10.07 ab	73.13 a	
US90-1028 X CP70-1133	14.23 a	10.31 a	72.51 a	
US90-1028 X CP81-1135	12.81 be	8.08 d	62.99 d	
US90-1028 X CP81-1425	14.05 a	10.05 ab	70.86 ab	
Grand mean	13.16	9.31	69.24	

* Means followed by the same letter(s) are not significantly different at the 0.05 probability level using Duncan's Multiple Range Test.

Table 2. Estimates of variance components and genetic variance of selected traits in BC_2 population of interspecific and intergeneric hybrids of sugarcane.

	Variance Component[1]				Genetic Variance[2]		
Character	s_m^2	s_f^2	s_{mf}^2	s_w^2	s_A^2	s_D^2	D/A
Stalk height	0.001*	0.008**	0.007*	0.094	0.004	0.028	7.00
Stalk diameter	0.190	1.095**	-0.243	8.001	0.760	-0.972	0
Stalk weight	0.008	0.072**	-0.028	1.359	0.016	-0.112	0
Stalk number	-0.256	0.289**	0.030	2.819	0	0.120	
Brix	0.117**	0.489**	0.129*	2.197	0.468	0.516	1.10
Sucrose (%)	0.273**	0.395**	0.153*	3.341	1.092	0.612	0.56
Purity (%)	3.829**	0.880**	2.340**	68.801	15.316	9.360	0.61

*, ** Significant F values for the corresponding mean squares at 0.05 and 0.01 probability levels, respectively.

[1] Variance components: s_m^2 = males, s_f^2 = females, s_{mf}^2 = female x male interaction, and s_w^2 = individual plants.

[2] Genetic variance: s_A^2 = additive, s_D^2 = dominance, and D/A = s_D^2: s_A^2 ratio.

Table 3. Estimates of heritability of morphological and juice-quality characters in BC_2 population of interspecific and intergeneric hybrids of sugarcane.

Character	Estimated heritability based on variance components[1]		
	h_m^2	h_f^2	h_{m+f}^2
Stalk diameter	0.075 ±0.093	0.430 ±0,120	0.252 ±0.108
Stalk height	0.052 ±1.248	0.290 ±2.072	0.171 ±2.510
Stalk weight	0.017 ±0.223	0.150 ±0.337	0.084 ±0.366
Stalk number	0	0.316 + 0.349	0.158 ±0.309
Brix	0.151 ±0.062	0.634 ±0.518	0.393 + 0.347
Percent sucrose	0.245 ±0.276	0.356 ±0.343	0.300 ±0.347
Percent purity	0.184 ±0.005	0.042 ±0.047	0.113 ±0.080

[1] h_m^2 = estimate based on male component; h_f^2 = estimates based on female component; and h_{m+f}^2 = estimates based on male and female components.

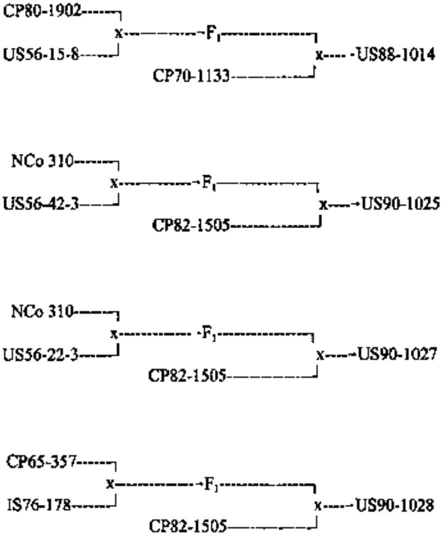

Fig. 1. Pedigrees of four female parents in a backcross population. US56-15-8 is a *Saccharum spontaneum* clone, US56-42-3 is a *Miscanthidium sorghum* clone, US56-22-3 is a *Miscanthus floridulus* clone, and IS76-178 is an *Erianthus arundinaceus* clone. Sugarcane cultivars:CP65-357, CP70-1133, CP80-1902, CP80-1505, and NCo 310.

BERMUDAGRASS (*Cynodon dactylon*) AND JOHNSONGRASS (*Sorghum halepense*) CONTROL PROGRAMS IN SUCCESSION-PLANTED SUGARCANE (*Saccharum* spp. hybrids)

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ABSTRACT

Sulfometuron applied preemergence (PRE) to succession-planted sugarcane controlled johnsongrass (79 to 93%) and reduced bermudagrass ground cover in the plant-cane crop when compared to metribuzin at standard rates. In three of four experiments, sulfometuron applied PRE after planting and, in the case of the bermudagrass study reapplied the following March, did not adversely affect crop emergence or early-season growth. When followed by a postemergence (POST) asulam application, johnsongrass panicle counts at the end of the plant-cane growing season were reduced 30% more where sulfometuron was applied at-planting compared to metribuzin. When PRE applications of sulfometuron were followed by asulam POST to control johnsongrass, plant-cane stalk counts and gross cane and sugar yields were at least 8% greater than the metribuzin followed by asulam treatment in the 1994-1995 experiment. A similar response was not obtained in the 1993-1994 experiment due to early-season crop injury from sulfometuron. In a separate study, gross cane yields were increased in the 1993-1994 experiment following at-planting and spring applications of metribuzin (15%) or sulfometuron (24%) to control bermudagrass when compared to the weedy check. Increases in bermudagrass control following treatment with sulfometuron were not reflected as further increases in sugar yields when compared to the metribuzin treatment. In the 1994-1995 experiment where low bermudagrass infestation levels did not negatively impact the crop, gross cane and sugar yields following treatment with sulfometuron were similar to the weedy check but at least 8% lower than the metribuzin standard. **Nomenclature:** Asulam, methyl[(4-aminophenyl)sulfonyl] carbamate; metribuzin, 4-amino-6-(l ,1 -dimethylethyl)-3-(methylthio)-l ,2,4-

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triazin-5(4*H*)-one; sulfometuron, 2-[[[[(4,6-dimethyl-2-pyrimidinyl)amino]carbonyl] amino]sulfonyl]benzoic acid; bermudagrass, *Cynodon dactylon* (L.) Pers.; johnsongrass, *Sorghum halepense* (L.) Pers.; sugarcane, a complex hybrid of *Saccharum* spp. CP 72-370 and LCP 82-89.

Key **words:** Asulam, crop injury, perennial weeds.

INTRODUCTION

In Louisiana, a plant-cane (first year) and two ratoon (second and third year) crops can be harvested following the planting of sugarcane stalks in August and September. Each crop occupies approximately one fourth of a producer's land with the remaining portion being fallowed in preparation for planting. During the 3-yr crop cycle, the row top remains undisturbed creating conditions which are conducive to the development of bermudagrass and johnsongrass. Bermudagrass biomass can increase 340 and 490% between the plant-cane and first-ratoon crop and first- and second-ratoon crops, respectively, with yield reductions of 10 to 17% per year (Richard 1993). Johnsongrass biomass can double between the plant-cane and first-ratoon crop with full-season johnsongrass interference in a first-ratoon crop reducing cane yields 86% compared with a 42% reduction in a plant-cane crop (Millhollon 1995). No herbicides are labeled for the selective POST control of bermudagrass in sugarcane (Richard 1992, 1996). Asulam applied POST can reduce the economic impact of johnsongrass by providing temporary control (Bruff et al. 1996, Richard 1990).

Fields are typically fallowed after the third harvest because increasing infestations of bermudagrass and johnsongrass, as well as diseases, make the profitability of a fourth harvest questionable (Faw 1995). The fallow period begins after harvest with the destruction of the sugarcane stubble by tillage and/or application of glyphosate [*N*-(phosphonomethyl)glycine]. Timely tillage (disking and plowing) and/or glyphosate applied POST during the fallow period also promotes the depletion of seeds, rhizomes, and stolons of perennial weeds (Richard 1997a, 1997b). At-planting and spring applications of metribuzin can control seedling bermudagrass, johnsongrass, and other weeds within the sugarcane crop, but not plants emerging from rhizomes and stolons (Sanders 1995). Hence, the effectiveness of a fallow weed control program directly impacts weed pressure in the plant-cane crop and the continued harvests of ratoon crops. Fallowing is costly when considering the time and money spent for weed control on land not providing a marketable crop.

In some instances, sugarcane is replanted immediately following the harvest of the second-ratoon crop without a fallow period. Although good in theory, this practice, known as succession planting, has several drawbacks. Whereas traditional planting occurs in August and September, succession planting occurs in late October and November, which translates into a shorter establishment period before winter frost. Succession planting also requires coordination of harvesting and planting operations during the same time period. The elimination of a fallow period also enhances the risk that a producer will begin a crop cycle with heavy perennial weed pressures (Faw 1995).

Despite these drawbacks, such alternative programs may aid in increasing producer profits. With a standard rotation system, 85% of gross income is absorbed by costs (Johnson et al. 1993). This compares with only 79% when succession planting is employed on 60% of the acreage slated for fallowing in the subsequent year. Where weeds are not a limiting factor and an at-planting fertilizer application is used, succession planted sugarcane can produce total crop cycle yields comparable to those obtained through conventional planting following a summer fallow period (Ricaud and Arceneaux 1988).

Sulfometuron applied to fallowed sugarcane fields can control seedling and rhizomatous weeds including johnsongrass and provide temporary control of bermudagrass (Richard 1997a, 1997b). Application of sulfometuron to sugarcane at planting PRE and again in the spring of the plant-cane growing season early POST at a reduced rate can provide selective control of rhizome johnsongrass (Richard 1998). A reduced rate of sulfometuron is needed in the spring because the potential for crop injury is greater following a POST application (Richard 1998).

Sugarcane injury potential following at-planting applications of sulfometuron may also be greater where sugarcane is succession-planted because the shorter fall growth period associated with the later planting date also shortens the interval for crop recovery from herbicide injury. These studies were conducted to compare the use of sulfometuron and metribuzin programs for the control of perennated bennudagrass and johnsongrass in succession planted sugarcane and to determine the subsequent effect on sugarcane growth and yield.

MATERIALS AND METHODS

Johnsongrass Study

Experiments were initiated in 1993 and 1994 on adjacent sites at the St. Gabriel Research Station in St. Gabriel, LA on a Commerce silt loam soil (fine-silty, mixed, nonacid, thermic Aeric Fluvaquent) pH 7.6. Following mid-October harvests of first-ratoon (1993) and second-ratoon (1994) crops, 5 cm of the row top was removed with a hydraulically driven revolving disk shaver. The rows were opened, rotary tilled, closed, and re-opened to insure destruction of the previous crop's stubble pieces and to create a planting furrow into which CP 72-370 sugarcane stalks were placed and covered with 8-cm of packed soil.

Treatments included at-planting PRE applications of metribuzin at 2,020 g ai/ha and sulfometuron at 53, 105, or 158 g ai/ha followed by a POST application of asulam at 3,740 g ai/ha during the plant-cane growing seasons of 1994 and 1995. Asulam applications were made in April (metribuzin) or May (sulfometuron) when johnsongrass was 75 to 130 cm tall with 75 to 85% panicle emergence and sugarcane was 45 to 95 cm tall. Johnsongrass height was measured from the soil surface to the tip of the longest leaf, and sugarcane height was measured from the soil surface to the collar of the youngest leaf below the whorl. At-planting treatments were broadcast with a tractor-mounted compressed air-pressurized sprayer delivering 140 L/ha. Asulam was applied to a

90-cm band using a $C0_2$-pressurized backpack sprayer delivering a broadcast aqueous carrier volume of 140 L/ha. Crop oil concentrate[2] at 1% (v/v) was applied with asulam.

Sugarcane responses to at-planting treatments were determined by counting the number of shoots in each plot in early January. Johnsongrass control (reductions in height and infestation levels) was visually rated in the spring of the plant-cane growing season prior to asulam application. Visual estimates of johnsongrass control were compared with nontreated areas within the field and based on a percentage scale of 0 to 100 with 100% representing no plants present. As another estimate of johnsongrass control, and to assess benefits of asulam application, johnsongrass panicles/plot were determined in late August of the plant-cane growing season.

Bermudagrass Control

Experiments were initiated in 1993 and 1994 on adjacent sites on a Mhoon silty clay loam soil (fme-silty, mixed, nonacid, thermic Typic Fluvaquent) with a pH of 6.2 at the USDA Ardoyne Farm in Houma, LA. Rows were prepared for planting LCP 82-89 sugarcane immediately after mid-October harvests of second-ratoon (1993) and first-ratoon (1994) fields.

At-planting PRE herbicide treatments included metribuzin at 2,580 g/ha and sulfometuron at 56 or 112 g/ha. A weedy check was also included for comparison. Atrazine [6-chloro-*N*-ethyl-*N'*-(1 -methylethyl)-1,3,5-triazine-2,4-diamine] at 2,240 g ai/ha was applied to the weedy check to limit interspecific weed competition. Herbicides were reapplied in late March at equivalent rates, except sulfometuron, which was applied at a reduced rate of 22 g/ha. All sulfometuron treatments were applied as mixtures with atrazine at 2,240 g/ha to insure control of broadleaf weeds. At-planting and March herbicide treatments were applied to a 90-cm band in a broadcast aqueous carrier volume of 190 L/ha using a tractor-mounted, compressed air-pressurized sprayer. At the time of the March applications, sugarcane was 9 cm tall and bermudagrass was dormant.

Bermudagrass control, based on visual estimates of the percentage of the soil surface covered with bermudagrass (0% = no cover and 100% = complete cover), was determined in mid-December (6 wk after planting) and again in late-May of the plant-cane growing season. Counts (number/plot) and height measurements (12/plot) of sugarcane shoots were also determined in mid-December as described previously.

Procedures Common to Both Studies

Fields were planted within 2 wk of the October harvest and subjected to conventional cultivation and fertilization practices. Plant-cane stalk counts (number/plot) and height

[2]Agri-Dex®, nonionic spray adjuvant is a crop oil concentrate that contains 83% heavy range, paraffinic petroleum hydrocarbons and 17% surfactant emulsifers (polyoxyethylene sorbitan fatty acid esters). Manufactured by Helena Chemical Co., Suite 500, 6075 Poplar Avenue, Memphis, Tenn. 38137.

measurements (12/plot) were made in late August. Plant-cane crops were mechanically-harvested in late November or early December of 1994 or 1995. Leaf material was removed from piles of harvested stalks by burning prior to weighing stalks to determine gross cane yield. A sample consisting of 15 harvested stalks, selected at random, was removed from each plot, weighed, and then crushed in a three-roller mill. Theoretically recoverable sugar (TRS) content of the extracted juice and sugar yields were determined using standard methodology.

