

PLENARY ONE

PEBBLE-BED MODULAR REACTORS

D NICHOLLS

SEVENTY-EIGHTH ANNUAL REVIEW OF THE MILLING SEASON IN SOUTHERN AFRICA (2002-2003)

SB DAVIS

Sugar Milling Research Institute, University of Natal, Durban, 4041, South Africa

E-mail: sdavis@smri.org

Abstract

Performance, throughput and other relevant aspects of the sugar industries in southern Africa are presented and discussed. Data from sugar mills in South Africa, Swaziland, Zimbabwe and Malawi are included. The cane crop and factory performance are discussed, with trends in RV receiving particular mention. The season was notable for the excellent cane quality throughout due to low summer rainfall. This resulted in the production of a record sugar tonnage in South Africa at a very good cane to sugar ratio. Mill performance was generally much improved over previous seasons as a result.

THE EXCEPTIONAL 2002-2003 SEASON: WHY DID IT HAPPEN?

A SINGELS¹, SB DAVIS² AND GRE LIONNET³

¹*South African Sugar Association Experiment Station, P/Bag X02,
Mount Edgecombe, 4300, South Africa*

²*Sugar Milling Research Institute, University of Natal, Durban, 4041, South Africa*

³*Tongaat-Hulett Sugar Ltd, Private Bag 3, Glenashley, 4022, South Africa*

Abstract

The 2002/3 crushing season in South Africa was characterised by cane quality, and factory throughputs and performances well above recent averages, with a record tonnage of raw sugar produced. The low and well-distributed rainfall was largely responsible for this, impacting on sucrose levels in cane, and steadiness of cane supply to the mills. A comparison of selected factory performance parameters over the past three seasons showed that the cane supply indeed impacted positively on factory performance.

PLENARY TWO

ON-LINE ANALYSIS OF QUALITY PARAMETERS IN CONSIGNMENTS OF SHREDDED CANE BY NEAR INFRARED SPECTROSCOPY (NIR)

KJ SCHÄFFLER¹, RC LOUBSER¹ AND T BAMBER²

¹*Sugar Milling Research Institute, University of Natal, Durban, 4041, South Africa*

²*South African Sugar Association Cane Testing Service, PO Box 700, Mount Edgecombe, 4300, South Africa*

Abstract

In South Africa (SA), individual consignments of shredded cane are analysed by the direct analysis of cane method (DAC). Although this procedure is capable of producing excellent sampling and accurate analysis of consignments, it is labour intensive.

NIR has been used by several sugar industries for determining cane quality for cane payment purposes. Earlier work in SA indicated that **At-line** NIR could produce excellent estimates of cane quality and could possibly replace the current DAC analysis for payment.

To be economically viable and to gain the best advantages, NIR has to be used **On-line** for automated analysis. This paper describes the progress made during the past two seasons.

TECHNICAL PARAMETERS USED TO MEASURE AND MONITOR LENGTH OF MILLING SEASON IN THE SOUTH AFRICAN SUGAR INDUSTRY

AT WYNNE

South African Cane Growers' Association, PO Box 888, Mount Edgecombe, 4300, South Africa

E-mail: Awynne@canegrowers.co.za

Abstract

The impact of season length on cane quality in the South African sugar industry has resulted in most mill areas agreeing on an optimal season length and implementing mechanisms to identify the cause of any season length extension beyond the agreed length of milling season. The impact of milling efficiency parameters such as budgeted and actual overall time efficiency (OTE), budgeted and actual mill stops, design and achieved crush rates (tons cane crushed per hour), horizontal expansion (increases in area) and vertical expansion (increases in yield) on season length are familiar to many industry stakeholders. The effects of 'slow' and 'fast' crushing (i.e. when actual throughput is slower/faster than mill design throughput) are less understood. This paper proposes a technical mechanism for matching cane supply to milling capacity within an agreed length of milling season, and quantifies the parameters that cause season length extensions. Identifying all the factors, including the impact of slow and fast crushing, that contribute to season length extensions is an important step in highlighting local inefficiencies. While the proposed mechanism identifies the parties responsible for any season length extension, it is likely that in many cases collaboration between the miller, growers and transporters will be required to rectify the cause of the inefficiency.

SUCCESSFUL INTERCROPPING OF SUGARCANE

MJ PARSONS

KwaZulu-Natal Department of Agriculture and Environmental Affairs, Private Bag X9059,
Pietermaritzburg 3200, South Africa.

*Currently: Hartpury College of Agriculture, University of the West of England, Hartpury,
Gloucestershire GL19 3BE, England*

doctor.mike@tiscali.co.uk

Abstract

A five year Joint Project between SASEX and the KwaZulu-Natal Department of Agriculture and Environmental Affairs was initiated in 1996, aimed at improving the crop production capabilities of small scale cane growers. As part of this Project, research trials were conducted to investigate the economics and practicalities of intercropping cane with food crops. Results from the first two years of trials were presented in 1999, showing that the most suitable food crops for this purpose were maize harvested for green mealies, and cabbages. This paper discusses the findings from nine subsequent field trials conducted at five sites, ranging from the coastal plain to inland areas, which researched crop interactions in both plant and first ratoon cane. Maize, cabbage and sweet potatoes were shown to be the most suitable food crops at all sites. All intercrops resulted in a reduction in cane yield, even where the cane was harvested 24 months after planting. In the trials where other factors were not limiting, the productivity of each individual food crop plant was greater in the cane interrows than when grown as a sole crop, in particular for maize and cabbages. Thus, small scale cane growers wishing to produce additional crops for food security or income while waiting for their cane to mature, would benefit by planting such crops in plant cane interrows rather than cultivating them on a separate piece of land. Two complex trials conducted at Bruyns Hill demonstrated how the time and method of planting the intercrops can be manipulated to reduce the deleterious competitive effects of the food crops on cane yields.

AGRICULTURE SESSION 1:

Integrated pest management

EFFECT OF FOUR SOURCES OF SILICON ON RESISTANCE OF SUGARCANE VARIETIES TO *ELDANA SACCHARINA* (LEPIDOPTERA: PYRALIDAE)

MG KEEPING AND JH MEYER

*South African Sugar Association Experiment Station, P/Bag X02, Mount
Edgecombe, 4300, South Africa*

Abstract

Soil amendment with various sources of silicon (Si) have been shown to increase resistance of sugarcane to several stem borers (Anderson and Sosa, 2001; Elawad *et al.*, 1985; Gupta *et al.*, 1992; Pan *et al.*, 1979; Savant *et al.*, 1999), including that of South African sugarcane to its major pest, *Eldana saccharina* Walker (Lepidoptera: Pyralidae) (Keeping and Meyer, 2002). This study examined the effect of four sources of silicon (calcium silicate from the USA; calcium silicate from Namibia [referred to here as 'local']; Slagment®; and flyash) on resistance of four sugarcane varieties to *E. saccharina*.

**IMPACT OF REPEATED APPLICATIONS OF
ALPHA-CYPERMETHRIN ON *ELDANA SACCHARINA*
(LEPIDOPTERA:PYRALIDAE) AND ON ARTHROPODS ASSOCIATED WITH
SUGARCANE**

GW LESLIE

*South African Sugar Association Experiment Station, P/Bag X02,
Mount Edgecombe, 4300, South Africa
E-mail: leslie@sugar.org.za*

Abstract

In five field-scale insecticide trials, the repeated application of the synthetic pyrethroid alpha-cypermethrin to carry-over cane, reduced damage caused by the sugarcane borer *Eldana saccharina* Walker (Lepidoptera: Pyralidae) to the crop. The insecticide was applied with mistblowers at a rate of 200 ml formulation/ha in 350 L water/ha, once every two weeks for 16 weeks, commencing when the crop was 6-9 months old. At harvest, average damage and larval numbers were reduced by 72% and 73% respectively. ERC % cane increased by an average of 28%.