Treatments were arranged in a randomized complete block design and replicated five (johnsongrass) or six (bermudagrass) times. Experimental plots consisted of three adjacent, 1.8 m wide rows 12.2 m (johnsongrass) or 10.7 m (bermudagrass) in length. Data in each study were subjected to analyses of variance within and across experiments (years) to determine significant interactions. Where interactions did not occur, data were combined. Where interactions occurred, data are presented for each experiment. Means of appropriate main effects and interactions were separated using Fisher's Protected LSD tests at $P = 0.05$.

RESULTS AND DISCUSSION

Johnsongrass Study

Metribuzin is relatively nonphytotoxic to sugarcane in Louisiana (Richard 1989). In the 1993-1994 experiment, sugarcane shoot numbers approximately 10 wk after planting were reduced 33, 58, and 68% following application of sulfometuron at 53, 105 or 158 g/ha, respectively, when compared with metribuzin (Table 1). In the 1994-1995 experiment, crop emergence was not affected by the at-planting applications of sulfometuron.

The difference in crop response between years can be explained by rainfall patterns and herbicide solubility. In 1993, above average (30 cm) rainfall fell during the 10-wk period after planting (12 cm within 15 d of treatment) compared with only 12 cm during the 10-wk period after plantmg in 1994. Sulfometuron, with a pKa of 5.2, becomes ionized at pH levels above this value thereby increasing water solubility (Harvey et al. 1985). Soil pH of 7.6, in combination with unusually high rainfall immediately after planting in 1993, may have resulted in leaching of the herbicide into the sugarcane root zone. The sugarcane cultivar CP 72-370 has greater susceptibility than other cultivars currently grown in Louisiana to several PRE herbicides (Millhollon and Koike 1986; Richard 1989), and the planting of a herbicide-sensitive cultivar may have also exacerbated injury potential under these conditions,

Where metribuzin was applied at planting, johnsongrass reached the designated growth stage for asulam treatment in the plant-cane crop in late-April each year. Similar growth stages were not reached until late-May when sulfometuron was applied. Sulfometuron at all rates provided commercially acceptable (79 to 93%) johnsongrass control in late May when compared to the 37% observed 4 wk earlier with at-planting metribuzin (Table 1). Johnsongrass control with sulfometuron was primarily associated with a reduction in johnsongrass height and stand. Despite some regrowth, johnsongrass panicle number was 30 to 43% lower late in the growing season when sulfometuron was followed by asulam than when metribuzin was followed by asulam (Table 1).

A significant year by treatment interaction was observed **for** sugarcane stalk counts in August. In the 1993-1994 experiment, sugarcane stalk numbers were equivalent for all sulfometuron and metribuzin treatments despite the injury observed earlier in the season (Table 2). In the 1994-1995 experiment, sugarcane stalk numbers for sulfometuron were similar regardless of rate and greater than for metribuzin. In another study where sugarcane was planted earlier into fields which were fallowed over the spring and summer months but heavily infested with rhizome johnsongrass, stalk numbers were higher when sugarcane was treated at-planting with sulfometuron than when treated with metribuzin (Richard 1998).

Sugarcane stalk height, stalk weight, and TRS levels did not differ for the various treatments both years (data not presented). As expected, gross cane and sugar yields in the 1993-1994 experiment were similar for the various treatments (Table 2). In the 1994-1995 experiment, gross cane and sugar yields were equivalent following the sulfometuron/asulam treatments. The sulfometuron followed by asulam treatments controlled johnsongrass sufficiently to produce cane yields greater than the metribuzin followed by asulam treatment. Of the sulfometuron treatments, only the at-planting application at 53 g/ha produced greater sugar yields than the standard metribuzin treatment, suggesting that higher rates of sulfometuron PRE applied late in the fall may be phytotoxic to succession-planted sugarcane on light-textured, high pH soils.

Bermudagrass Study

Sugarcane shoot populations in the fall were not affected by the various herbicide treatments 6 wk after planting in both experiments (Table 3). Bermudagrass development in the cool growth period in the fall after succession planting was slow as evidenced by the small amount (13%) of ground cover in the weedy check (Table 3). Nonetheless, sulfometuron did suppress bermudagrass cover relative to metribuzin. Bermudagrass cover in May of 1994 was much higher (88%) for the weedy check (Table 3). Lowest bermudagrass cover was observed following at-planting applications of sulfometuron at 112 g/ha. In May of 1995, bermudagrass covered only 26% of the row top in the weedy check. Differences between the treatments were not detected in 1995 as a result of slow bermudagrass development. The higher bermudagrass levels observed in 1994 were due to higher initial infestation from the preceding crop and to the fact that a more favorable growing season in 1995 resulted in higher sugarcane stalk populations and gross cane and sugar yields.

Although differences in bermudagrass control were noted in the fall following at-planting treatments and in the spring of 1994, they were not manifested as higher stalk populations (data not presented). Higher levels of bermudagrass in the weedy check (Table 3) caused a slight reduction in stalk height when compared with the other treatments in the 1993-1994 experiment (Table 4). In the 1994-1995 experiment, stalk height was reduced where sulfometuron was applied at 112 g/ha at planting and again in the spring at 22 g/ha. Differences in stalk height were reflected as reductions in stalk weight in the 1993-1994 experiment but not in the 1994-1995 experiment (data not presented). Differences in TRS levels between the various treatments were not detected in either experiment.

Metribuzin can temporarily suppress the development of bermudagrass within the sugarcane crop when applied in the spring (Richard 1993). Gross cane yields were 15% higher and sugar yields were 17% higher than the weedy check where metribuzin was applied at planting and again in the spring in the 1993-1994 experiment (Table 4). Sulfometuron controlled bermudagrass to a greater extent than metribuzin (Table 3). Hence, gross cane yields were at least 9% higher than the metribuzin treatment and 24% higher than the weedy check (Table 4). Sugar yields following treatment with sulfometuron to control bermudagrass were greater (25%) than the weedy check but similar to the metribuzin treatment. In the 1994-1995 experiment, the lower bermudagrass infestation did not negatively impact the crop. With one exception, both gross cane and sugar yields in the 1994-1995 experiment were higher for metribuzin than for sulfometuron. Reduced yield following sulfometuron in the 1994-1995 experiment may be attributable to crop injury which was detected in the stalk height measurements (Table 4).

In these studies, neither perenniated bermudagrass nor johnsongrass was completely eliminated by the weed control programs implemented. However, infestation levels of both weeds were generally reduced following at-planting applications of sulfometuron. As has been demonstrated in sugarcane planted after a conventional spring/summer fallow period (Richard 1998), where the presence of vegetative propagules of perennial weeds is anticipated in succession-planted sugarcane, use of sulfometuron at planting would lessen the economic impact of these weeds on the plant-cane crop and insure the competitiveness of the subsequent crops as weed infestation levels increase. Knowledge of soil pH and the potential for injury to succession-planted sugarcane following at-planting applications of sulfometuron at rates in excess of 56 g/ha would be critical to the success of this program, however.

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Table 1. Sugarcane shoot counts, johnsongrass control, and panicle counts after at-planting PRE applications of sulfometuron and metribuzin to succession-planted sugarcane.

		Sugarcane shoots[a]		Johnsongrass[b]	
Herbicide	Rate	93/94	94/95	Control	Panicles
	g/ha	no./ha		%	no./ha
Sulfometuron	53	10,500	8,500	79	8,600
Sulfometuron	105	6,600	6,700	87	9,500
Sulfometuron	158	5,000	8,600	93	10,600
Metribuzin	2020	15,600	8,500	37	15,100
LSD (0.05)		1,400	NS	11	3,600

[a]Sugarcane shoot counts were made in January of the plant-cane growing season 10 wk after planting in 1993 and 1994.

[b] Johnsongrass control estimates were made prior to asulam applications in April (metribuzin) and May (sulfometuron) while panicle counts were made in August. Data are pooled over experiments.

Table 2. Sugarcane stalk counts and gross cane and sugar yields after sulfometuron and metribuzin at-planting PRE followed by POST asulam applications to succession-planted sugarcane[3].

		Stalks[b]		Cane		Sugar	
Herbicide	Rate	93/94	94/95	93/94	94/95	93/94	94/95
	g/ha	no./ha		kg/ha			
Sulfometuron	53	41,600	67,900	17,500	30,900	5,500	9,600
Sulfometuron	105	37,100	64,500	16,300	29,100	5,300	8,800
Sulfometuron	158	34,900	72,500	16,300	30,000	5,000	8,900
Metribuzin	2020	38,500	54,300	16,300	26,300	5,400	8,100
LSD (0.05)		NS	9,200	NS	2,700	NS	1,100

[a]Asulam at 3,740 g/ha was applied to metribuzin treatments in April and to sulfometuron treatments in May,

[b]Sugarcane stalks were counted in August of the plant-cane growing season.

Table 3. Sugarcane shoot counts and bermudagrass cover in the fall and spring following at-planting PRE and March POST applications of sulforneturon and standard herbicides.

Herbicide	Rate at-planting	Rate spring	Sugarcane shoots[a]	Bermudagrass cover[a] fall	Bermudagrass cover[a] 5/94	Bermudagrass cover[a] 5/95
	g/ha		no./ha		%	
Sulfometuron[b]	56	22	16,500	7	59	14
Sulfometuron[b]	112	22	16,100	6	41	20
Metribuzin	2,580	2,580	16,900	16	72	17
Weedy check[c]	---	---	15,200	13	88	26
LSD (0.05)			NS	7	16	NS

[a]Sugarcane shoot populations and bermudagrass cover were determined in December after planting with bermudagrass cover being determined again in May of the plant-cane growing season.

[b]Sulfometuron treatments also contained atrazine at 2,240 g/ha.

[c]Atrazine at 2,240 g/ha was applied at-planting and in the spring to the weedy check to insure that bermudagrass was the predominant weed species present.

Table 4. Late-season sugarcane stalk height and gross cane and sugar yields following at-planting PRE and March POST applications of sulfometuron and standard herbicides.

	Rate		Stalk height		Cane yield		Sugar yield	
Herbicide	at-planting	spring	93/94	94/95	93/94	94/95	93/94	94/95
	g/ha		cm		kg/ha			
Sulfometuron[a]	56	22	202	218	67,600	79,900	9,600	9,400
Sulfometuron[a]	112	22	203	203	68,600	80,500	9,600	9,600
Metribuzin	2580	2580	204	221	62,300	86,700	9,000	10,600
Weedy check[b]	---	---	193	220	54,300	84,300	7,700	10,300
LSD (0.05)			7	12	6,900	6,600	1,100	900

[a] Sulfometuron treatments also contained atrazine at 2,240 g/ha.

[b] Atrazine at 2,240 g/ha was applied at-planting and in the spring to the weedy check to insure that bermudagrass was the predominant weed species present.

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IMPACT OF THE CLEAN AIR ACT ON FLORIDA SUGAR MILLS

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ABSTRACT

This paper presents an overview of the Clean Air Act, and how the State of Florida has been implementing the rules and regulation from this Act since the 70's, requiring special attention and large investments from the industry throughout the years. The impact of the amendments on this law is becoming more and more significant, since the industry must comply with regulations which call for limits on the emissions of air pollutants, which could lead us into the installation of very expensive and advanced equipment we can not afford.

The Title V of the Clean Air Act is requiring construction permits for some facilities, and is also calling for the accounting of not only boiler emissions, but for all emissions including fugitive ones of these facilities. Section 129, now under preparation, intends to consider bagasse boilers as incinerators, requiring Maximum Achievable Control Technology to achieve compliance with the new standards.

INTRODUCTION

The Clean Air Act, adopted by The Environmental Protection Agency (EPA) in the seventies has a substantial impact in the sugar industry, particularly in Florida, where the State, through the Department of Environmental Regulation (DER), which is now Department of Environmental Protection requested the installation of pollution control devises to existing and new major sources, such as sugar mill boilers, The DEP set limits to emissions of particulate matter (PM) based on mmBTUs of the heat input. An efficiency of 55% was selected and accepted for the purpose of heat input calculations in compliance tests.

A standard of 0.3 LB/mmBTU determined by EPA's reference test method V was adopted to demonstrate compliance once a year and a BACT (best available control technology) was required for every major source. In those days, the BACTs were the wet scrubbers, which most of the bagasse and residue boilers in the State of Florida now have in service.

By 1975, at a cost of several millions of dollars, all Florida sugar mill boilers had scrubbers installed to comply with the limit of 0.3 LB/mmBTU for particulate matter. Atlantic's boiler # 4 is probably the only one in the state with 0.29 LB/mmBTU because it was a new source at the time and had to have a lower standard than the older ones.

By the late seventies most boilers were passing the annual compliance tests fairly well and some environmentalists started a campaign challenging the legal 55% efficiency as a good value. New concepts like the "F factor" (theoretical volume of flue gas produced by a given fuel), continues compliance, PM10 (particulate matter smaller than 10 microns), and the impact of other pollutants such as NOx (nitrogen oxides), VOC (volatile organic compounds), and S02 (Sulfur oxides) was recognized. After a broad study and data collection the DER accepted the 55% efficiency for heat input calculations; but for new sources, limits for other pollutants were established.

DISCUSSION

The fugitive emissions from bagasse handling equipment became an area of concern by the Department of Environmental Regulation (DER), and the industry agreed to "take all the necessary precautions to minimize these fugitive emissions" such as to cover some bagasse conveyors. Atlantic Sugar made a study of rationalization for the bagasse conveyors. Three conveyors were eliminated and several small slats conveyors were substituted by screw conveyors, which generate less "bagacillo" emissions. All dropping points were enclosed and walls were added to the boilers" building to attenuate the effect of the wind to the conveyors. A very satisfactory system of gates and controls was developed to recover the leftover bagasse passing the last boiler and to incorporate it into the bagasse coming from the mill which not only diminished the emissions but provided better feeding to the boilers. The excess of bagasse was dropped at the end of the main conveyor and into an enclosure where it was taken by a front end loader and either fed back to the reclaiming conveyor or taken to the bagasse pile. Since the Clean Air Act also contemplates fugitive emissions and basically all kinds of emissions, it is possible that more modifications to the bagasse handling equipment would be in the near future.

By 1980, the EPA (Environmental Protection Agency) and DER wanted lower PM (particulate matter) standards for new sources, therefore, four new permits were issued with 0.15 LB/mmBTU limit of particulate mater. New federal regulations from EPA required construction permits for new sources, which included a computer model of the facility in order to estimate the impact of air pollutants on surrounding areas, which mean that these boilers are subject to what is called a PSD regulation or "Prevention of Significant Deterioration". A computer model is now required not only for new sources but also when a change or modification that could have a significant environmental impact is anticipated.

Atlantic's boiler 5 was built in 1981, which consequently was a transition time concerning air pollution. It is a PSD boiler with a wet scrubber as BACT to achieve 0.15 LB/mmBTU on PM (particulate matter), but also requires compliance with the emissions of other pollutants such as VOC (volatile organic compounds), NOx (nitrogen oxides), S02 (sulfur dioxide), and CO (carbon monoxide). Since no data was available for bagasse boilers, the standards were based on AP-42 (EPA publication) factors derived from "similar type of boilers" so we ended with very low allowable emissions for PSD boilers. A good example was CO emissions. In the past the test method for CO emissions was method III or the Orsat apparatus, which is incapable of reporting very low CO concentrations however, when method X was adopted, which is far more precise, we found that the AP-42 factor used underestimated CO emissions which, in reality, are several times higher than those from AP-42.

Wet scrubbers are marginal to achieve 0.15 LB/mmBTU burning bagasse, so the boilers must be in very good shape and very well operated to meet such standards. Furthermore the excess air can have opposite effects on NOx and VOC/CO emissions so there is no room for big variations from the optimum bagasse/air ratio. Bagasse boilers are difficult to "fine tune", especially when the bagasse is taken directly from the mill tandem which at the same time is propelled by steam turbines fed from the boilers themselves. Dumping and traveling grate boilers with water cooled walls have a quick response to bagasse changes in quantity and quality as well. The boilers' performance can suffer by the tandem operational changes such as "cuts", "chokes", cane plugs, clogging, etc., not to mention cane fiber, trash, mud, mechanical wear of cane knives, scrappers, etc..

The Clean Air Act implementation has been incorporating addenda called Titles, therefore the regulations have become more astringent on emissions. The PM allowable emissions for new sources is now well below 0.15. It is also necessary to comply with PM10 (emission of particulate matter smaller than 10 microns). As we stated before, wet scrubbers are ineffective in the removal of the very small particles. As a matter of fact the scrubber's efficiency is proportional to the particles' size. A different technology such as electrostatic precipitators must be installed to effectively remove more of the tiny particles.

The Sugar Cane League has been monitoring the air quality around the Everglades Agricultural Area year round for PM 10 and S02. The concentration of those pollutants has been well below the maximum allowable values.

New bagasse boilers must achieve compliance on the emission of several air pollutants, requiring new advanced design for good combustion, and better instrumentation for fine tuning, etc. The required pollution control equipment for new boilers will probably fall in the category of what is called "maximum achievable control technology" (MACT). Latest studies revealed that many of our old boilers lack furnace volume to achieve the near perfect combustion required for minimum emission rates that the regulatory agencies are now requesting.

When Palm Beach County was declared a "non attainment area" by EPA in 1991, the Florida Department of Environmental Protection initiated a remedial campaign to resolve the situation. For example it is mandatory to test car emissions of VOC and CO in order to obtain tags and registration in Palm Beach, Broward and Dade Counties. Major sources like mill boilers qualified for the RACT (Reasonable Available Control Technology) program, which means that limits for VOC and NOx are now in effect for all boilers in PBC, even the "grandfather" ones. It has been recognized by DEP that most bagasse boilers do not operate during the "ozone season" of June, July and August, so their operations have no significant impact on the ozone layer, nevertheless the boilers' permits have been modified.

The Title V of the 1990's Clean Air Act also sets a threshold for emission of 189 chemical elements and compounds known as HAPs (hazardous air pollutants). Under Title V a source is the entire facility and units are the individual boilers and any other equipment with the potential to emit regulated pollutants or HAPs, The regulations also establish which sources must apply for a Title V permit based on quantity and nature of air pollutants, as follows:

1- Major sources or those with the potential to emit 100 tons/ year of any regulated pollutant.

2- Sources with the potential to emit 10 tons/year of a single HAP.

3- Sources with the potential to emit 25 tons/ year of different aggregation of HAPs.

4- More than 5 tons/year of Lead.

Example: A mill which grinds 400,000 tons/year of cane with 25% of bagasse % of cane, produces 100,000 tons/year of bagasse for the boilers.

The potential CO emissions using the AP-42 factors is :

CO emissions = 100,000 tons/year x 2 lbs./ton x 1 ton/ 2,000 lb. = 100 tons/year

This mill can be considered a Title V facility and if this is the case, it must apply for a construction permit, no matter how old it really is.

In Florida, working along with other industries and by participation in the rulemaking process, we have accomplished some success in certain areas, such as excluding from the permits some activities which might be considered insignificant from the emissions point of view but just to prove their insignificance could require costly research and testing. It would be extremely costly to test for 189 chemicals just to prove that their emissions are below the threshold set by the regulations. However the Title V facilities are required to somehow demonstrate compliance with the permitted emission limits through testing, monitoring, etc. on a continuos bases.

The continuos assurance monitoring (CAM)rules are still in preparation by EPA, and we do not know at this time what kind of enhancement they will require for existing bagasse boilers which operate seasonally and out of the so called "ozone season" of June, July, and August. Big boilers and new coogeneration facilities are required to employ continuos emission monitoring (CEM) of major air pollutants, which not only implies the equipment but certified technical personnel for calibration and of course state of the art instrumentation to keep the boiler within the emission limits at all times.

We are optimistic that our bagasse boilers will be treated differently, in fact we are requesting other means of demonstrating compliance such as surrogated parameters. We anticipate complicated permits which will require more testing. In fact these new permits will incorporate limits for NOx and VOCs under RACT rules for ozone layer protection, despite the fact that we do not operate in the summer and Palm Beach County is no longer a "non attainment area". We must emphasize that boiler operating fees have been paid annually based on tons of pollutants emitted, excluding carbon monoxide. Under present regulations the owners of major sources paid $25/ ton of pollutants (excluding CO), with a cap of 4,000 tons/year as a maximum fee, which means up to $ 100,000 per year/facility. We anticipate the top fee of $35 per ton of pollutant in the near future. DEP expressed its intention of financing its own testing program with this money to determine compliance with the emission standards.

Title V facilities, as it was stated above, must report all kind of HAPs (hazardous air pollutants) emissions, including fugitive ones like dust from roads or conveyors, etc.. Other emission points such as vents, open tanks and vessels must be identified, as well as activities which have the potential to generate HAPs.

Section 112 of Title V will regulate HAPs emissions and it is now under development. It looks as if this Section does not represent a major threat to sugar mills immediately but it might make some mills subject to MACT determination upon its completion by the year 2,002. We must emphasize that Title V is a Federal matter. Here in Florida EPA is working closely with DEP, but this may not be the case in other states. The Federal Government could take action if the State fails to implement these rules.

EPA is now preparing a new rule for incinerators under Section 129. Bagasse boilers might be considered as incinerators by the EPA, based on the fact that we burn what they consider to be an agricultural waste. As of the date of this publication, the sugar companies have joined together to act in a proactive participation in the ongoing rulemaking of Section 129. They are trying to establish that bagasse is a fuel and not a waste, therefore, qualifying our boilers as such and not as incinerators. It is almost certain that we will have to claim an exemption from this rule, since we all know that bagasse boilers are exactly that; boilers. The purpose of our boilers is to produce power and process steam.

We know that EPA is considering requesting MACT determinations for the incinerators which will be regulated under Section 129. The preparation of the rules for Section 129 is somewhat unique; the EPA is inviting representatives from different sectors such as industry and also environmentalists to take part. Their intention is to create work groups and a "Coordinating

Committee" to develop the rule. Even when the sugar industry may want to be out of this regulation, we have taken the opportunity to participate in the process, through technical consultants and of course, lawyers. It is my opinion that we should continue to participate in this rulemaking process, but as the whole sugar industry, not Florida alone, since this is a Federal issue concerning all of us.

The future for the Florida Sugar Industry, will include further development of emission control techniques for the boilers, as well as for other areas of the factories, since we still do not know the implications of the Section 112 until it's completion. We should anticipate more sophisticated instrumentation, as well as more personnel training and better skilled personnel, more managerial involvement on pollution matters, and more legal counseling, along with more money being spent.

For other states it is difficult to know how the Federal Government or the State Government will act to enforce the new regulations. We know that EPA is working on their National Combustion Strategy, which includes Sections 111, 112 and 129. The public opinion, media, and politics are also part of the game, in fact, any environmental organization can and has sued the State or EPA whenever they find the regulatory agencies are not doing their jobs correctly.

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40 CFR 82 : Protection of Stratospheric Ozone

40 CFR 82, Subpart B: Servicing of Motor Vehicle Air Conditioners (MVAC)

40 CFR 82, Subpart F: Recycling and Emission Reduction

STATE:

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SEMINARS

TITLE V PERMITTING WORKSHOP - APRIL 22, 1996 - TAMPA, FLA.

CORRESPONDENCE

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A PRELIMINARY STUDY ON THE EFFECT OF SUGARCANE LEAVES AND MUD ON COLOR IN SUGARCANE JUICE

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ABSTRACT

During routine sediment tests conducted on cane juice samples from sugarcane stalks containing varying amounts of leafy cane trash and mud (0, 10, 20, and 30%, alone and in combination, by weight of clean cane stalks of the cultivar, CP 70-321), a wide range in color was noted in the supernatant which did not correlate to the sediment load in the juice. From these observations, a series of experiments was conducted to quantify the effect of leafy cane trash and mud on juice color. Results confirmed the deleterious effect of leafy cane trash, to include sugarcane leaf blades and sheaths but no tops, both desiccated and fresh, on juice color, with an approximate 6-fold increase in color over the range in leafy cane trash studied. The effect of leafy cane trash on color appeared nonlinear: color increased at a greater rate with each incremental increase in the level of cane leafy trash. On the other hand, mud (Mhoon silty clay loam with approximately 33% moisture) alone showed a decolorizing effect, due, undoubtedly, to the ion exchange properties of the soil type. Further, the effect of mud on color appeared linear: a decrease of 1.6% in color for each 1 % increase in mud added to the cane sample. Leafy cane trash and mud in combination (equal amounts of both leafy cane trash and mud by weight of cane up to a total of 30% trash) showed the opposing effects of the two components: color increased with an increase in total trash but not as much as with the leafy cane trash alone. The overall effect was nonlinear. In summary, it appears that in these preliminary studies leafy cane trash added significant colorant to cane juice while heavy textured soil, i.e., silty clay loam, helped to decolorize cane juice.

INTRODUCTION

Field trash is defined as leaves, tops, dead stalks, roots, soil, etc. delivered together with cane (3). Legendre (6) noted that field trash has increased as a result of mechanical harvesting. Prior to 1943 in Louisiana, the average trash in hand-cut, hand-stripped, and hand-loaded cane was less than 1.9% (6). However, since 1943, field trash levels have increased to over 10% in cane cut and loaded by mechanical means. The same trend has also occurred in Florida.

In studies in South Africa (2), it was reported that with each 1% addition of tops to clean cane the color of clear juice was increased by 1.3% while with each 1% addition of mud to clean cane the color of clear juice was increased by 3.6%. Subsequent studies by Purchase, et al. (9) in South Africa showed that trash contributed substantial color and turbidity to juice. He found that trash appeared to contribute more color than tops alone but when results were normalized there was a linear relationship between color in juice and extraneous material. The composition of the trash was not specifically defined in this work, but based on the nature of the experiments, it probably did not contain field soil or mud. In Australia, Ivin and Doyle (5) defined trash as incorporating the remains of leaves attached to the cane stalk but not including field soil. Further, tops were defined as that portion of the cane stalk above the break point approximately 10 inches in length, minus the top leaves normally cut and blown clear by the cut-chop (combine) harvester. They found that juice color increased an average of 25% with the addition of 6% trash (i.e., a 4.2% color increase for every 1% trash). They also noted a 12% increase in juice color by the addition of 6% green tops (i.e., a 2% increase for every 1% tops); however, the increases in juice color were highly dependent on the cultivar of cane as well, with tops contributing as little as 2% color in one cultivar and as high as 29% color in another. The range for trash effects alone on color by cultivar was from as low as 9.8% to as high as 47.6%

Studies designed to measure relative changes in juice quality are conducted on a continuing basis at the Sugarcane Research Unit, Houma, Louisiana on first-ratoon cane. During routine sediment tests on cane juice, a wide range in cane juice color was noted; color did not always correlate positively to the sediment load in the juice. A series of experiments was set up to quantify the effect on cane juice color of various concentrations of leafy cane trash alone, mud alone, and a combination of leafy cane trash and mud.

MATERIALS AND METHODS

In the present study, leafy cane trash was defined as trash with approximately 60% desiccated and 40% green leaves. The type of field soil (mud) added was Mhoon silty clay loam (Fine-silty, mixed, nonacid, thermic, Typic, Fluvaquents) with approximately 33% moisture. To clean sugarcane stalks of the cultivar, CP 70-321, varying amounts of leafy cane trash and mud (0,10,20, and 30%, alone and in combination, by weight of cane) were added. Approximately 100 hand-stripped stalks of sugarcane were shredded through a pre-breaker. To weighed quantities of the clean, chopped cane, the stated proportion of leafy cane trash or mud or the combination of leafy cane trash and mud was added and the mixture homogenized by passing it once again through the pre-breaker. A 2.2 lb subsample was pressed for 2 minutes, 15 seconds in a 3-basket hydraulic press at 2,500 lb/in^2. Each treatment was replicated six times. Fifteen ml of expressed juice from each subsample was centrifuged for 10 minutes at 3,000 RPM according to the sediment test described by Birkett (I). The supernatant was analyzed for color at 420 nm, which is the standard wavelength for ICUMS A color determination (3), and at 560 nm. Samples were filtered on 0.45m membrane for the determination. A high color reading at 560 nm relative to 420 nm is said to be a measure of the relative amount of very high molecular weight (MW) colorant (7). There was insufficient juice sample to adjust pH to 7.0, so all color measurements were taken at "natural pH". It is possible that leafy trash and/or mud can change pH of juice samples with lower pH, lower color and higher pH, higher color.