Arthropods were monitored in two of the trials by means of pitfall trapping. Results showed that there was some impact of the treatment on abundance and diversity, primarily over the period of treatment application. However, at crop harvest, five months after treatment application ended, there was no significant effect. The impact on ants, considered important predators of eldana, was similar. It is concluded that this approach to suppressing borer infestations may have commercial value.

THE EFFECT OF GREEN MANURE CROPS ON PLANT PARASITIC NEMATODES IN THE SOUTH AFRICAN SUGAR INDUSTRY

SD BERRY AND EJ WISEMAN

*South African Sugar Association Experiment Station, P/Bag X02,
Mount Edgecombe, 4300, South Africa*

shaunber@sugar.org.za

jean.wiseman@sugar.org.za

Abstract

Plant parasitic nematodes, *Meloidogyne javanica* in particular, cause significant yield losses in sugarcane crops in South Africa. The chemicals at present available for nematode control are expensive and potentially detrimental to the environment. It has been reported that various types of crops reduce the numbers of plant parasitic nematodes. Seven green manure crops (sunn hemp, marigold, oats, dolichos beans, velvet beans, forage peanuts and cowpeas), as well as tomato and sugarcane variety N12, were evaluated in a glasshouse trial to assess their susceptibility to *M. javanica*, as well as their influence on other nematode populations. Initial results indicate resistance of forage peanuts, marigolds and sunn hemp to *M. javanica*. Cowpeas, dolichos beans and tomato were particularly good hosts. The host status of velvet beans and sugarcane variety N12 differed in inoculated and naturally infested soils. Numbers of *Xiphinema elongatum* were not affected by any of these crops. Forage peanuts and sunn hemp increased the free-living nematode populations more so than did the other crops.

BURKHOLDERIA TROPICALIS, A POTENTIAL BACTERIAL INOCULANT TO CONTROL NEMATODES AND IMPROVE SUGARCANE GROWTH

S GUYON², JL VOGEL¹, J OMARJEE¹, T VAN ANTWERPEN¹,
P CADET^{1,3} AND J BALANDREAU^{2,3}

¹South African Sugar Association Experiment Station and ³Institute of Research for
Development, P/Bag X02, Mount Edgecombe, 4300, South Africa

²Ecologie Microbienne UMR5557 CNRS-Universite Claude Bernard Lyon 1,
43 Boulevard du 11 Novembre 1918, F-69622 Villeurbanne cedex, France

Abstract

The bacterial genus *Burkholderia* is abundant in the sugarcane rhizosphere. Literature states that some *Burkholderia* strains are nematode and fungal antagonists and/or plant growth promoters. Research was undertaken to obtain indigenous sugarcane-associated *Burkholderia* strains that possess these properties. Preliminary screening produced 13 isolates that are able to paralyse juveniles of *Meloidogyne* spp. This collection of isolates comprised *Burkholderia cepacia* complex, *B. gladioli*, *B. caribensis*, *B. fungorum* and a new species, *B. tropicalis*. Since *B. cepacia* complex and *B. fungorum* are associated with hospital infections, these species were omitted from further study. *B. gladioli* is often a mild plant pathogen, and was thus also eliminated. *B. tropicalis*, which has never been associated with clinical cases, was found to be an endophyte that enhances maize growth and fixes nitrogen. Consequently, search was made in sugarcane for N-fixing strains of *B. tropicalis* that are antagonistic to plant parasitic nematodes and various plant pathogens such as the smut fungus, *Ustilago scitaminea*, and *Fusarium* spp. Strain LM1-376.8 belongs to *B. tropicalis* and has been isolated from the rhizosphere of sugarcane. It fixes nitrogen and is antagonistic to nematodes, but not to certain pathogenic fungi. A culture medium has been designed for the isolation of more N-fixing *B. tropicalis*. To confirm the identification of *B. tropicalis*, a species-specific PCR was designed. The expected outcome of this research is the selection of strains whose inoculation would benefit sugarcane yield through a combination of anti-nematode, anti-fungal and growth promotion properties.

IMPROVEMENT OF QUARANTINE PROCEDURES FOR THE DETECTION OF SUGARCANE PHYTOPLASMAS

AE BRUNE¹, G CHANDRASENA² AND RS RUTHERFORD¹

¹*South African Sugar Association Experiment Station, P/BagX02,
Mount Edgecombe, 4300, South Africa*

²*Sugarcane Research Institute, Uda Walawe 561, Elvitigala Mw. Colombo 5, Sri Lanka*

Abstract

The importation of sugarcane varieties from other countries is necessary for the breeding of new varieties suited to the diverse environmental conditions in South Africa. To prevent the introduction and spread of new diseases, it is crucial that any imported pathogens are detected before the cane is released from quarantine. Although not present in South Africa, Grassy Shoot (GS) and Sugarcane White Leaf (SCWL) are economically significant phytoplasmal diseases that cause yield loss in sugarcane in a number of countries. Despite phytoplasmas being important pathogens that have been implicated in more than 300 plant diseases worldwide, these organisms have as yet not been cultured *in vitro*. The most reliable and rapid method of detection has been the use of nested polymerase chain reaction directed to conserved sequences in the 16S rRNA gene, where DNA isolation follows a phytoplasmal enrichment procedure. The process is both expensive and time consuming. This study investigated the use of FTATM paper (Whatman BioScience) for DNA extraction, and the use of a radioactive probe in conjunction with a tissue blot procedure to detect phytoplasmas in sugarcane leaf samples exhibiting symptoms of GS and SCWL, and in Bermuda grass leaf samples showing symptoms of Bermuda Grass White Leaf disease. The FTATM paper method was effective in extracting the DNA from which specific identifications could be made. As well as being more rapid, this method effected a two-thirds reduction in cost compared with the enrichment method. The radioactive probe was less useful because both mitochondrial and phytoplasmal DNA were detected.

AGRICULTURE SESSION 2: Biotechnology

THE SUGARCANE METABOLOME

S BOSCH^{1*}, JM ROHWER² AND FC BOTHA^{1,3}

¹*Institute for Plant Biotechnology, University of Stellenbosch, P/Bag X1, Matieland, 7602, South Africa*

²*Department of Biochemistry, University of Stellenbosch, P/Bag X1, Matieland, 7602, South Africa*

³*South African Sugar Association Experiment Station, P/Bag X02, Mount Edgecombe, 4300, South Africa*

*Corresponding author, E-mail: plantb6@sun.ac.za

Abstract

Despite having been studied for many years, there is still a significant lack of understanding of the mechanisms that govern the regulation of sucrose accumulation in sugarcane. Although the expression and activity of all the enzymes directly involved in the system have been described, crucial questions have been left unanswered. In the past few years the study of the regulation of plant metabolism has expanded to include metabolomics. In the same way that genomics studied the differential expression of genes and their potential interactions, metabolomics examines expression profiles on the metabolite level. Changing steady state levels of metabolites could be an indication of points of control in a specific pathway. This work describes the first phase of setting up GC-MS technology that would allow the separation and identification of multiple metabolites. Already single runs allow the identification of approximately 30 metabolites, which exceeds all previous analysis of sugarcane tissue. This method is sensitive enough to allow quantification and identification of metabolites that may previously have been overlooked in similar studies, including less abundant amino and organic acids, as well as sugars which could play a role in signaling (e.g. trehalose). This data would allow comparison of metabolite levels that would lead to the identification of metabolic control points. Current work is focused on comparing metabolite levels between low and high sucrose storing sugarcane varieties.

PROGRESS IN GENETIC MAPPING OF SUGARCANE SMUT RESISTANCE

LM RABOIN¹, JY HOARAU³, L COSTET¹, H TELISMART¹,
JC GLASZMANN² AND A D'HONT²

¹*CIRAD Pôle de protection des plantes, 7 ch. de l'IRAT 97410 Saint Pierre, Réunion, France*

²*CIRAD Avenue Agropolis 34398 Montpellier cedex 5, France*

³*CERF BP 315, 97494 Ste Clotilde, Réunion, France*

Abstract

A Quantitative Trait Locus (QTL) mapping study is under way to analyse the genetic determinism underlying sugarcane smut resistance. A total of 1295 polymorphic AFLP markers have been generated on a population of 200 individuals derived from a cross between R 570 (resistant) and MQ 76/53 (highly susceptible). This population is under evaluation for its resistance to smut in the field over three successive crop cycles and in two different locations on Reunion island. Inoculation was performed by dipping three-bud cuttings in a spore suspension, and susceptible clones were regularly interspersed in the field to trigger the epidemy. Different inoculation methods were also compared in greenhouse trials. The bud puncture method appeared the most efficient and will be used for further greenhouse evaluations of the progeny. Detection of marker-trait associations has been performed and so far has indicated a complex determinism for smut resistance. Many markers are involved with little effects. Nevertheless, among other traits that were looked at, two putative major genes originating from MQ 76/53 have been tagged: a gene involved in the red color of the internode and a rust resistance gene. Locus specific markers, SSR markers from sugarcane and maize and sequences differentially expressed in response to challenge by smut (provided by the South African Sugar Association Experiment Station), will be mapped. This should help explain the genetic variation in smut resistance observed in the trials.

ERADICATING SUGARCANE YELLOW LEAF VIRUS IN SUGARCANE VARIETY N32 THROUGH TISSUE CULTURE

L PILLAY, SD BERRY AND RS RUTHERFORD

*South African Sugar Association Experiment Station, P/Bag X02,
Mount Edgecombe, 4300, South Africa*

Abstract

Yellow Leaf Syndrome of sugarcane is caused by Sugarcane Yellow Leaf Virus (SCYLV) and/or Sugarcane Yellows Phytoplasma (SCYP). Using tissue blot immunoassay to determine the presence of SCYLV, leaf samples of sugarcane variety N32 taken from a propagation plot at Mount Edgecombe all tested positive. In this study, two methods of tissue culture were used in an attempt to eradicate SCYLV from N32. In the first method, meristems were excised and cultured on a medium containing 1 mg kinetin/litre, which caused the direct production of shoots (organogenesis). Although a moderate number of shoots were produced from the cultured meristems, the virus remained. The second method involved culturing immature leaf-roll discs on media containing 0.6 and 3 mg 2,4-D/litre for the production of callus (indirect somatic embryogenesis). An average of 58.8 plants per stalk were produced from discs cultured on the medium containing 0.6 mg 2,4-D/litre, whereas 31.5 plants per stalk were produced from the medium containing 3 mg 2,4-D/litre. Of the 202 plants regenerated, one plant tested positive for SCYLV. The culture medium containing 0.6 mg 2,4-D/litre produced the highest number of virus-free plants and thus proved the most efficient method of production.

ISOLATION AND EVALUATION OF A DEVELOPMENTALLY REGULATED SUGARCANE PROMOTER

J VAN DER MERWE*¹, S GROENEWALD² AND FC BOTHA^{1,3}

¹*Inst for Plant Biotechnology, University of Stellenbosch, P/Bag XI, Matieland, 7602, South Africa*

²*Inst for Wine Biotechnology, University of Stellenbosch, P/Bag XI, Matieland, 7602, South Africa*

³*South African Sugar Association Experiment Station, P/Bag X02, Mount Edgecombe, 4300, South Africa*

*Corresponding author, E-mail: plantb8@sun.ac.za

Abstract

Young internodal tissue of sugarcane is an ideal target for genetic manipulation, to potentially alter metabolism and control diseases and pests. As no regulatory sequences that specifically drive transgene expression in these young internodes are available, the objective of this study was to isolate and evaluate such potential sequences. The approach followed was to identify an endogenous gene expressed in the desired pattern, and isolate the corresponding promoter. The promoter of a gene encoding UDP-glucose dehydrogenase (UGDH) was selected for isolation. Expression analysis of sugarcane UGDH confirmed that gene expression was correlated with growing and expanding tissues. The promoter region was isolated and subsequently fused to the GUS reporter gene for plant transformation. Preliminary analysis of transgenic sugarcane plants indicates that the promoter is able to drive GUS expression in a tissue-specific manner. This promoter will be a valuable tool for any genetic manipulation of sugarcane.

AGRICULTURE SESSION 3:

Economic considerations

MANUAL SUGARCANE CUTTER PERFORMANCES

IN THE SOUTHERN AFRICAN REGION

E MEYER¹ AND LJ FENWICK²

¹*South African Sugar Association Experiment Station, P/Bag X02,
Mount Edgecombe, 4300, South Africa*

²*South African Cane Growers' Association, PO Box 888, Mount Edgecombe, 4300, South Africa*

Abstract

The South African sugar industry harvests in excess of 20 million tons of sugarcane annually. More than 90% of this tonnage is currently being harvested manually. During 2002, the South African Sugar Association Experiment Station's Agricultural Engineering Department conducted a comprehensive cane cutter survey throughout the South African and Swaziland sugar industries. The primary objective was to identify the productivity ranges for manual cane cutters across various harvesting systems, in both green and burnt cane. Factors impacting on cane cutter performance were also investigated. A small number of time and motion studies were also conducted to identify the time utilisation of the various cane cutter tasks.

Results indicate that cane cutter performances vary widely between cutters, farms and regions, and average output is greatly dependent on harvesting systems. Factors influencing cutter performance appear to follow Herzberg's 'Motivation-Hygiene' response theory, where general working conditions and wages do not affect productivity if they are adequate, but aspects such as conferring responsibility motivate for higher output. Future research requirements are also proposed.

AN ANALYSIS OF THE RELATIONSHIP BETWEEN FARM MARGINS AND LAND VALUES IN THE SOUTH AFRICAN SUGAR INDUSTRY

A CHURCH AND G GROOM

South African Cane Growers' Association, PO Box 888, Mount Edgecombe, 4300, South Africa

Abstract

This paper analyses the relationship between net farm incomes and market values of cane land within the South African sugar industry. A comparison is drawn between market values represented by actual sales, and productive land values, which relate more specifically to net farm incomes. The aim of the paper is therefore to estimate the degree of correlation between net farm incomes and land market values, with a view to analysing the variation in the return on investment between farming regions.

All data was sourced from the South African Cane Growers' Association and South African Sugar Association surveys that are conducted annually to collate information on grower costs, land transfers, area under cane and cane production. All data is presented on a 'per hectare under cane' basis.