RESULTS AND DISCUSSION

Figure 1 shows, in bar graph form, the effect of leafy cane trash, mud, and the combination leafy cane trash/mud mixture on the color of cane juice. Figure 2 shows the effect on color when the data are normalized by the treatments. The mean data for all treatments are shown in Table 1. The deleterious effect of leafy cane trash on juice color was confirmed, with more than a 6-fold increase in color over the treatment range studied. There was a 13% increase in juice color for every 1 % leafy cane trash added, up to the 10% level, which is within the range of the Australian experience (5). Mud alone showed a decolorizing effect, due, undoubtedly, to the ion exchange properties of the soil type. The effect of mud was linear with an approximately 1.6% decrease in color per 1% of added mud up to the 30% level. This was contrary to the results found in South Africa where mud also increased the color of juice (2). The results for the combination effects of leafy cane trash and mud mixture reflect the opposing effects of the two components. Color increased from the control but not as much as with leafy cane trash alone because of the decolorizing effect of the mud. The effect, however, was not linear with the rate of color increase going down as the proportion of total trash increased. There was an 11.5% increase in juice color for every 1% combine trash added, up to the 10% level.

Further, there was a trend toward higher MW colorant in juice with leafy trash and lower in juice with mud (data not shown). Also, the mud component, undoubtedly, removed high MW colorant in the leafy trash/mud combination. In this preliminary study, it appears that leafy trash not only increases overall color but also increases the load of high MW colorant.

These results show that the components of trash can have different effects on cane juice color, and it is important to define the composition of the trash. Further, only one cane cultivar was studied, CP 70-321, a cultivar with low cane juice color and low phenolics, known color precursors (4, 8). Further, the Mhoon soil series with its high level of clay has ion exchange properties enabling it to remove color from the juice. Therefore, the soil type is obviously another important factor in determining the effect of trash under field conditions.

However, the harmful effects of mud, such as, contributing to sugar losses in bagasse and filter press mud, increased turbidity and ash, wear and tear to equipment, lowered fuel value of bagasse, etc., would still dictate care in delivering clean, fresh cane to the factory for processing.

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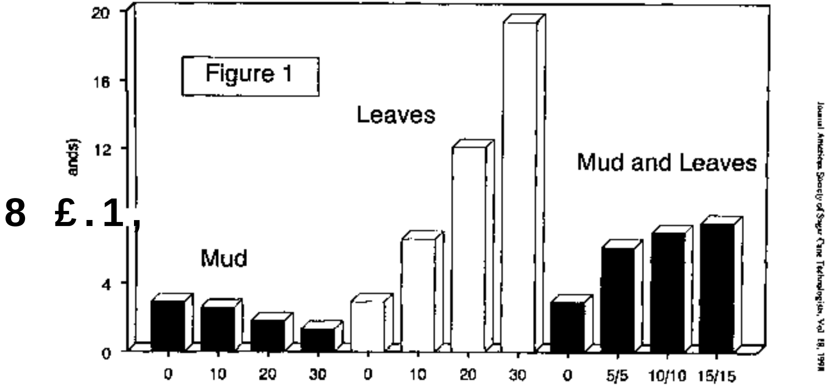
Table 1. Average values for color of centrifuged cane juice determined at 420 nm in the presence of various admixtures of leafy trash and mud (cultivar CP 70-321).

Percentage added	Mud	Leaves	Mud + Leaves
0	2,910	2,910	2,910
5 + 5	-------	------	6,208
10	2,554	6,665	------
10+10	------	-----	7,084
20	1,799	12,148	-------
15 + 15	------	-----	7,645
30	1,315	19,432	-----

Cane Juice Color

Effect of Extraneous Material



Percent of mud and leaves in juice

Figure 1. Effect of leafy cane trash, mud, and the combination of leafy cane trash/mud mixture on the color of centrifuged cane juice determined at 420 nm for the sugarcane cultivar CP 70-321.

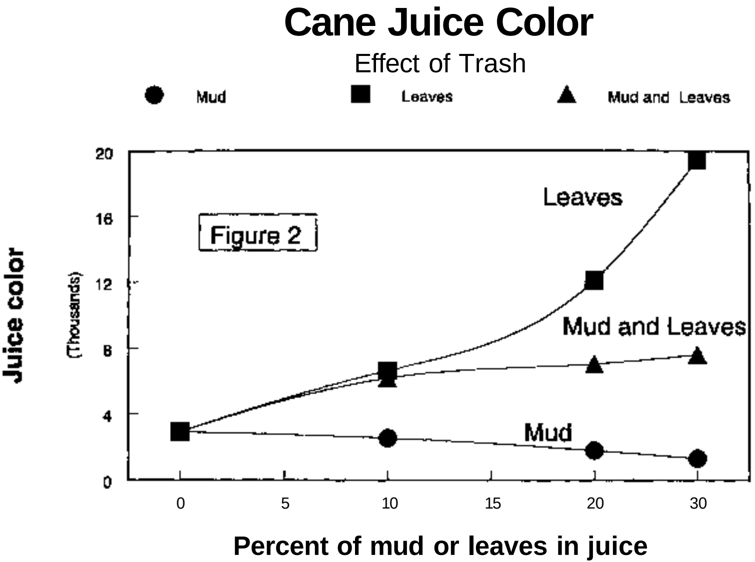


Figure 2. Effect of leafy cane trash, mud, and the combination of leafy cane trash/mud mixture on the color of centrifuged cane juice determined at 420 nm for the sugarcane cultivar CP 70-321 when the data are normalized by the treatments.

Journal American Society of Sugar Cane Technologists, Vol. 18, 1998

AGRICULTURE ABSTRACTS

WIDESPREAD OCCURRENCE OF YELLOW LEAF SYNDROME IN SUGARCANE CLONES AT CANAL POINT, FLORIDA

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Sugarcane commercial cultivars and parental clones used in the Florida, Louisiana and Texas crossing programs at Canal Point were assayed for the presence of yellow leaf syndrome (YLS). The CP 95 Series clones that had been advanced to the Stage III were also assayed. The sugarcane yellow leaf virus was detected by a polymerase chain reaction (PCR) assay using YLS primers developed by M. S. Irey (US Sugar Corp.) and ELISA using antisera developed by B. E. Lockhart (Univ. of Minnesota). Of the 46 CP parental and/or commercial clones used in Florida only six (CP 57-603, CP 82-1592, CP 89-1509, CP 92-1167, CP 92-1647, and CP 92-1684) were negative in both assays. Of the 71 parental clones used in the Louisiana and Texas breeding programs only four (CP 57-614, CP 92-624, HoCP 93-741, and TCP 91-3543) were negative in both the assays. Of the 136 CP-95 Series clones plus check cultivars in Stage II, 47.8% were positive using the PCR assay. The high incidence of YLS in the CP clones indicates resistance is either lacking or at a low level. The lower incidence in the CP-95 Series clones may reflect a lack of opportunity of infection since the plants had been derived from true seed only two years previously. Although plants with the YLS symptoms usually assayed positive for sugarcane yellow leaf virus, a high number of plants that assayed positive for the virus had no symptoms of YLS. High Brix readings of juice expressed from the midrib were associated with these symptomatic plants. The 46 CP parental clones in Florida program that were assayed had been planted with heat treated seedcane (50 °C for 2 hours). This indicates that either the treatment was ineffective or that infection is very quick. Although YLS is widespread, yield losses in Florida have not been quantified. There probably is tolerance to the virus.

POLYMERASE CHAIN REACTION (PCR) PROTOCOLS FOR DETECTING THE BACTERIA THAT CAUSE LEAF SCALD AND RATOON STUNTING DISEASES OF SUGARCANE

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Two pairs of polymerase chain reaction (PCR) primers were developed that primed specific amplification of the 16S and 23S ribosomal intergenic transcribed spacer region from *Xanthomonas albilineans* and *Clavibacter xyli* subsp. *xyli*, the causal agents of sugarcane leaf scald and ratoon stunting disease, respectively. A PCR protocol using primers PGBLl and PGBL2 amplified a specific 288 bp DNA product from all *X. albilineans* strains collected worldwide including representatives of serovars I, II, and III. No amplification was observed from sugarcane bacterial saprophytes, *C. xyli* subsp. *xyli*, or other related *Xanthomonas* species tested. Results were obtained in less than two hours. Another PCR protocol with primers Cxxl and Cxx2 amplified a specific 438 bp DNA product from the genomic DNA of 21 C. *xyli* subsp. *xyli* strains collected worldwide. No amplification of DNA from sugarcane bacterial saprophytes, *X. albilineans,* or other closely related *Clavibacter* species was observed. DNA products can be amplified directly from cultured *X. albilineans* and C. *xyli* subsp. *xyli* cells without prior extraction of the genomic DNA. These two pathogen-specific PCR protocols can be used as diagnostic tools for identification and early detection of the two important sugarcane diseases.

MULTIPLEX POLYMERASE CHAIN REACTION (PCR) FOR DIAGNOSIS OF LEAF SCALD AND RATOON STUNTING DISEASES

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Cloned DNA's from the region between the 16S rRNA and 23S rRNA genes *of Clavibacter xyli* subsp. *xyli,* the causal bacterium of ratoon stunting disease of sugarcane, and from the albicidin gene complex of *Xanthomonas albilinians,* the causal bacterium of leaf scald disease of sugarcane, were sequenced, and the sequences used to design PCR primers for detection of the two pathogens. Different combinations of paired primers were examined for detection of both pathogens in single multiplex reactions. When purified total DNA of each pathogen were tested, a minimum of 25 pg or less of DNA was detected with most primer pairs; however, detection limits in multiplex PCR were adversely affected when DNA of the two pathogens were present in disproportionate amounts. Some primers or combinations of primers produced unexpected amplification products in multiplex PCR.

The relative sensitivity of detection for primer pairs varied for detection of the pathogens in sugarcane extracts, apparently because plant DNA or PCR inhibitors in the extracts had a differential effect on PCR with different primers. Some combinations of primers also produced PCR products when bacterial contaminants isolated from sugarcane were tested. PCR detection of the pathogens, in both single and multiplex reactions, was improved by careful selection of PCR primers and reaction parameters.

IMPACT OF NEMATODES ON SUGARCANE IN LOUISIANA

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Plant and ratoon sugarcane crops were surveyed at 12 locations in Iberville, Ascension, West Baton Rouge, and St. James parishes. Phytoparasitic nematode populations were found to be progressively higher in each successive crop cycle year. Species of *Tylenchorhynchus, Criconemella, Paratrichodorus, Pratylenchus*, and *Helicotylenchus* were found with the greatest frequency.

Two greenhouse trials evaluated nematode pathogenicity and reproduction on five sugarcane cultivars. Plants from single-node cuttings of CP 65-357, CP 70-321, LCP 82-89, HoCP 85-845, and LCP 86-454 were transplanted into 20.3-cm-diameter clay pots containing 4 kg of methyl bromide-treated soil. The soil was infested with 0, 1,000 or 4,000 nematodes (a mixture of stunt, stubby-root, and ring nematodes) per pot. All five cultivars were damaged by the nematodes. Plant height was reduced ($P<0.05$) at the high infestation level. Additionally, top and root dry weights were reduced by both high and low nematode levels. Each cultivar supported approximately 50,000 nematodes per pot for each infestation level and cultivar after 4 months.

Microplot experiments were conducted with CP 70-321 and LCP 82-89 in 45.7-cm-diameter pots containing 35 kg of methyl bromide-treated field soil. Three nematode infestation levels (0, 1,200, and 12,000 nematodes per microplot) were employed. For both tests, the inoculum consisted of approximately 35% stubby-root, 35% stunt, and 30% ring nematodes. In 1995, reductions in shoot and root weights were observed for LCP 82-89. Both LCP 82-89 and CP 70-321 supported high nematode populations. In 1996, nematode reproduction was greater on CP 70-321, and there was a reduction in root weight. LCP 82-89 also supported higher nematode reproduction than in 1995; however, growth reductions were not observed.

Nematicide trials were established in Ascension and St. James parishes. Temik 15 G, Mocap 10 G, and Thimet 15 G were applied at the recommend rate at planting. At the St. James location, millable stalks per acre were increased by all three chemical treatments. Cane tonnage was increased only where Temik had been applied, but sugar per acre was increased by Mocap and Temik. At the Ascension site, yield responses were observed in the Temik and Thimet treatments as increases in millable stalks per acre. For both sites, a nematode response to the chemical treatments was not detected.

MORTALITY INDUCED BY *BACILLUS POPILLIAE* IN *CYCLOCEPHALA PARALLELA* (COLEOPTERA: SCARABAEIDAE) HELD UNDER SIMULATED FIELD TEMPERATURES

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The bacterium, *Bacillus popilliae* Dutky, causes milky disease in numerous species of scarabs around the world. *Bacillus popilliae* induced mortality in naturally infected grubs (third instars) of *Cyclocephalaparallela* Casey was measured when held under simulated field temperatures. Our data show that visual examination in the field underestimates the percentage of grubs actually infected by *B. popilliae*. 5.6 to 8.2 times as many milky disease infected grubs died during the first 60 days of incubation under simulated field temperatures than did uninfected grubs. These data show that the widely used prevalence value underestimates the total mortality which this bacterium ultimately causes to *C. parallela.*

SEASONAL ACTIVITY OF ADULT LESSER CORNSTALK BORERS *(ELASMOPALPUS LIGNOSELLUS)* AND SUGARCANE BORERS *(DIATRAEA SACCHARALIS)* BASED ON PHEROMONE TRAPPING IN FLORIDA

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Pheromones have proven to be useful management tools for some insect pests. The number of insects collected at traps baited with a pheromone can be used to obtain information on the seasonal dynamics of a pest, to identify areas where a pest is abundant, and to properly time management tactics. Some success has been achieved in managing certain insect species by applying pheromones to disrupt mating. Relatively little has been published on using pheromones in management programs for sugarcane insects in the United States. Research in Florida was conducted to obtain information on using pheromones to monitor two sugarcane pests, the lesser cornstalk borer and the sugarcane borer. Local populations of the lesser cornstalk borer were attracted to traps baited with a synthetic sex pheromone during 1992-1993. Males of this insect were abundant at traps run during the winter and spring, but almost none were collected during late August through late October. The synthetic pheromone should be useful for predicting when lesser cornstalk borer infestations first develop in cane during the fall or winter. Traps baited with virgin female sugarcane borers (no synthetic sex pheromone was available) were used to monitor populations of adult male sugarcane borers during 1996-1997. Relatively large numbers of males (e.g., more than 20) were sometimes collected at the traps. In contrast to males of the lesser cornstalk borer, males of the sugarcane borer were collected throughout the year. No distinct generations of the sugarcane borer were apparent based on the trapping data. The data indicated a synthetic pheromone might be useful in a management program for the cane borer.