FACTORS AFFECTING THE LOAN STATUS OF SUGARCANE FARMERS USING A GRADUATED MORTGAGE LOAN REPAYMENT SCHEME IN KWAZULU-NATAL

M MASHATOLA¹ AND MAG DARROCH²

¹*c/o Canegrowers, PO Box 306, Umhlali, 4390, South Africa*

E-mail: mopai@canegrowers.co.za

²*University of Natal, Pietermaritzburg, P/Bag X01, Scottsville, 3209, South Africa*

E-mail: darroch@nu.ac.za

Abstract

Factors affecting whether or not 83 medium-scale sugarcane farmers using a graduated mortgage loan repayment scheme in KwaZulu-Natal were current or in arrears on loan repayments as at 31 March 2001 were analysed using a logit model. Results show that the estimated probability of a farmer in the scheme being current on loan repayments was higher for clients with higher levels of average annual gross turnover relative to loan size, and for clients with access to substantive off-farm income. This suggests that farm size (proxied by annual gross turnover) does matter when policymakers in South Africa consider future similar schemes designed to improve access to commercial farmland by people that previously could not buy farmland. Access to off-farm income could also be considered as a criterion in selecting potential farmers for such schemes as it helps to provide additional liquidity to fund future operations and debt repayments.

USE OF VARIETIES TO MINIMISE LOSSES FROM SUGARCANE DISEASES IN SOUTH AFRICA

RS RUTHERFORD, SA MCFARLANE, T VAN ANTWERPEN
AND K MCFARLANE

South African Sugar Association Experiment Station, P/Bag X02,

Mount Edgecombe, 4300, South Africa

E-mail: rutherford@sugar.org.za

Abstract

The current low incidence of sugarcane diseases in the South African sugar industry has been hard-won. This achievement is due largely to the selection and release of resistant varieties. Consequently, current estimates of crop loss due to smut and mosaic indicate reductions in yield of only 0.2% in total, equivalent to R7 million per annum. In the absence of an RSD variety resistance screening method, the incidence of this disease has been reduced via the use of RSD-free seedcane and the employment of field hygiene measures. Loss due to RSD is estimated at 0.3% of yield, equivalent to R10 million per annum. The continued control of other important sugarcane pathogens is based on selecting and releasing varieties with satisfactory resistance. The benefit of growing sugarcane varieties that minimise losses from diseases can be demonstrated by quantifying the effect of diseases on susceptible varieties.

AGRICULTURE SESSION 5:

Environmental management and alien control

AN ENVIRONMENTAL MANAGEMENT SYSTEM FOR SUGARCANE IN THE NOODSBERG AREA OF SOUTH AFRICA

GW MAHER¹ AND L SCHULZ²

*¹South African Sugar Association Experiment Station, P/Bag X02,
Mount Edgecombe, 4300, South Africa*

E-mail: geoff.maher@sugar.org.za

*²Noodsberg Cane Growers' Association, PO Box 487, Wartburg, 3233, South Africa
E-mail: lotar@schulz.co.za*

Abstract

The Noodsberg Cane Growers' Association (NCGA) initiated an environmental management system (EMS) in the Midlands North region of the South African sugar industry, based on ISO 14001. A brief description of ISO 14001 is given, outlining the principles behind the system. The course of action taken in the development of the NCGA management system is described. A breakdown of the components of the EMS components is given, and the tasks required to satisfy them are discussed.

NATURAL INSECT ENEMIES FOR THE CONTROL OF *CHROMOLAENA ODORATA*

LW STRATHIE

*Agricultural Research Council – Plant Protection Research Institute,
P/Bag X6006, Hilton, 3245, South Africa*

E-mail: ntlws@natal1.agric.za

Abstract

Chromolaena odorata (L.) King & Robinson (Asteraceae: Eupatorieae), a shrub of neotropical origin, is a primary threat to the conservation of biodiversity, and to pastoral and crop agriculture and forestry in the subtropical regions of South Africa. It invades much of the sugarcane growing areas in KwaZulu-Natal and thus impacts negatively on the South African sugar industry. The plant presents similar problems in other parts of Africa, as well as in south-east Asia and Australia.

Since the inception of the chromolaena biocontrol research programme in South Africa in 1988, three species of *Pareuchaetes* moths (*P. pseudoinsulata* Rego Barros, *P. aurata aurata* (Butler) and *P. insulata* (Walker) (Lepidoptera: Arctiidae)), the larvae of which defoliate chromolaena, have been released into the field, but with minimal success. These agents have a mixed record worldwide, and no single factor has been pinpointed in determining their establishment or non-establishment. In conjunction with the Agricultural Research Council – Plant Protection Research Institute and the Department of Water Affairs and Forestry's 'Working for Water' programme, the South African Sugar Association Experiment Station has been, and is currently, involved in the production of substantial numbers of healthy *Pareuchaetes* larvae for release in the field (Muir and Conlong, 2003). Despite two years of releases of more than 800 000 *P. insulata* originally from hot, humid Florida (Muir and Conlong, 2003; Parasram, 2003), there has been limited success, possibly due to the exceptionally dry conditions that have been experienced in many areas of KwaZulu-Natal. Releases of two strains of *P. insulata* from Jamaica and the dry regions of Cuba are now being attempted, as these should be better suited to the local climate or host plant biotype, two factors which may have complicated establishment of previous releases.

**LABORATORY REARING OF *PAREUCHAETES INSULATA* (LEPIDOPTERA:
ARCTIIDAE), A BIOLOGICAL CONTROL AGENT OF *CHROMOLAENA ODORATA*
(ASTERACEAE)**

AJ WALTON AND DE CONLONG

*South African Sugar Association Experiment Station, P/Bag X02,
Mount Edgecombe, 4300, South Africa*

E-mail: xentam@sugar.org.za

Abstract

Since 2001, *Pareuchaetes insulata* Walker has been reared in the Insect Unit of the South African Sugar Association Experiment Station for release at selected sites in KwaZulu-Natal, by the Department of Water Affairs and Forestry's Working for Water programme. To date, more than 650 000 *P. insulata* larvae have been supplied to Working for Water for release against *Chromolaena odorata*, an extremely invasive alien plant. This paper describes the rearing methodology used to produce *P. insulata*, and the monthly production over the period 2001 to 2002.

**RELEASE OF *PAREUCHAETES INSULATA* (LEPIDOPTERA: ARCTIIDAE) AGAINST
CHROMOLAENA ODORATA (ASTERACEAE) IN KWAZULU-NATAL**

D MUIR¹ AND DE CONLONG²

¹*Department of Water Affairs and Forestry, Working for Water Programme,
Midmar Dam, KwaZulu-Natal, South Africa*

E-mail: NTDM@agric1.ac.za

²*South African Sugar Association Experiment Station, P/Bag X02,
Mount Edgecombe, 4300, South Africa*

E-mail xentdc@sugar.org.za

Abstract

In late 2000, *Pareuchaetes insulata* was collected from *Chromolaena odorata* in Florida, USA, and sent to the Agricultural Research Council's Plant Protection Research Institute quarantine laboratories at Cedara, KwaZulu-Natal (KZN). Upon its release from quarantine, it was sent to the South African Sugar Association Experiment Station insect unit for mass propagation. The first insects were released in early March 2001 and, since then, in excess of 650 000 *P. insulata* have been released. Initial releases were spread throughout coastal KZN, with each release site receiving 20 000 individuals. During releases, heavy defoliation of *C. odorata* was noticed, but subsequent surveys after releases were terminated provided no evidence of establishment. In 2002, it was decided to concentrate releases in two release areas, one of the south coast and another on the north coast of KZN. Heavy defoliation was again recorded at these sites during releases, and also considerable spread of *P. insulata* at the south coast site. This paper records the release sites used, and shows the impact caused by *P. insulata* while releases were in progress. It also discusses the suitability of the Floridean strain of *P. insulata* for use against *C. odorata* in KZN, and the way forward.

**THE ROLE OF CLIMATE IN OPTIMAL RELEASE STRATEGY DESIGN FOR
PAREUCHAETES INSULATA: A NEW CONTROL AGENT FOR TRIFFID WEED
(*CHROMOLAENA ODORATA*) CONTROL**

WA PARASRAM^{1,2}

¹*Ecophysiological Studies Research Group, School of Animal Plant and Environmental Sciences,
P/Bag 3, Wits 2050, Johannesburg, South Africa*

²*South African Sugar Association Experiment Station, P/Bag X02, Mount Edgecombe,
4300, South Africa*

E-mail: tryffan@webmail.co.za

Abstract

Pre-adaptation to the local climate, or the lack thereof, has been widely cited as one of the main reasons certain introduced natural enemies fail to establish on target weed species. Locally, the biological control programme on *Chromolaena odorata* has resulted in the unsuccessful releases of both *Pareuchaetes pseudoinsulata* (Lepidoptera: Arctiidae), the most successful agent released globally against the weed, and *P. aurata aurata*. In both cases the reasons for the failure to establish self-sustaining populations were unclear, although climate is likely to have played a role. Concurrent with the release of a new species, *P. insulata*, from climatically similar Florida, USA, into KwaZulu-Natal, a study of physiological tolerances was undertaken to evaluate the potential of this species to survive the local climate. This included degree-day development as well as computer modelling to find optimal release sites, which were ranked in terms of suitability. Results show that, while average local temperatures and humidities at most sites are significantly lower than those of Florida, and generational turnover will be negatively affected, all life stages should be able to survive locally. However, the relative importance of climate in successful establishment cannot be discounted and, with clarification of the roles of other factors, chiefly predation and parasitism, the answer to the question, "What has happened to them?" could well be answered in the near future.

BIOTYPE MATCHING OF CHROMOLAENA FOR MORE SUCCESSFUL BIOLOGICAL CONTROL

C ZACHARIADES

*Agricultural Research Council -Plant Protection Research Institute
(Cedara Weeds Laboratory), P/Bag X6006, Hilton 3245, South Africa
E-mail: ntczs@natall.agric.za*

Abstract

Many phytophagous insects and pathogens are highly specific in their host requirements, and will develop sub-optimally or not at all on biotypes of a plant species dissimilar from that on which they are collected. This clearly has major implications for the success of biological control.

Chromolaena odorata has a native range stretching from the southern USA to northern Argentina. The species displays wide phenotypic variation, both across its range and within localised areas. Until 1997, the biotype of chromolaena invasive in southern Africa had not been found to match that of any plants from its native range. Such matching was considered a priority because of the low success of some agents in the biocontrol programme in South Africa. Since 1997, increasing evidence has accumulated indicating that the southern African chromolaena biotype originates from one or more of the islands of the Greater Antilles in the northern Caribbean. Taking into account findings in the field as well as colonial links, Jamaica seems the most likely origin.

Recent surveys of both Jamaica and Cuba have revealed a relatively poor diversity of insects on chromolaena relative to the South American mainland. It is thus still considered necessary to target insect species from the latter area, if it can be shown that they are not biotype-specific.

JOINT AGRICULTURAL & FACTORY SESSION 6:

Modelling

USING THE INTERNET-BASED CANESIM MODEL FOR CROP ESTIMATION IN THE UMFOLOZI MILL SUPPLY AREA

J DE LANGE¹ AND A SINGELS²

¹Illovo Sugar Ltd, Umfolozi Mill, Private Bag X12, Mtubatuba, 3935, South Africa

*²South African Sugar Association Experiment Station, P/Bag X02
Mount Edgecombe, 4300, South Africa*

Abstract

An accurate estimate of the size of the sugarcane crop in a mill supply area is essential to ensure efficient milling of the crop. This paper describes the use of the Internet-based Canesim model to forecast the 2002/03 crop in the Umfolozi mill supply area. The model uses near real time data from three automatic weather stations in the area, data representing a likely future weather scenario and an irrigation strategy, as well as crop cycle dates and available soil water capacity (TAM) to calculate fresh cane yield.

Yields at were calculated for three groups of growers for each month of the milling season. The TAM used for each group was determined by a calibration process on historic yield and weather data. Calculated yields were adjusted with a management factor also determined from historic data. Estimates made in March through to November were compared with actual cane deliveries. The value of the estimates and problems that were encountered, are discussed. Improvements to the system are recommended.

HOW ACCURATE ARE CANESIM ESTIMATES OF SUGARCANE PRODUCTION?

CN BEZUIDENHOUT* AND A SINGELS

*South African Sugar Association Experiment Station, Private Bag X02,
Mount Edgecombe, 4300, South Africa*

**Currently: University of Natal, Pietermaritzburg, P/Bag X01,
Scottsville, 3209, South Africa*

Abstract

Forecasting the size of the sugarcane crop is essential to the industry for optimising cane milling and sugar marketing. The SASA Experiment Station provides regular forecasts of mill and industry average cane yields from a climatic perspective. The usefulness of this information depends on its accuracy, and this communication reports briefly on this aspect.

Future yields are calculated by applying the Canesim crop model to historic weather data, likely future weather scenarios, soil characteristics and management practices. Data from approximately 70 weather and rainfall stations are used to simulate the crop for each month of the milling season. Mean yields are calculated for homogenous climate zones, mill areas and the industry as a whole, and are expressed as a percentage of the yield from the previous season. The information is disseminated to the industry bi-monthly from February to August.

Estimation accuracy was determined by calculating the relative mean absolute error between estimated and actual tonnage. Actual yields were adjusted for long term trends in harvest age, the extent of the area that receives irrigation, and any water restrictions. This was compared with the inter-annual coefficient of variation in actual yields to assess the potential value of the forecasts.

The mean absolute error (MAE) for the industry estimate was 6.6% compared with an inter-annual variation in actual yield of 15.4%. This suggests that the industry cane crop estimate should be of value to decision-makers. On average, the MAE at the mill level was 12%, and ranged from 26% for Komatipoort to 8% for Amatikulu. These results indicate that, although further improvements to estimates are needed for irrigated mill areas, the estimates for most dryland areas are sufficiently accurate to be of value to mill management.