PRECISION FARMING APPLICATIONS FOR SUGARCANE IN SOUTH FLORIDA

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A relatively new development in agriculture, known as Precision Farming, is being evaluated for sugarcane in south Florida. It utilizes the Global Positioning System (GPS) to manage crop inputs on a scale as precise as one acre. Recent innovations which make Precision Farming possible are the development of Differential GPS (DGPS), affordable yet fieldworthy microcomputers, and software to link the sample results with their corresponding location and vary the rate of crop inputs such as fertilizer for these sites. Significant acreages cropped in sugarcane in south Florida have already been mapped using DGPS and large variations in a number of soil parameters have been discovered. Contour maps of soil organic matter, pH, available soil silicon and many nutrient elements have been produced by grid sampling of both sand and muck fields. In addition to field mapping of soil test results, a large, self- propelled spinner-type spreader has been equipped with DGPS, rate controller, and on-board computer to apply materials at variable rates based on site-specific soil test results. Since October of 1996, dry fertilizer, calcium silicate slag, and lime have been applied to sugarcane fields using this equipment.

EFFECT OF COMPOSTED MUNICIPAL WASTE AND SUGARMILL WASTE ON SUGARCANE YIELDS AND NITROGEN FERTILIZER REQUIREMENTS

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Municipalities and sugarmills face a growing problem of disposing of their solid wastes. A possible solution to this problem is to use these wastes in agricultural production. Consequently, a sugarcane *Saccharum* interspecific hybrids nitrogen by waste product study (2x6) was initiated in September of 1992. The experiment consisted of twelve treatments that had two rates of nitrogen (0 vs. the recommended N rate) in combination with six compost and waste treatments. Where no nitrogen was used, filter press mud (38.1 t/ha), liquid fish (224 L/ha), and compost (89.7 t/ha), all increased ($P<0.10$) cane tonnage (12.1,11.2, and 23.1 t/ha) and sugar yield (1490, 1270, and 2540 kg/ha). Where the recommended rate of nitrogen fertilizer was used, only bagasse (33.6 t/ha) and sewage (8.1 t/ha), and compost (89.7 t/ha) increased both cane tonnage (7.4 and 9.2 t/ha) and sugar yield (720 and 1080 kg/ha).

VARIABILITY OF LEAF PHOSPHORUS AMONG SUGARCANE GENOTYPES GROWN ON EVERGLADES HISTOSOLS

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The phosphorus content of drainage water of the Everglades Agricultural Area (EAA) of Florida must be reduced by at least 25% from a baseline mean calculated using 1978 through 1988 data. This minimum P reduction is one of several measures to sustain much of the unique habitat of remaining natural regions of the Everglades. The objectives of this study were to evaluate variability in leaf tissue P concentration among elite sugarcane (interspecific hybrids *ofSaccharum* spp.) clones and to recommend sampling strategies to detect differences among clones. Leaf samples were collected four times per annual crop in the plant-cane and first-ratoon crops from three fields, representing low, medium, and high available soil P. Leaf P of sugarcane should be tested at several locations in at least two crop years, and at least once, but preferably twice per crop. The clone with the most leaf P had 0.65 g P kg"[1] leaf tissue more than the clone with the least. This difference among leaves allowed us to speculate that P removal may differ by about 8.5 kg ha"[1] among commercial cultivars and that genetic improvement of this trait could be feasible. If further studies show that differences in leaf P concentration can reliably predict differences in total P removal from a sugarcane field, then classification of cultivars for leaf P concentration could make available to EAA sugarcane fanners another best management practice (BMP) to reduce P content of their drainage waters.

MECHANICAL PLANTING OF WHOLESTALK SUGARCANE IN LOUISIANA

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Renewed interest in mechanical planters prompted by increased farm size and the need for efficiency of time and labor has brought about changes in planter design. The performance of eight mechanical planters were compared to hand planting at two locations during 1993 by measuring the amount of seedcane used, distribution of stalks in the planting furrow and seed-piece damage. Gaps (unplanted space of at least three feet) were measured each spring and yield data were collected during the plant cane and first stubble crops. Comparisons to earlier tests indicate that mechanical planter improvements have reduced the amount of seedcane used and seed-piece damage, but the consistency of the seeding rate is not well enough advanced to reduce planting rates to that of hand planting. In these two tests, a machine planted rate equal to the hand planted rate produced the fewest piles but the most gaps and the lowest yields. Every 1 % of rowfeet with gaps of three feet or more resulted in a .14 to .22 ton loss in cane yield.

Journal American Society of Sugar Cane Technologists, Vol. 18, 1998

SOYBEANS IN ROTATION WITH SUGARCANE

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Three experimental sites, differing in soil organic matter content and soil texture, were used to evaluate the influence of fallow-period soybean, *Glycine max* L., occupation on sugarcane, *Saccharum spp.*, yield. Fallow-period treatments were a conventional fallow, green manure soybeans and cash crop soybeans. Plant cane N application rates were 0 to 134 kg/ha. All ratoon crops received recommended N fertilizer rates. Sugar yields for all crops of the three cycles were not influenced by the presence of the legume crops during the fallow period. Combined experiment averages were 7,394, 7,270, 7,087, 7,186, 7,183 and 7,461 kg sugar/ha, respectively, for unfertilized cane after fallow, fertilized cane after fallow, unfertilized cane after green manure soybeans, fertilized cane after green manure soybeans, unfertilized cane after cash soybeans and fertilized cane after cash soybeans. The unremarkable differences (P=.12) in sugar yield among treatment averages implies an insensitivity of sugarcane to departure from conventional fallow activities. Differences among the treatments did occur for soil nitrate and plant nitrogen content, but they were relatively modest and did not affect sugar yield. The failure of sugarcane to respond favorably to the additional soil nitrogen contained in soybeans (green manure and cash crop residue) and commercial nitrogen fertilizer forcefully suggests nitrogen was not limiting for growth and development following the fallow period at any of the three sites. If growers do not have to compromise on weed control or seedbed preparation for fall planting, then the costs of the soybean crop should substitute for standard fallow activity and seedbed preparation costs.

GREEN CANE TRASH BLANKET EFFECTS ON WEED AND SUGARCANE DEVELOPMENT IN LOUISIANA

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The ability to effectively harvest high tonnage, lodged cane without burning is the primary impetus for the increase in combine harvester usage in Louisiana. With the combine, leafy trash removed from the stalks is evenly blanketed over the field. Field studies were conducted in second-ratoon fields of CP 70-321 sugarcane in 1994 and 1995 to determine the effects of this green cane trash blanket (GCTB) on weed and cane development.

When removed within 10 days of 1993 and 1994 harvests, the dry weight of the GCTB from the first-ratoon crops averaged 6430 kg/ha and formed a blanket that was approximately 10 cm thick. Cool-season weed infestations in the spring of the second-ratoon crops were at least 62% lower when the GCTB was allowed to remain. The morningglory species comprised the bulk of the warm-season weeds that developed in 1994; warm-season weed development was not observed in 1995. As a complex, the morningglory infestation was 79% lower in 1994 where the GCTB was allowed to remain on the soil surface than where the GCTB was removed the previous fall. The GCTB also suppressed sugarcane shoot development both years. As an average of the two years, sugarcane shoot numbers in March were 29% lower where the GCTB was not removed. As the growing season progressed into August each year, differences in shoot numbers between the + GCTB treatments decreased. Sugarcane shoot heights were also reduced where the GCTB was allowed to remain but not as dramatically as shoot numbers. Failure to remove the GCTB resulted in a 5 to 6% reduction in gross cane and sugar yields, respectively.

The effects of various removal dates and methods were investigated during the 1996 growing season in a first-ratoon field of CP 70-321. In this study, the GCTB was removed from the row tops on Feb. 27, Mar. 19, and Apr. 4 either mechanically with a revolving disk shaver set to remove the GCTB, emerged shoots, and approximately 1 cm of soil or by hand with a rake that removed the GCTB with minimal disturbance to the emerged shoots. The dry weight of cane residue removed on each date was similar and averaged 7540 kg/ha. Differences in sugarcane shoot numbers and heights for the three removal dates were not detected because of severe freezes on February 3 (-7 C) and March 9 (-2 C). However, it was noted that billets on the soil surface that were covered with the GCTB still had viable buds after the Feb. 3 freeze while buds were killed on billets that were not covered. Gross cane and sugar yields were at least 5% higher where the GCTB was removed either by shaving or raking as an average of all removal dates.

Results suggest that GCTBs can have a beneficial influence on the sugarcane crop by reducing grower dependency on herbicides and by providing some freeze protection to stubble-buds. However, failure to remove the GCTB in the early spring may result in a reduction of cane and sugar yields, at least for CP 70-321 sugarcane grown in Louisiana.

SPRAY DROPLET SIZE OF HERBICIDES AND HERBICIDE/ADJUVANT COMBINATIONS

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In Louisiana off target movement of the herbicide 2,4-D has been well documented especially in cotton producing areas. In 1996, numerous drift complaints were reported for Roundup Ultra. Many factors can be attributed to off target movement of agricultural chemicals and spray droplet size can play an important role. Previous research has shown that droplets less than 105 microns are more susceptible to drift. Studies were conducted to determine droplet sizes of selected postemergence herbicides and herbicide/adjuvant combinations using a Malvern 2600 Laser Particle Analyzer. Herbicide treatments were mixed assuming 15 gallons per acre spray volume and applied at pressures of 30,40, and 50 psi. Data were expressed as a percent of total spray droplets less than 100 microns.

Roundup Ultra and Roundup (1.5 qts/A), and Roundup D-Pak (30 oz/A) were evaluated alone or in combination with various adjuvants. For individual treatments, in most cases percent of total spray droplet less than 100 microns increased as pressure increased. At all spray pressures, percent of total spray droplets less than 100 microns was equivalent for Roundup Ultra and Roundup plus the nonionic surfactant Induce (0.50% v/v). However, percent of total spray droplets less than 100 microns for Roundup Ultra was at least twice that of Roundup D-Pak plus Induce (1.0% v/v). In contrast, addition of the silicone adjuvant Kinetic HV (0.25% v/v) to Roundup D-Pak almost doubled the percent of small droplets compared with Roundup Ultra.

Graminicides including Assure II, Poast Plus, Select, Fusilade, Fusilade 2000, Fusilade DX, and Fusion at currently recommended rates were also evaluated. Percent of total spray droplets less than 100 microns increased in most cases as pressure increased. At each spray pressure percent of total spray droplets less than 100 microns was equivalent for the graminicides.

Phenoxy herbicides Hi-Dep, Weedar 64, and Weedone LV4 were evaluated at a rate of 3 pts/A. For Hi-Dep and Weedar 64, percent of total spray droplets less than 100 microns was equivalent when applied at 40 or 50 psi. For all pressures, percent of spray droplets less than 100 microns for Hi-Dep and Weedar 64 was at least 3.3 times that for Weedone LV4. Percent of total spray droplets less than 100 microns for the combination of Roundup Ultra and Weedone LV4 was at least half that of Roundup Ultra applied alone.

BERMUDAGRASS CONTROL IN SUGARCANE WITH ROUNDUP AND A HOODED SPRAYER

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Bermudagrass is becoming more prevalent in Louisiana sugarcane fields and currently labeled herbicides used within the crop do not provide adequate control. Roundup and Roundup Ultra applied with a hooded sprayer in April or October were evaluated for bermudagrass control. In one study, CP 65-357 sugarcane was planted in December 1993 and the field was not worked prior to Roundup application on April 26 of the following year. Bermudagrass covered 30 to 70% of the row tops and sides when Roundup plus Induce nonionic surfactant was applied. Hoods were 48 inches wide and covered the row middles leaving a nontreated area approximately 24 inches wide on the row top. Even though wind speed was 7 to 10 mph during Roundup application, no significant sugarcane injury was observed. At 10 days after treatment (DAT), bermudagrass control within the treated area ranged from 84 to 93%. Roundup at 3.5 and 4 quarts/A provided greater control of bermudagrass than 2.5 quarts/A. On July 18, bermudagrass ground cover on the row tops was 90% for the nontreated check, but no more than 32% for the Roundup treatments. Even so, sugarcane stalk population and height in August, and sugarcane and sugar yields were equivalent whether or not Roundup was applied.

In 1995, Roundup plus Induce was applied with a hooded sprayer on October 20 to CP 70-321 sugarcane harvested for seed. Bermudagrass ground cover was approximately 85% and sugarcane regrowth was present at application. Bermudagrass control within the treated area 43 DAT was 68, 80, and 91% for 1, 2, and 3 qts/A, respectively. On May 17 of the following year, bermudagrass coverage of the row top was 28, 24, and 11% for Roundup at 1, 2, and 3 qts/A, respectively, compared with 71% for the nontreated check. Because of the poor sugarcane stand the stubble was destroyed.

In 1996, two experiments were conducted. Roundup Ultra was applied at 2 qt/A on October 15 to CP 70-321 sugarcane planted 8 weeks earlier. Bermudagrass ground cover was variable and approximately 25% in experiment 1 and 40% in experiment 2. Sugarcane was 12 to 15 inches tall with 3 to 5 leaves and wind speed was 7 to 10 mph at application time. Bermudagrass control was compared using a standard hood and one equipped with a Weedseeker™ Model 600 system (Patchen California, Inc.), which consisted of four plant sensors with internal light sources and solenoid/nozzle assemblies. The unique differences in the spectral characteristics of light reflected from green plant material and bare soil can be detected by the sensors allowing herbicide to be applied only when weeds are present. Both hoods were attached to the same tool bar to allow for side-by-side comparisons. Use of the sensor-equipped hood resulted in 29 to 68%

savings (experiment 1) and 5 to 27% savings (experiment 2) in Roundup volume sprayed compared with the standard hood that sprayed continuously. Bermudagrass control on the row tops and in the middles 24 DAT was excellent (98 to 100%) where both the standard and sensor-equipped hoods were used. Ability of sensors to detect weed presence and activate and deactivate solenoids that controlled spray delivery was particularly impressive since ground speed was 5 mph. A slight reduction (5-10%) in sugarcane plant height was observed 24 DAT. On March 21 of the following year, bermudagrass ground cover was no more than 3% in either experiment where Roundup was applied compared with 25% (experiment 1) and 61% (experiment 2) for the nontreated checks. No visual differences in sugarcane height or shoot population were observed between the treated and nontreated plots.

Results indicate that Roundup application with a hooded sprayer can be an effective bermudagrass management tool. Use of a sensor-equipped hooded sprayer significantly reduced herbicide cost without sacrificing bermudagrass control. When Roundup was applied in October the rate required for bermudagrass control was less than when applied in April. Research is underway to determine the effect of fall applications of Roundup on bermudagrass infestation in ratoon crops.

AZAFENIDIN: A NEW BROAD-SPECTRUM HERBICIDE FOR SUGARCANE

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Azafenidin has been under investigation as a possible preemergence herbicide for the control of annual grasses, broadleafs, and sedges in citrus, sugarcane and grapes. In Louisiana, it has been evaluated under the code name DPX-R6447 as an at-planting, preemergence application in the fall and as a postemergence to the crop but preemergence to seedling weeds application in the spring in plant-cane crops of sugarcane in both sandy and clay soils at rates of 0.56 to 1.12 kg ai/ha. To date, azafenidin applied at planting at rates of 0.56 to 1.12 kg ai/ha has provided good to excellent control of a number of cool-season weeds including: ryegrass, Carolina geranium, purslane, henbit, and sowthistle. March applications of azafenidin at similar rates has controlled many warm-season seedling weeds including: johnsongrass, junglerice, itchgrass, and a number of morningglory species. Acceptable (>60%) levels of purple and yellow nutsedge control have also been observed with at-planting and March applications of azafenidin, particularly at the higher rates.

Sugarcane injury following at-planting applications of azafenidin at rates up to 1.12 kg/ha was minimal 4 weeks after treatment averaging 10% or less. When azafenidin was applied postemergence to the crop in the spring some crop injury in the form of a reddening of the treated leaves was observed within 7 days of treatment. The injury was generally transient in nature and rate-dependent and was not evident as a reduction in harvestable sugarcane stalk counts, heights,or weights or as a reduction in gross cane and sugar yields when compared to standard applications of metribuzin at 2.0 kg ai/ha, terbacil at 1.6 kg ai/ha, and mixtures of pendimethalin with atrazine each at 3.0 kg ai/ha.

Azafenidin offers several advantages over currently used preemergence herbicides. It controls ryegrass and itchgrass better than at-planting and spring applications of terbacil and metribuzin and is less affected than pendimethalin by environmental extremes. Its posternergence activity on seedling weeds may be less than that observed with terbacil and metribuzin, however.

To insure control of weeds that may be emerged at the time of application, particularly when applications are made in the spring, azafenidin may have to be partnered with other herbicides.

NEGATIVE RELATIONSHIP BETWEEN SUCROSE AND TONNAGE IN SUGARCANE: IMPLICATIONS FOR A BREEDING PROGRAM

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Plant breeders select an array of traits or characters to develop a cultivar. In sugarcane, total sugar per hectare (determined by total tonnage and sucrose concentration) is of primary concern. Their contribution to total sugar have different effects, and increasing one could be at the expense of the other. The objectives of this paper were to illustrate how, through the use of an economic index, clones that are somewhat ambiguous in merit can be selected amongst, and how the relationship between sucrose and tonnage can differ when viewed from an economic rather than a biological perspective. Data from 20 years of selection of Stage IV in the Canal Point breeding program were analyzed. The 164 clones and three crops provided 492 observations. Correlation and regression analyses were conducted. The economic index proved extremely useful in balancing the yield variables. The correlation between sucrose and tonnage variables did not show a consistent negative relationship. A different perspective was obtained when the two variables were plotted using the rankings from the economic index, allowing the evaluation of biological variables for how they contribute to the economics of the crop.

INTRAROW PLANT SPACING AND FAMILY BY ENVIRONMENT INTERACTION EFFECTS ON SUGARCANE CROSS EVALUATION

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Cross evaluation via progeny testing is used to select the best crosses (families) prior to individual plant selection, and to guide hybridizing and seedling planting decisions by personnel in the Louisiana Sugarcane Variety Development Program. Research to optimize the progeny testing methodology examined the relative importance of cross, within cross, years, locations, replication and intrarow plant spacing on the effectiveness of the testing procedure. Variances component analysis indicated that cross by environment (locations, years) interaction is only a minor inhibitor of selection effectiveness. Within-field variance is the largest source of variation for the five traits considered (plant weight, stalk number per plant, stalk weight, stalk diameter and stalk length). For stalk weight, length and diameter, the slim majority of this within-field variance is due to genetic within family plant-to-plant variation. Partitioning of plant-to-plant variation for plant weight and stalks per plant was not possible. Cross by spacing interaction was not important as evidenced by the genetic correlations of family means of the same trait at different spacings and cross by spacing interaction variance component magnitude. These genetic correlations were

essentially unity. Estimates of direct and correlated response to selection showed that wider spaced family (81 cm between plants) results was more effective than narrowly spaced testing (41 cm between plants) and selection. Since cross by environment variances were minor compared to other sources of variation, testing scenario effectiveness was mostly a function of plant number and spacing. Replication across environments only marginally improved selection effectiveness. Predicted gain for almost all traits demonstrated from 20 to 31 % increase in selection effectiveness by using widely spaced plants. The only exception was stalk diameter which showed between 2 and 4% increase. Results from this study strongly suggest that selection using widely spaced plants would be more accurate than narrowly spaced plants.

BREEDING STUDIES OF THE DWARF, MULTIPLE BUD, AND RED LEAF MUTANTS OF SUGARCANE

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Mutants are the foundation of genetic variation without which the identification, isolation, and analysis of genes would be impossible. There are no registered mutants of sugarcane, which further hinders genetic analysis of this high-level, complex polyploid. Our laboratory has a collection of plants with stable mutant phenotypes, i.e., dwarf, multiple bud, and red leaf. We are evaluating the morphology and inheritance of mutant characteristics with the objective of registering the mutants as genetic stocks. Two dwarf clones were developed from callus culture of the sugarcane variety LCP 83-137. Dwarfs were unresponsive to exogenous application of gibberellic acid (GA_3). Flowering of this mutant has not been previously reported. Dwarf was male sterile and female fertility was low. Segregation analysis of two crosses (70 progeny) in which dwarf was the female parent showed that the trait was qualitatively transmitted at a ratio of about 1 dwarf: 2 normal. Compared to LCP 83-137, the dwarf stature appeared to be caused by reduced internode length. As expected, agronomic performance of dwarf tended to be inferior to either LCP 83-137 or its normal sibs. Multiple bud could reduce seed cane requirements, thus it is a trait with potential agronomic value. However, its rarity in the population suggests that the trait has little selective advantage. Field studies of seven multiple bud clones of diverse parentage showed that multiple bud mutants were generally comparable to checks in millable stalks per stool. Two mutants (MB 84-3065 and US 93-14) equaled the checks in TRS, and three (MB 84-3065, US93-13, and US 94-12) equaled the checks in shoot and stalk numbers. We evaluated 1800 progeny from 19 crosses in which one parent was multiple bud. Multiple bud was transmitted at low frequency - only 40 progeny (2%) expressed the trait. A previous report by Irvine et al. (1991) indicated that multiple bud is expressed only intermittently. Thus, transfer of the multiple bud trait to a sugarcane cultivar would be difficult. Red leaf mutants were progeny of CP 55-30 RL, an extinct, red-leaved variant of the cultivar CP 55-30. Segregation analysis of seven crosses having a red-leaved parent (813 progeny) were in the ratio of 1 strong red leaf: 1 weak red leaf: 2 green progeny. Red leaf progeny had decreased stalk weight, length, and diameter compared to green progeny. The mutants may be useful as morphological and molecular markers in genetic studies of sugarcane.

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MANUFACTURING ABSTRACTS

FAST-TRACK TO MILLING CONTROL

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The commitment of the milling train is to exact as much pol as economically possible from sugar cane. It does so through mechanical operations, i.e., shredding, crushing, and leaching, grouped under the generic term "milling." Managing an efficient train implies a different viewpoint from normal day-to-day operation's. Unfortunately, operational challenges seem more urgent than performing efficiently; most plant personnel attend to the important job of running a dependable train, while they might need help seeing the challenge from the viewpoint of recovering sugar, reducing bagasse losses.

The efficiency of the milling process is measured as "Pol Extraction," or the proportion of pol extracted percent on pol in cane. Determination of Pol Extraction requires both analyses and calculation, as well as sampling of juice and bagasse. Samples are taken on a certain schedule, and some of them may be composed for several hours. Analyses of the composite samples are performed, again on a schedule, and at the end of the day Extraction is calculated and reported. Thus, the mill engineer gets his feedback from the Lab with a considerable time lag.

Insofar as the sugar mill is a machine designed to extract juice, and since it cannot tell pol from impurities, then it is only logical for the millwright to use brix to grade efficiency of his train, as brix can be measured easily at millsite. Thus, a couple of spindles and cylinders will help us estimate an Extraction that correlates well with Pol Extraction, which can be used advantageously for the controlling function of management, as it eliminates the time lag. However, determination of this extraction must not be encumbered with the calculation involved, and in order for the mill foreman to perform the task himself, a suitable nomograph must be used.

Significant linear relationships between the level of brix degrees of the first and the last expressed juices and the Extraction have been derived using industrial data. Weekly data from the last eight crops, as appeared in the S.C.G.C. of Florida Weekly Technical Reports were used. Inordinate scatter of the data from three crops, associated with either unusually high extraction, or abnormally high grinding rate, or else, the grinding of stale cane after a freeze, made them candidates for dismissal; they were retained, however, to make an expression generic for the whole spectrum of performance from poor to outstanding, even though error for average results is thereby magnified. Ratio brix of last expressed juice / brix of crusher juice was regressed against extraction. A linear regression by the method of least squares yielded an expression that was used to construct the nomograph.

This paper describes the foreman's nomograph, and shows a comparison of our millsite figures for Extraction, vis-a-vis the Lab's Pol Extraction.

COMPUTERS IN THE SUGAR FACTORY

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In today's technical world, computers are an unavoidable, and sometimes, overwhelming reality. However, very often, there is much confusion as to what computers can and can't do in our sugar mills, and as to where and when they should be used.

The objective of this presentation will be to: 1) dissipate many, if not all, of the misconceptions and myths surrounding their purpose and use in the sugar factory, 2) explain the reasons why we should take advantage of the computer technology in the sugar industry, and 3) issue recommendations on how to develop and implement a plan to "computerize" a sugar factory.

SUMMARY OF MILLING STUDIES IN LOUISIANA (1992-1996)

Harold Birkett and Jeanie Stein
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Summary results of mill tests conducted in Louisiana from 1992 through 1996 will be presented. Included in the presentation will be moisture, fiber, ash, individual and cumulative extraction plots. Open cells across the tandem and imbibition efficiencies will also be presented. Data on special tests conducted will also be shown.

MILL IMPROVEMENT PROGRAM AT ST. JAMES SUGAR COOP., INC. AN UPDATE

Manolo A. **Garcia**
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The second step in the three-pronged program to improve mill efficiency at St. James Sugar Coop., Inc. was accomplished for the start of the 1995 grinding season. An assessment of the results for the 1995 and 1996 crops showed the targeted improvements were attained.

THE BARANDALLA TRASHPLATE: THE MINIMAL FRICTION SPIRAL

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All along the 1991-92 harvest, S.C.G.C.'s milling trains faced ahard time. Suffering from severe steam shortages, our mills barely managed to grind their commitment for the first half of the crop. In February 1992, however, as fiber content increased substantially along with the proportion of mature canes coming in, the turbines driving the first two mills of each train began slowing down under load and eventually stalling from either the permanent lack of steam, or frequent episodes of low steam pressure.

Having no other options, the immediate and frustrating expedient of releasing some hydraulic pressure from several mill rams to reduce horsepower demand proved costly: sucrose in bagasse went up, and the mill performance was spoiled for the remainder of the crop, never to recover. Probably, the only place to cut down energy demand of the cane sugar mill without sacrificing performance is at the trashplate. During that month, in an attempt to prevent future fiascoes, a study was conducted to explore the possibility to reduce friction losses, and the "Barandalla Trashplate" was born as a result. We have been using it ever since.

Bergmann, of the Java Experimental Station, had shown more than a century ago that the trashplate profile should be that of a logarithmic spiral wound around the top roll center. Now, the "Barandalla" (Basque for "February") affords the least friction spiral layout for any given mill. It may be shown that the friction loss at the trashplate is a function of roll radius, of front mill opening, of the angle included for the subtended spiral arc of the trashplate profile, of a constant inherent to the logarithmic spiral, and of the coefficient of friction between bagasse and iron.

Real-life calculations of trashplate friction, some tables useful in the selection of least friction "Barandallas" for every occasion, and the conclusions that follow are included in the paper.

IMPROVING GEAR BOX DURABILITY

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The wear life of a gear box can be greatly extended with a good gear replacement selection process and a good preventive maintenance (PM) program. The PM program should include periodic inspections of the gear teeth for wear, analysis of the lubrication for contaminants, and measurements of bearing endplay and operating temperatures. This paper will provide a discussion of several preventive maintenance practices and illustrate the benefits of a comprehensive program. The paper will also discuss factors that should be considered during a gear replacement selection process.

DETECTION OF SUGAR IN MULTIPLE EFFECT EVAPORATOR CONDENSATE SYSTEMS USING FLUORESCENCE

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Condensate from the multiple effect evaporators used for concentrating sugar juice is frequently reclaimed and returned to the boiler. Evaporator condensate typically contains few contaminants and has a relatively high Btu value, making the condensate an ideal candidate for reuse as makeup water to the boiler. Occasionally, the condensate becomes contaminated with sugar from the process. Such "sugar shots" cause a depression in boiler water pH as the sugars break down into organic acids. Fluorescent monitoring techniques were successfully used to detect

low concentrations of sugar jiuice in evaporator condensate. Second effect evaporator condensate was monitored on-line at the American Crystal Sugar Plant. Fluorescence readings were directly compared to a sodium analyzer and alpha naphthol readings. In addition, bench testing was completed on samples from several sugar cane mills as well. Development and field trial data will be discussed in the paper.