VALIDATION OF CANEGRO-DSSAT V3.5 FOR CONTRASTING SUGARCANE VARIETIES IN MAURITIUS

FB CHEEROO-NAYAMUTH¹, CN BEZUIDENHOUT*², GA KIKER³
AND ARH NAYAMUTH¹

¹*Mauritius Sugar Industry Research Institute, Reduit, Mauritius*

²*South African Sugar Association Experiment Station, P/Bag X02,
Mount Edgecombe, 4300, South Africa*

³*CEERD-EP-R, US Army Engineer Research and Development Center,
3909 Halls Ferry Rd, Vicksburg, MS 39180-6199, USA*

**Currently: University of Natal, Pietermaritzburg, P/Bag X01,
Scottsville, 3209, South Africa*

Abstract

The Canegro module available in the DSSAT V3.5 suite of models has been developed with genetic coefficients of varieties NCo376 and N12. Since the morphology and phenology of varieties grown in Mauritius are different, the use of coefficients available in the original version of the model for variety R 570 resulted in gross overestimation of the leaf area indices (LAI), aboveground biomass, and stalk and sucrose yields. The coefficients were therefore amended to suit variety R 570 and two other contrasting varieties, namely, M 13/56 (an efficient sucrose partitioning but low yielding variety) and M 555/60 (a drought resistant, medium yielding variety). Coefficients were computed from available growth analysis data. Regression of simulated versus observed stalk dry mass of variety R 570 under different water regimes (rainfed to fully irrigated) gave R^2 and RMSE of 0.613 and 6.25 t/ha respectively, for dry mass yields ranging from 0 to 55 t/ha. For the same parameter, the R^2 and RMSE were 0.589 and 7.34 t/ha respectively, for variety M 13/56, and 0.618 and 7.84 t/ha respectively for variety M 555/60. These values are comparable with those published in recent literature, confirming that model performance is satisfactory.

IN SEARCH OF PARAMETERS TO MODEL CULTIVAR-SPECIFIC CANOPY DEVELOPMENT

RA DONALDSON, KA REDSHAW AND A SINGELS

*South Arican Sugar Association Experiment Station, P/Bag X02,
Mount Edgecombe, 4300, South Africa*

Abstract

The primary role of a crop canopy is to capture sunlight that can be converted to biomass, including sucrose stored in stalks. Canopy development also has a bearing on the amount of water used by the crop and how soon weeds are shaded out. Cultivars are known to differ in the rate of canopy closure in the field, and also differ in traits that determine canopy development, such as leaf size and shoot density.

Crop simulation models have proven to be valuable tools in optimising management practices and they may also be useful in plant breeding programmes for identifying ideal cultivars for a range of environments (Yin *et al.*, 2003), provided they adequately capture cultivar differences. Accurate simulations of biomass (and sucrose) production are dependent on how well canopy development and light interception is mimicked. Singels and Donaldson (2000) have shown that the Canegro model (Inman-Bamber, 1991) does not adequately capture differences in canopy development between cultivars. Experiments were therefore conducted at Pongola and Mount Edgecombe to study selected aspects of canopy development of different cultivars at different times of the year.

PHYSIOLOGICAL PARAMETERS FOR MODELLING DIFFERENCES IN CANOPY DEVELOPMENT BETWEEN SUGARCANE CULTIVARS

M ZHOU¹, A SINGELS² AND MJ SAVAGE³

¹*Zimbabwe Sugar Association Experiment Station, P/Bag 7006, Chiredzi, Zimbabwe*

²*South African Sugar Association Experiment Station, P/Bag X02, Mount Edgecombe, 4300, South Africa*

³*University of Natal, Pietermaritzburg, P/Bag X01, Scottsville, 3209, South Africa*

Abstract

For crop models to be used as an aid to plant improvement programmes, they should adequately represent cultivar traits. Biomass production depends on photosynthetically active radiation (PAR) intercepted by the canopy. Canopy development depends on the production and senescence of tillers and leaves on tillers, processes that are controlled mainly by temperature and PAR. Cultivar traits could be simulated by physiological parameters where these are stable across environments, show significant differences between cultivars and have physiological meaning. Our aim was to quantify cultivar control of canopy development by defining key physiological parameters and determining the values for these in sugarcane cultivars ZN6, ZN7, N14 and NCo376 grown in Zimbabwe. The parameters studied were thermal time requirements for shoot emergence, leaf and tiller appearance, surface area and leaf number of the youngest biggest leaf, PAR transmission at the start of tiller senescence and PAR extinction coefficient. The potential use of a new phyllochron reference point as a cultivar parameter is discussed. Cultivar ZN7 had the highest and NCo376 the lowest rate of leaf emergence. Cultivar N14 had the largest and NCo376 the smallest leaves. Low stalk population cultivars ZN6 and ZN7 initiated tiller senescence at higher levels of transmitted PAR than higher population cultivars N14 and NCo376. Results indicated that cultivars with higher tiller production rates were more efficient in capturing PAR. The importance of traits such as leaf size and canopy architecture was secondary.

AGRICULTURE SESSION 7:

Patterns of pest and disease occurrence

FACTORS AFFECTING THE DISTRIBUTION OF PLANT FEEDING NEMATODES IN KWAZULU-NATAL

VW SPAULL¹, P CADET^{1,2} AND C GERS¹

¹*South African Sugar Association Experiment Station and* ²*Institute of Research for
Development, P/Bag X02, Mount Edgecombe, 4300, South Africa*

Abstract

Data from a survey of nematodes associated with sugarcane conducted in South Africa in 1978 (Spaull, 1981) were re-examined in combination with associated soil, climatic and topographic data. The objective was to identify associations between the distribution of the nematodes and soil, climatic and topographic factors in sugarcane fields in KwaZulu-Natal. The procedures used in the survey are summarized as follows. Soil and root samples were collected from 124 fields on a range of soil types in the 11 extension areas of the sugarcane growing regions in KwaZulu-Natal (Figure 1). Nematodes were extracted from the soil and roots, and the numbers of each genus recorded. Soil texture, organic matter content and pH were recorded using conventional methods. Mean annual rainfall, temperature, A-pan evaporation and solar radiation, as well as the altitude of the sites, were obtained from local records. Irrigation water applied to fields was added to the rainfall figures. Distribution and association of the abiotic factors and the nematode genera were studied separately by principal component analysis (PCA) using ADE4 software (Thiolouse *et al.* (1997). PCA values for the data were projected onto the map of the survey area to study spatial distribution. Association between abiotic factors and nematodes was studied using co-inertia analysis.

ASSOCIATION BETWEEN NUTRIENTS AND RUST IN SUGARCANE IN KWAZULU-NATAL

P CADET^{1,2}, SA McFARLANE² AND JH MEYER²

¹*Institute of Research for Development and* ²*South African Sugar Association Experiment Station, P/Bag X02, Mount Edgecombe, 4300, South Africa*

Abstract

Brown (common) rust has recently been prevalent in the South African sugar industry, particularly on N29, a sugarcane variety that is often severely affected by the disease. Cool, moist conditions have favoured the development of rust, but there has been a tendency for more severe infections to be associated with well grown sugarcane. To investigate this observation, two parallel rows, one with higher rust levels than the other, were selected in a field of N29. Soil and leaf samples were taken at 3 m intervals along each row and analysed for nutrients, and the leaves were assessed for the severity of rust infection. The data were subjected to principle component analysis. The results indicated that rust strongly interfered with the physiology of the plant. The presence of rust appeared to favour the uptake of K, to the detriment of Ca, Mg and Si. It is hypothesised that early application of Ca, before rust infection, may reduce levels of infection by limiting the uptake of K. The results also suggested that the application of Si might offer some protection against the fungus. Nematodes did not influence rust severity.