IMPROVED CLARIFICATION THROUGH INCREASED INORGANIC PHOSPHATE CONCENTRATIONS WITH A NOVEL ENZYME

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BASF's Naruphos 5000L is a natural *Aspergillus niger* enzyme, which frees up inorganic phosphate from phosphorus containing organic molecules present in the cane juice. Optimum operating conditions are: 98°C, pH 5.5 to 7.0 and 15 to 20 min. reaction time. When added to the primary juice, it may increase the P_20_5 levels by 10 to 30%. This improved the Bogstra-ratio: P_20_5 / ($Si0_2$ + $A1_20_3$ + F e ^) in several cases to over 0.25 and the corresponding suspended solids level to less than 500 mg/L, yielding a better clarified juice.

THE FREEZE OF 1997: THE GOOD, THE BAD, AND THE UGLY (A GENERAL MANAGER'S VIEW)

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The objective is to make a general and practical presentation of the effects of the Freeze of January 19,1997 on a particular Florida Sugar Mill (Atlantic), with no warm lands, and limited cane supply (1,200,000 tons). The presentation will show: a. Graphs of the sucrose of the leading cane varieties before and after the freeze, b. Graphs of mill yields before and after the freeze, c. Graphs of dextran levels both direct from the field, in the yard, and in trailer storage, d. Discussion of managing strategies to cope with the changing conditions of the cane in: 1. burning, 2. harvesting, 3. grinding, 4. fabrication, and 5. storage with regard to climatological, scheduling, fields, and geographical situation.

LOSSES OF SUCROSE IN BILLET CANE FROM WASH WATER

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At several of the factories in Louisiana Dr. Willem Kampen attained some samples of wash water and analyzed it for sugar content. At each of the mills he estimated a flow rate for the water and the cane in the feed table. From these data Dr. Kampen could determine the amount of sucrose, glucose, and fructose lost in the wash water. At the Florida ASSCT meeting I will report on these findings. The presentation will follow the brief outline: Introduction, Identification of the mills involved (angles of feed table, styles of feed tables, and flow rates of water and cane), graph

of the relation of water flow to cane flow, graph of the relation of water flow to sucrose lost, graph of the relation of cane flow to water flow, mathematical relationships, conclusions, and questions.

POST-HARVEST MANAGEMENT OF BILLETED CANE FOR OPTIMAL CANE AND JUICE QUALITY

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Increasing environmental regulations may soon restrict or reduce the extent of field burning in Louisiana for the removal of leafy trash from sugarcane stalks prior to harvest. Further, there is evidence that field burning of whole-stalk cane may actually reduce sugar yield even though little or no deterioration products can be detected in the juice. Many growers are using cane combines to harvest newer varieties of sugarcane which produce higher tonnages but are subject to lodging. The combine chops the cane stalks into billets of 7 to 14 in (17.5 to 35.0 cm) and, with the aid of extractor fans, removes a significant portion of the leafy trash without burning. The number of cane combines operating in Louisiana has increased from 2 three years ago to more than 60 during the 1996-97 harvest. It is anticipated that for the 1997-98 harvest, the number of combine harvesters operating in Louisiana will double and that 50% of the crop will be harvested with this system. Although the combine can harvest green cane, many growers are burning standing cane prior to harvest to increase the efficiency of the harvester. Experience in other countries has shown that burned and/or billeted cane deteriorates faster than whole stalk cane.

To evaluate post-harvest management of billeted cane in Louisiana for optimization of cane and juice quality, two field experiments comparing green vs. burned and whole vs. billeted cane of two varieties, CP 70-321 and LCP 85-384, were conducted during the 1996-97 harvest season. Samples of whole stalks of green and burned cane were harvested by hand in standing cane while samples of green and burned, billeted cane were taken directly from the elevator of the cane combine operating in the fields. Average billet length in both experiments was 10.1 in (25.7 cm). Estimated yield (stalks per acre X average stalk weight)of gross cane per acre averaged 45.8 and 45.5 tons (102.7 and 102.0 tons/ha) for CP 70-321 and LCP 85-384, respectively.

Whole and chopped stalks of both green and burned cane were milled within 24 h of harvest and at 1,2, and 3 d intervals thereafter. Cane samples were analyzed for fiber content while juice samples were analyzed for Brix, sucrose, purity (ratio of sucrose to Brix), and dextran concentration. Samples for delayed milling were stored in a greenhouse at 80 °F (26.6 °C) and high humidity (60-100%) which had been found in previous studies to contribute to a significant increase in dextran concentration of juice within a 24-h period in billeted cane but not whole-stalk cane.

Whole stalks of green and burned cane harvested by hand had a trash content of 15.5 and 11.8% for CP 70-321 and 10.9 and 5.8% for LCP 85-384, respectively. Trash content of green and burned, billeted cane averaged 9.9 and 8.4% for CP 70-321 and 14.8 and 10.0% for LCP 85-384, respectively. The higher level of trash, to include cane tops, in the green cane harvested by combine increased fiber content. The higher fiber content would be expected to lower extraction and, with the non-sucrose solids expected from the processing of cane tops, also lower boiling house efficiency, and, in the final outcome, lower overall sugar recovery.

Deterioration rate and dextran concentration were variety dependent, higher in billeted cane than whole-stalk cane (2,136 vs. 199 ppm, respectively, for CP 70-321 and 9,033 vs. 233 ppm, respectively, for LCP 85-384, as an average of both burned and unburned cane for all dates of milling), and higher in burned cane than in green cane (1,221 vs. 1, 1 13 ppm for CP 70-321, respectively, and 6,211 and 3,055 ppm, respectively, for LCP 85-384, as an average of both whole-stalk and billeted cane for all dates of milling). Chopping appeared to have a greater deleterious effect on juice quality than burning with burn to crush management also crucial to juice quality when harvesting cane by combine. On the other hand, no significant increase in dextran concentration was noted in either green or burned, whole-stalk cane for either variety.

In summary, harvest management of billeted cane is the key to optimizing cane quality while post-harvest management is the key to juice quality. The dextran concentration of juice found in these experiments for either green or burned, billeted cane necessitates that cane be processed in a timely fashion. Further, the dextran concentration in sugar is linked to the dextran in juice and is likely to exceed industry standards (250 M.A.U.) when green, billeted cane of CP 70-321 is held for up to 48 h but only 24 h or less for burned, chopped cane at the conditions outlined in the study. However, for LCP 85-384 the standard would be exceeded in both green or burned, billeted cane within 24 h. Finally, results from previous studies have shown that with lower ambient temperatures, i.e. 50 °F (10 °C), and/or with lower relative humidity, rapid deterioration as found in these studies is less likely to occur.

AMERICAN SOCIETY OF SUGAR CANE TECHNOLOGISTS EDITORIAL POLICY

Nature of papers to be published:

Papers submitted must represent a significant technological or scientific contribution. Papers will be limited to the production and processing of sugarcane, or to subjects logically related. Authors may submit papers that represent a review, a new approach to field or factory problems, or new knowledge gained through experimentation. Papers promoting machinery or commercial products will not be acceptable.

Frequency of publication:

The Journal will appear at least once a year. At the direction of the Joint Executive Committee, the Journal may appear more frequently. Contributed papers not presented at a meeting may be reviewed, edited, and published if the editorial criteria are met.

Editorial Committee:

The Editorial Committee shall be composed of the Managing Editor, Technical Editor for the Agricultural Section, and Technical Editor for the Manufacturing Section. The Editorial Committee shall regulate the Journal content and assure its quality. It is charged with the authority necessary to achieve these goals. The Editorial Committee shall determine broad policy. Each editor will serve for three years; and may at the Joint Executive Committee's discretion, serve beyond the expiration of his or her term.

Handling of manuscripts:

Four copies of each manuscript are initially submitted to the Managing Editor. Manuscripts received by the Managing Editor will be assigned a registration number determined serially by the date of receipt. The Managing Editor writes to the one who submitted the paper to inform the author of the receipt of the paper and the registration number which must be used in all correspondence regarding it.

The Technical Editors obtain at least two reviews for each paper from qualified persons. The identities of reviewers must not be revealed to each other nor to the author during the review process. Instructions sent with the papers emphasize the necessity for promptness as well as thoroughness in making the review. Page charges will be assessed for the entire manuscript for non-members. Members will be assessed for those pages in excess often (10) double spaced Times New Roman (TT) 12 pt typed pages of 8 1/2" x 11" dimension with one (1) inch margins.

When a paper is returned by reviewers, the Technical Editor evaluates the paper and the recommendations of the reviewers. If major revisions are recommended, the Technical Editor sends the paper to the author for this purpose, along with anonymous copies of reviewers' recommendations. When the paper is returned to the Technical Editor, he/she will judge the adequacy of the revision and may send the paper back to any reviewer for further review. A paper sent to its author for revision and held more than 6 months will be given a new date of receipt when returned. This date will determine the priority of publication of the paper.

A paper rejected by one reviewer may be sent to additional reviewers until two reviewers either accept or reject the paper. If a paper is judged by two or more reviewers as not acceptable for the Journal, theTechnical Editor returns it to the author along with a summary of the reasons given by the reviewers for the rejection. The registration form for the paper is filled out and returned to the Managing Editor along with copies of the reviewers' statements and a copy of the Technical Editor's transmittal letter to the author. The names of all reviewers must be shown on the registration form transmitted to the Managing Editor.

When a paper is recommended by two reviewers for publication in the Journal, it is read by the Technical Editor to correct typographical, grammatical, and style errors and to improve the writing where this seems possible and appropriate, with special care not to change the meaning. The paper is then sent by the Technical Editor to the Managing Editor who notifies the authors of the acceptance of the paper and of the probable dates of publication. At this time, the Managing Editor will request a final version in hardcopy and on diskette in WordPerfect format from the corresponding author.

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The paper is printed in the proper form for reproduction, and proofs are sent to the authors for final review. When the proofs are returned, all necessary corrections are made prior to reproduction. The author will be notified at the appropriate time to order reprints at cost.

Any drawings and photographs for the figures in the paper are "scaled" according to their dimensions, the size of lettering, and other factors. They are then sent to the printer for camera work. Proofs of the illustrations are sent to the authors. Any changes requested at this stage would be expensive and authors will be expected to pay the cost of such changes.

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RULES FOR PREPARING PAPERS TO BE PRINTED IN THE JOURNAL OF THE AMERICAN SOCIETY OF SUGAR CANE TECHNOLOGISTS

Format

Unless the nature of the manuscript prevents, it should include the following sections in the order listed: ABSTRACT, INTRODUCTION, MATERIALS and METHODS, RESULTS, DISCUSSION (OR RESULTS AND DISCUSSION), CONCLUSIONS, ACKNOWLEDGMENTS, and REFERENCES. Not all the sections listed above will be included in each paper, but each section should have an appropriate heading that is centered on the page with all letters capitalized. Scientific names shall be italicized.

All material (including tables and figures) shall be submitted on 8V2 **X11 inch paper with one inch margins on all sides.** If using WordPerfect, set the bottom margin at 0.5 inches. This will set the page number at 0.5 inches and the final line of text at 1 inch from the bottom margin. Exactness in reproduction can be insured if electronic copies of the final versions of manuscripts are submitted. Authors are encouraged to contact the managing editor for specifics regarding software and formatting software to achieve ease of electronic transfer.

Authorship

Name of the authors, institution or organization with which they are associated, and their locations should follow the title of the paper.

Abstract

The abstract should be placed at the beginning of the manuscript, immediately following the author's name, organization and location.

Tables

Number the tables consecutively and refer to them in the text as Table 1, Table 2, etc. Each table must have a heading or caption. Capitalize only the initial word and proper names in table headings. Headings and text of tables should be single spaced. Use TAB function rather than SPACE BAR to separate columns of a table.

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Number the figures consecutively and refer to them in the text as Figure 1, Figure 2, etc. Each figure must have a legend. Figures must be of sufficient quality to reproduce legibly.

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Drawings and photographs must be provided separately from the text of the manuscript and identified on the back of each. Type figure numbers and legends on separate pieces of paper with proper identification. Drawings and photographs should be of sufficient quality that they will reproduce legibly.

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The heading for the literature cited should be REFERENCES. References should be arranged such that the literature cited will be numbered consecutively and placed in alphabetical order according to the surname of the senior author. In the text, references to literature cited should be made by name of author(s) and year of publication from list of references. Do not use capital letters in the titles of such articles except in initial words and proper names, but capitalize words in the titles of the periodicals or books.

Format Example

ITCHGRASS *(ROTTBOELLIA COCHINCHINENSIS) CONTROL* IN SUGARCANE WITH POSTEMERGENCE HERBICIDES

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ABSTRACT

INTRODUCTION

MATERIALS AND METHODS

RESULTS AND DISCUSSION

Table 1. Visual itchgrass control and sugarcane injury as influenced by over-the-top herbicide application at Maringouin and Thibodaux, LA, 1989.

CONCLUSIONS

ACKNOWLEDGMENTS

REFERENCES

GUIDELINES FOR PREPARING PAPERS FOR JOURNAL OF ASSCT

The following guidelines for WordPerfect software are intended to facilitate the production of this journal. Authors are strongly encouraged to prepare their final manuscripts with WordPerfect 6.0 or a later version for Windows. Please contact the Managing Editor if you will not use one of those software packages.

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Do not use hard returns at the end of sentences within a paragraph. Hard returns are to be used when ending paragraphs or producing a short line.

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1. Smith, I. M., H. P. Jones, C. W. Doe, 1991. The use of multidiscipline approaches to control rodent populations in plants. Journal of American Society of Plant Management. 10:383-394.

CONSTITUTION OF THE AMERICAN SOCIETY OF SUGAR CANE TECHNOLOGISTS

As Revised and Approved on June 21, 1991
As Amended on June 23,1994
As Amended on June 15, 1995

ARTICLE I

Name. Object and Domicile

Section 1. The name of this Society shall be the American Society of Sugar Cane Technologists.

Section 2. The object of this society shall be the general study of the sugar industry in all its various branches and the dissemination of information to the members of the organization through meetings and publications.

Section 3. The domicile of the Society shall be at the office of the General Secretary-Treasurer (as described in Article IV, Section 1).

ARTICLE II

Divisions

The Society shall be composed of two divisions, the Louisiana Division and the Florida Division. Each division shall have its separate membership roster and separate officers and committees. Voting rights of active and honorary members shall be restricted to their respective divisions, except at the general annual and special meetings of the entire Society, hereinafter provided for, at which general meetings active and honorary members of both divisions shall have the right to vote. Officers and committee members shall be members of and serve the respective divisions from which elected or selected, except the General Secretary-Treasurer who shall serve the entire Society.

ARTICLE III

Membership and Dues

Section 1. There shall be five classes of members: Active, Associate, Honorary, Off-shore or Foreign, and Supporting.

Section 2. Active members shall be individuals residing in the continental United States actually engaged in the production of sugar cane or the manufacture of cane sugar, or research or education pertaining to the industry, including employees of any corporation, firm or other organization which is so engaged.

Section 3. Associate members shall be individuals not actively engaged in the production of sugar cane or the manufacture of cane sugar or research pertaining to the industry, but who may be interested in the objects of the Society.

Section 4. Honorary membership shall be conferred on any individual who has distinguished himself or herself in the sugar industry, and has been elected by a majority vote of the Joint Executive Committee. Honorary membership shall be exempt from dues and entitled to all the privileges of active membership. Each Division may have up to 15 living Honorary Members. In addition, there may be up to 5 living Honorary members assigned to the two Divisions jointly.

Section 5. Off-shore or foreign members shall be individuals not residing in the continental United States who may be interested in the objects of the Society.

Section 6. Supporting members shall be persons engaged in the manufacturing, production or distribution of equipment or supplies used in conjunction with production of sugar cane or cane sugar, or any corporation, firm or other organization engaged in the production of sugar cane or the manufacture of cane sugar, who may be interested in the objects of the Society.

Section 7, Applicants for new membership shall make written application to the Secretary-Treasurer of the respective divisions, endorsed by two members of the division, and such applications shall be acted upon by the division membership committee.

Section 8. Minimum charge for annual dues shall be as follows:

Active Membership	$10.00
Associate Membership	$25.00
Honorary Membership	NONE
Off-shore or Foreign Membership	$20.00
Supporting Membership	$50.00

Each Division can assess charges for dues more than the above schedule as determined by the Division officers or by the membership at the discretion of the officers of each Division.

Dues for each calendar year shall be paid not later than 3 months prior to the annual meeting of the member's division. New members shall pay the full amount of dues, irrespective of when they join. Any changes in dues will become effective in the subsequent calendar year.

Section 9. Dues shall be collected by each of the Division's Secretary-Treasurer from the members in their respective divisions. Unless and until changed by action of the Joint Executive Committee, 50 percent of the minimum charge for annual dues, as described in Section 8 for each membership class, shall be transmitted to the office of the General Secretary-Treasurer.

Section 10. Members in arrears for dues for more than a year will be dropped from membership after thirty days notice to this effect from the Secretary-Treasurer. Members thus dropped may be reinstated only after payment of back dues and assessments.

Section 11. Only active members of the Society whose dues are not in arrears and honorary members shall have the privilege of voting and holding office. Only members (all classes) shall have the privilege of speaking at meetings of the Society.

ARTICLE IV

General Secretary-Treasurer and Joint Executive Committee

Section 1. The General Secretary-Treasurer shall serve as Chief Administrative Officer of the Society and shall coordinate the activities of the divisions and the sections. He or she will serve as ex-officio Chairperson of the Joint Executive Committee and as General Chairperson of the General Society Meetings, and shall have such other duties as may be delegated to him or her by the Joint Executive Committee. The office of the GenerarSecretary-Treasurer shall be the domicile of the Society.

Section 2. The Joint Executive Committee shall be composed of the elected members of the two division Executive Committees, and is vested with full authority to conduct the business and affairs of the Society.

ARTICLE V

Division Officers and Executive Committee

Section 1. The officers of each division of the Society shall be: a President, a First Vice-President, a Second Vice-President, a Secretary-Treasurer or a Secretary and a Treasurer, and an Executive Committee composed of these officers and four other members, one from each section of the Division (as described in Section 3 of Article VII), one elected at large, and the President of the previous Executive Committee who shall serve as an Ex-Officio member of the Division Executive Committee. The office of the Secretary-Treasurer in this constitution indicates either the Secretary-Treasurer, or the Secretary and the Treasurer.

Section 2. These officers, except Secretary-Treasurer, shall be nominated by a nominating committee and voted upon before the annual division meeting. Notices of such nominations shall be mailed to each member at least one month before such meeting. Ballots not received before the annually specified date will not be counted.

Section 3. The Secretary-Treasurer shall be appointed by and serve as a non-voting member at the pleasure of the Division Executive Committee. The Secretary-Treasurer may not hold an elected office on the Executive Committee.

Section 4. The duties of these officers shall be such as usually pertain to such officers in similar societies.

Section 5. Each section as described in Article VII shall be represented in the offices of the President and Vice-President.

Section 6. The President, First Vice-President, and Second Vice-President of each Division shall not hold the same office for two consecutive years. Either Section Chairperson (as described in Section 3 of Article VII) may hold the same office for up to two consecutive years. The terms of the otner officers shall be unlimited.

Section 7. The President shall be elected each year alternately from the two sections hereinafter provided for. In any given year, the Presidents of the two Divisions shall be nominated and elected from different sections. The President from the Louisiana Division for the year beginning February, 1970, shall be nominated and elected from the Agricultural Section. The president from the Florida Division for the year beginning February, 1970, shall oe nominated and elected from the Manufacturing Section.

Section 8. Vacancies occurring between meetings shall be filled by the Division Executive Committee.

Section 9. The terms "year" and "consecutive year" as used in Articles V and VI shall be considered to be comprised of the elapsed time between one annual division meeting of the Society and the following annual division meeting of the Society.

ARTICLE VI

Division Committees

Section 1. The President of each division shall appoint a committee of three to serve as a Membership Committee. It will be the duty of this committee to pass upon applications for membership in the division and report to the Secretary-Treasurer.

Section 2. The President of each division shall appoint each year a committee of three to serve as a Nominating Committee. It will be the duty of the Secretary-Treasurer of the Division to notify all active and honorary members of the Division as to the personnel of this committee. It will be the duty of this committee to receive nominations and to prepare a list of nominees and mail this to each member of the Division at least a month before the annual meeting.

ARTICLE VII

Sections

Section 1. There shall be two sections of each Division, to be designated as:

1. Agricultural
2. Manufacturing

Section 2. Each active member shall designate whether he or she desires to be enrolled in the Agricultural Section or the Manufacturing Section.

Section 3. There shall be a Chairperson for each section of each Division who will be the member from that Section elected to the Executive Committee. It will be the duty of the Chairperson of a section to arrange the program for the annual Division meeting.

Section 4. The Executive Committee of each Division is empowered to elect one of their own number or to appoint another person to handle the details of printing, proofreading, etc., in connection with these programs and to authorize the Secretary-Treasurer to make whatever payments may be necessary for same.

ARTICLE VIII

Meetings

Section 1. The annual General Meeting of the members of the Society shall be held in June each year on a date and at a place to be determined, from time to time, by the Joint Executive Committee. At all meetings of the two Divisions of the Society, five percent of the active members shall constitute a quorum. The program for the annual meeting of the Society shall be arranged by the General Secretary-Treasurer in collaboration with the Joint Executive Committee.

Section 2. The annual meeting of the Louisiana Division shall be held in February of each yean at such time as the Executive Committee of the Division shall decide. The annual meeting of the Florida Division shall be held in September or October of each year, at such time as the Executive Committee of that Division shall decide. Special meetings of a Division may be called by the Executive Committee of such Division.

Section 3. Special meetings of a Section for the discussion of matters of particular interest to that Section may be called by the President upon request from the respective Chairperson of a Section.

Section 4. At Division meetings, 10 percent of the active division members and the President or a Vice-President shall constitute a quorum.

ARTICLE IX

Management

Section 1. The conduct and management of the affairs of the Society and of the Divisions including the direction of work of its special committees, shall be in the hands of the Joint Executive Committee and Division Executive Committees, respectively.

Section 2. The Joint Executive Committee shall represent this Society in conferences with the American Sugar Cane League, the Florida Sugar Cane League, or any other association, and may make any rules or conduct any business not in conflict with this Constitution.

Section 3. Four members of the Division Executive Committee shall constitute a quorum. The President, or in his or her absence one of the Vice-Presidents, shall chair this committee.

Section 4. Two members of each Division Executive Committee shall constitute a quorum of all members of the Joint Executive Committee. Each member of the Joint Executive Committee, except the General Secretary-Treasurer, shall be entitled to one vote on all matters voted upon by the Joint Executive Committee. In case of a tie vote, the General Secretary-Treasurer shall cast the deciding vote.

ARTICLE X

Publications

Section 1. The name of the officialjournal of the Society shall be the "Journal of the American Society of Sugar Cane Technologists." This Journal shall be published at least once per calendar year. All articles, whether volunteered or invited, shall be subject to review as described in Section 4 of Article X.

Section 2. The Managing Editor of the Journal of the American Society of Sugar Cane Technologists shall be a member of either the Florida or Louisiana Divisions; however, he or she shall not be a member of both Divisions. The Division affiliation of Managing Editors shall alternate between the Divisions from term to term with the normal term being three years, unless the Division responsible for nominating the new Managing Editor reports that it has no suitable candidate. The Managing Editor shall be appointed by the Joint Executive Committee no later than 6 months prior to the beginning of his or her term. A term will coincide with the date of the annual Joint Meeting of the Society. No one shall serve two consecutive terms unless there is no suitable candidate from either Division willing to replace the current Managing Editor. If the Managing Editor serves less than one year of his or her three-year term, another candidate is nominated by the same Division, approved by the other Division, and appointed by the General Secretary-Treasurer to a full three-year term. If the appointed ManagingEditor serves more than one year but less than the full three-year term, the Technical Editor from the same Division will fill the unexpired term of the departed Managing Editor. In the event that the Technical Editor declines the nomination, the General Secretary-Treasurer will appoint a Managing Editor from the same Division to serve the unexpired term.

Section 3. The "Journal of the American Society of Sugar Cane Technologists" shall have two Technical Editors, which are an Agricultural Editor and a Manufacturing Editor. The Managing Editor shall appoint the Technical Editors for terms not to exceed his or her term of office. Any Technical Editor shall be a member of either the Louisiana or Florida Division. Each Division will be represented by one technical editor at all times unless the Executive Committee of one Division and the Managing Editor agree that there is no suitable candidate willing to serve from that Division.

Section 4. Any member or nonmember wishing to contribute to the Journal of the American Society of Sugar Cane Technologists shall submit his or her manuscript to the Managing Editor. The Managing Editor shall then assign the manuscript to the appropriate Technical Editor. The Technical Editor shall solicit peer reviews until, in the opinion of the Technical Editor, two responsible reviews have been obtained that either accept (with or without major or minor revision) or reject the manuscript. For articles accepted with major revision, it shall be the responsibility of the Technical Editor to decide if the authors have satisfactorily completed the major revision(s). The Technical Editor may solicit the opinion of the reviewers when making this decision. The Technical Editors shall not divulge the identity of any reviewer. The Managing Editor shall serve as Technical Editor of any manuscript which includes a Technical Editor as an author.

ARTICLE XI

Amendments

Section 1. Amendments to this Constitution may be made only at the annual meeting of the Society or at a special meeting of the Society. Written notices of such proposed amendments, accompanied by the signature of at least twenty (20) active or honorary members must be given to the General Secretary-Treasurer at least thirty (30) days before the date of the meeting, and he or she must notify each member of the proposed amendment before the date of the meeting.

ARTICLE XII

Dissolution

Section 1. All members must receive notification from the General Secretary-Treasurer of any meeting called for the purpose of terminating the Society at least thirty (30) days prior to the date of the meeting. After all members have been properly notified, this organization may be terminated at any time, at any regular or special meeting called for that purpose, by an affirmative vote of two-thirds of the total honorary and active members in good standing present at the meeting. Thereupon, the organization shall be dissolved oy such legal proceedings as are provided by law. Upon dissolution of the Joint Society, its assets will be divided equally between the two Divisions of the Society. Dissolution of the Joint Society will not be cause for automatic dissolution of either Division. Upon dissolution of either Division, its assets will be divided in accordance with the wishes of its members and in conformity with existing IRS regulations and other laws applicable at the time of dissolution.

ARTICLE XIII

Assets

Section 1. No member shall have any vested right, interest or privilege of, in, or to the assets, functions, affairs or franchises of the organization; nor any right, interest or privilege which may be transferable or inheritable.

AUTHOR INDEX

Alvarez, J. 55
Astua-Monge, Gustavo 46
Bedford, Binu S. 59
Birkett, Harold 58
Bond, J. P. 47
Brown, L. P. 49
Burner, D. M. 46, 56
Cabiness, J. 52
Cardentey, Hector J. 32, 60
Castner, E. P. 54
Cherry, R. H. 48
Clay, P. A. 52, 53
Comstock, *J.C.* 45
Damann, Jr., K. E. 46
Davis, Michael J. 46
Deren, Christopher W. 50, 55
DeSousa, Orlando 55
Entrialgo, Jr., Luis 60
Fanjul, John A. 60
Garcia, Manolo A. 58
Glaz, Barry 50, 55
Godshall, Mary An 39
Griffin, James L. 18, 52, 53
Grisham, M. P. 46
Grueneich, David P. 59
Grymes, C. F. 52, 53
Hall, David G. 48
Hallmark, W. B. 49
Hanks, James E. 53
Hawkins, G. L. 49
Herscovici, Saul 59
Hoy, J. W. 47
Irey, M. S. 45
Jackson, Windell 50
Kampen Willem H. 60
Klein, M. G. 48
Lama, Miguel 60
Landry, Dalton 50
Larson, David 0. 59
Legendre, Benjamin L. 39, 46, 56, 61
Legendre, Duane 1
Li, Q. W. 8
Lockhart, B.E.L. 45
Lockhart, Mike 49
McGawley, E. C. 47
McGillivray, Terry 59
Miller, Donnie K. 18 53
Miller, J. D. . . . . . 8 ,45
Milligan, Scott 55
Milner Edward W. 60
Miranda, Xavier M. 39
Murray, Travis 49
Pacheco, Adalberto 60
Pan, Y.-B. *46*
Proven, John G. 59
Richard, Charley 50
Richard, Jr., Edward P. 18, 51, 54 61
Rott, Philippe 46
Seaborn, Sheldon 59
Snyder, George H. 50
Stein, Jeanie 58
Stuart, Christine M. 59
Tai, P.Y.P. 8
Turner, R. G. 54
Ulibarri, Rogelio M. 58
Ulloa, Modesto F. 3
Viator, Howard P. 51
Waguespack, Jr., Herman 50
Wang, Z. K. 45
Wei, 6. 46
Xiao, F.H. 8
Zarraluqui, Luis R. 57, 58