IMPACT OF NEMATODES ON SUGARCANE AND THE BENEFIT OF TOLERANT VARIETIES

VW SPAULL¹ AND P CADET^{1,2}

¹South African Sugar Association Experiment Station and ²Institute of Research for Development, P/Bag X02, Mount Edgecombe, 4300, South Africa

Abstract

The importance of growing sugarcane varieties that minimise losses from nematodes is linked to the effect that the nematodes have on the cane. Revised estimates of crop loss from nematodes in South Africa indicate a reduction in yield equivalent to more than 1.6 million tons cane per annum. The most pathogenic species on sugarcane, *Meloidogyne javanica*, is restricted to very sandy soils. The other pathogenic and much more widespread nematodes are *Pratylenchus zaeae*, *Xiphinema elongatum* and species of *Paratrichodorus*. The varieties generally tolerant of these nematodes can be identified by their smaller response to treatment with nematicide. The contribution that tolerant varieties make in minimising losses from nematodes was quantified by comparing their yield with susceptible varieties in six field trials conducted on sandy soil in three regions of the sugar industry, with between three and six crops per trial. Where a nematicide was not used, growing a tolerant variety increased yields by between 25 and 124% (average 83%) over that of a susceptible variety. The benefit was broadly equivalent to the increased yield achieved by treating the susceptible variety with a nematicide. In the six trials this represented an average increase of 34 t cane/ha. It is also shown that nematode tolerant varieties can sustain yields over time through the continued production of high yielding ratoon crops.

**PATTERNS OF DAMAGE FROM *ELDANA SACCHARINA* (LEPIDOPTERA:
PYRALIDAE) IN THE SOUTH AFRICAN SUGAR INDUSTRY**

MJ WAY AND FR GOEBEL

*South African Sugar Association Experiment Station, Private Bag X02,
Mount Edgecombe, 4300, South Africa*

Abstract

In the South African sugar industry, internal tissue of sugarcane stalks attacked by *Eldana saccharina* Walker (Lepidoptera: Pyralidae) often turns a red colour as a result of secondary infection by various organisms. In the factory, less sugar is extracted from these sections because sucrose is inverted to glucose. The length of stalk that is red thus provides an indication of the amount of sugar that will be lost as a result of damage by this pest. Loss estimates are important because they are used to calculate the cost:benefit ratios that are required to assess potential control options against *E. saccharina*.

Each season Local Pest, Disease and Variety Control (LPD&VC) teams conduct field surveys throughout the industry to determine the extent of red tissue. Stalk length red is expressed as a percentage of the total length of the stalk examined (% SLR). This short communication gives results from investigations into the patterns of this measure detected during the surveys. Data were collected from January to December 2002, from a range of geographical areas and varieties, in seasonal and older crops.

MAXIMISING FIELD TRIAL INTERPRETATION BY MAPPING SOIL HETEROGENEITY

P CADET^{1,2}, SD BERRY² AND VW SPAULL²

¹*Institute of Research for Development and* ²*South African Sugar Association Experiment Station, P/Bag X02, Mount Edgecombe, 4300, South Africa*

Abstract

Plant growth is influenced by the physical and chemical properties of the soil. These properties vary horizontally and vertically and, as a result, increase the variability between field trial plots and thus the precision of field trials. A study was undertaken to assess the feasibility of mapping the distribution of soil factors to identify heterogeneous areas. The data were collected from the sixth ratoon crop of a nematicide x variety trial on the North Coast of KwaZulu-Natal. The trial comprised nematicide treated and untreated plots of six cane varieties, N12, N16, N17, N23, N24 and NCo376, each replicated six times. When the cane was nine months old, soil samples were collected from the 0-20 and 20-40 cm layers. The soil from the two layers was analysed for pH, P, K, Ca, Mg, Na, Zn, Al, Mn, Fe, % clay, % silt, % fine sand, % medium sand and % coarse sand. ADE4 software was used for the principal component analysis (PCA) and Statview for the analysis of variance (ANOVA).

The PCA of the data from the topsoil identified two areas of, for the most part, contiguous plots with contrasting physical and chemical characteristics. Two similar areas could be distinguished from the analysis of the 20-40 cm layer. Analysis of the change per plot in soil characteristics with depth also identified an area that was not only different on the surface, but also in the deeper layer. Identification of plots located on different soils meant that those with a different set of characteristics could be removed before performing the analysis of variance to compare treatments. Without this adjustment three varieties, N12, N16 and N23, when treated with a nematicide, were statistically better than varieties N17, N24 and NCo376. However, after removing the 23 plots with the different topsoil, or after removing the 10 plots with a different topsoil and a different subsoil layer, N12, N16 and N23 were no longer statistically different from N17 or NCo376 (all treated with nematicide). This technique offers an unbiased method of eliminating replicates in a trial. However, reducing replicates decreases the strength of the statistical analysis. A better approach would be to recalculate yields according to the average content of the main soil components that induce the soil heterogeneity. This would not only reduce within-site variability but would maintain the full complement of replicates and allow the use of the Fisher block ANOVA.

AGRICULTURE SESSION 8:

Pests

***IDAECAMENTA EUGENIAE* (COLEOPTERA: SCARABAEIDAE: MELOLONTHINAE): A NEW SPECIES OF WHITE GRUB IN UGANDAN SUGARCANE**

DE CONLONG¹ AND AM MUGALULA²

¹*South African Sugar Association Experiment Station, P/Bag X02,
Mount Edgecombe, 4300, South Africa
(E-mail xentdc@sugar.org.za)*

²*Kinyara Sugar Works Ltd, Masindi, Uganda
(E-mail MugalulaA@kinyara.org.ug)*

Abstract

Towards the end of 2001, at Kinyara Sugar Works Ltd (KSWL) in Uganda, it was noticed that large areas of sugarcane on the estate were dying. After considering and investigating numerous possible causes, it was found that under the stools of dead or dying sugarcane were numerous white grub larvae. Adults of this insect were collected and sent to the Natural History Museum in London, where they were identified as *Idaecamenta eugeniae* Arrow.

This paper documents the first areas attacked by this species on KSWL, the severity of infestation at that time and the spread of *I. eugeniae* on the estate since then. It also documents the occurrence of fungal and bacterial pathogens of the larvae, as well as a dipteran predator. Cultural treatment of the first infected fields by ploughing reduced levels in those fields from more than 20 larvae per pit in 2001, to less than two in late 2002.

INVESTIGATION OF THE IMPACT OF *ELDANA SACCHARINA* (LEPIDOPTERA: PYRALIDAE) ON SUGARCANE YIELD IN FIELD TRIALS IN ZULULAND

FR GOEBEL AND MJ WAY

*South African Sugar Association Experiment Station, P/Bag X02,
Mount Edgecombe, 4300, South Africa*

Abstract

Through a joint SASEX/CIRAD, project the effect of *Eldana saccharina* Walker (Lepidoptera: Pyralidae) damage on stalk yield components was studied in fields at the SASEX farms at Gingindlovu and Empangeni. The formal experiment design consisted of randomised plots to compare natural infestation, artificial infestation and chemical treatments. Damaged stalks from infested plots had lower sucrose, higher fibre and lower stalk mass levels than treated plots. Stalk length and other parameters were also affected, particularly at Gingindlovu, where the level of damaged internodes reached 18%. The relationship between damage level and various other stalk components was also investigated. Stalk weight, stalk length and sucrose parameters were negatively correlated with percentage internodes bored. Increased fibre content, resulting in less juice, was positively correlated with the damage.

Results are generally consistent with past studies and with other methods used to assess loss. Information on the effect of stalk mass and height in damaged sugarcane was obtained for the first time in this study.

***ELDANA SACCHARINA* (LEPIDOPTERA: PYRALIDAE) IN SUGARCANE
(*SACCHARUM* HYBRIDS), SEDGE (*CYPERUS DIGITATUS*) AND BULRUSH (*TYPHA
LATIFOLIA*) IN SOUTH-EASTERN ZIMBABWE**

R MAZODZE¹ AND DE CONLONG²

¹Zimbabwe Sugar Association Experiment Station, P/Bag 7006, Chiredzi, Zimbabwe

E-mail: 259927@ecoweb.co.zw

²South African Sugar Association Experiment Station, P/Bag X02,
Mount Edgecombe, 4300, South Africa

E-mail: xentdc@sugar.org.za

Abstract

Random surveys of potential cultivated and indigenous host plants of *Eldana saccharina* Walker, a recent pest of sugarcane in Zimbabwe, were completed. Samples of *E. saccharina* were collected monthly, from February 2002 to January 2003 from four sugarcane sites and from *Cyperus digitatus* Roxb. subsp. *auricomus* (Sieber) Kuk. (Cyperaceae), an indigenous host plant, to study population fluctuations and parasitism of this pest. Included are data from *Typha latifolia* L. subsp. *capensis* (Typhaceae), which was sampled regularly from October 2002, following the discovery that large numbers of *E. saccharina* were feeding on the roots of this plant that were not submerged in water. Two new Cyperaceae are added to the list of known host plants of *E. saccharina*, viz. *C. digitatus* and *Cyperus involucratus* Rottb., as is *T. latifolia*. *E. saccharina* was not found in *Cyperus articulatus* L., nor in *Sorghum arundinaceum* (Graminae).

E. saccharina damage increased with crop age, and dropped dramatically following harvest. Numbers of *E. saccharina* followed the same pattern. However, the percentage internode damage showed no clear pattern and appeared to remain unchanged. Of the internodes bored, 77% were in the bottom third of the sugarcane stalk, 21% in the middle third and 2% in the top third. Infestations were higher in sugarcane than in *C. digitatus*. In *C. digitatus* most *E. saccharina* were found in almost equal numbers in the rhizome and the base of the main stalk. First and second instar larvae attacked only the inflorescence. In *T. latifolia*, *E. saccharina* were mostly in the root and the thickened lower part of the stalk. There were no *E. saccharina* in the inflorescence. No parasitoids of *E. saccharina* emerged from larvae and pupae collected from sugarcane or indigenous host plants during the 12 months of sampling. A final instar *Sesamia calamistis* Hampson (Lepidoptera: Noctuidae) larva, recovered from a sugarcane field, was parasitised by *Cotesia sesamiae* Cameron (Hymenoptera: Braconidae). *Beauveria bassiana* (Bals.) Vuill, was identified from two dead *E. saccharina* larvae collected in July 2002 from the bottom and middle stalk portions of sugarcane. Only one *Chilo partellus* (Swinhoe) (Lepidoptera: Crambidae) larva was found in sugarcane during the sampling period.

SURVEYING *ELDANA SACCHARINA* (LEPIDOPTERA: PYRALIDAE) IN A SMALL SCALE GROWER SECTOR OF THE SOUTH AFRICAN SUGAR INDUSTRY

MJ WAY¹, FR GOEBEL² AND WA GILLESPIE¹

¹*South African Sugar Association Experiment Station and* ²*Centre de Cooperation International en Recherché Agronomique pour le Developpement, P/Bag X02, Mount Edgecombe, 4300, South Africa*

Abstract

In 2002, an Integrated Pest Management (IPM) project between the South African Sugar Experiment Station (SASEX) and Centre de Cooperation International en Recherché Agronomique pour le Developpement (CIRAD) was initiated in one of the small scale sectors of the South African sugar industry. The aims are to study the current pest status of stem borers in these communities in relation to farming practices, and to collect information on any relevant environmental, socio-economic and agronomic conditions. During May 2002, preliminary surveys were completed in 55 fields at Sezela (30.22S 30.39E), in 12-month old sugarcane varieties NCo376 and N12 on small scale farms at Mission Section (MS) and 35 in comparable fields in the commercial sector (CS), which is in close proximity to Mission Section.

Despite generally low borer populations, the numbers of *Eldana saccharina* Walker (Lepidoptera: Pyralidae) larvae were significantly lower at MS than at CS. An average of 0.2 larvae/100 stalks were recovered at MS, compared with 3.2 larvae/100 stalks at CS (Table 1). Larvae were less widespread in the small scale area, where 20.7% of the fields contained individuals, compared with 74.3% of the fields surveyed in the commercial sector nearby. All but one of the lowest infestations were recorded at MS, and *vice versa*. There were also significantly lower levels of damage at MS than at CS ($t = -4.89$, $P < 0.0001$). Only 7.1% of the stalks at MS were damaged, whereas 14.9% stalks at CS were damaged. The intensity of damage in the stalk, assessed as % internodes bored, followed the same trend. In this study, % internodes bored and % stalk length red (results not shown) were strongly correlated ($r = 0.89$). These differences in infestations between small scale and commercial farms are consistent with past perceptions (Atkinson and Carnegie, 1989).

**TRICHOGRAMMA CHILONIS (HYMENOPTERA : TRICHOGRAMMATIDAE)
AS A BIOLOGICAL CONTROL AGENT OF *CHILO SACCHARIPHAGUS*
(LEPIDOPTERA : CRAMBIDAE) IN REUNION ISLAND : INITIAL FIELD TRIALS**

B SOULA¹, FR GOEBEL², P CAPLONG³, H KARIMJEE³,
R TIBERE¹ AND E TABONE⁴

¹CIRAD, Pôle de protection des Plantes, 97410 Saint-Pierre, Reunion, France

²SASEX/CIRAD, P/Bag X02, Mount Edgecombe, 4300, South Africa

³FDGDEC, 97460 Saint-Paul, Reunion, France

⁴INRA, Entomologie et Lutte Biologique, 37 Bd du Cap 06606, Antibes, France

Abstract

The spotted stalk borer, *Chilo sacchariphagus* Bojer, is a major pest of sugarcane in southern Asia, the Indian Ocean islands and Mozambique in southern Africa. Since 1999, a biological control programme has been developed on this pest in Reunion Island through a partnership between research and development organisations. *Trichogramma chilonis* Ishii has been shown to be the most naturally efficient parasitoid of the borer in Reunion, following a comparison of the bionomics of different strains of *T. chilonis*, and one strain was selected for mass production and field release testing. In 2002, two distinct sites, Savannah (SAV) and Sainte-Marie (SMA), were chosen for field experiments. At each site, plots were treated with releases of 150 000 *T. chilonis* per hectare and compared with untreated plots. In both plots, efficacy of these releases was assessed through damage to sugarcane internodes and mass of millable stalks at harvest. In treated plots, the percentage of bored internodes at harvest was 45% less than the controls at SAV and 36% at SMA. The mean stalk mass was 14% higher in treated plots at SAV, and 12% at SMA, corresponding to increases of 15 and 12 tons of cane per hectare, respectively. These results are presented and improvements in a new trial are suggested.

AGRICULTURE SESSION 9:

Soils management

THE IMPACT OF LIME AND GYPSUM ON SUGARCANE YIELDS AND SOIL ACIDITY IN THE SOUTH AFRICAN SUGAR INDUSTRY

DJ NIXON¹, JH MEYER¹, D McARTHUR² AND AW SCHUMANN³

¹*South African Sugar Association Experiment Station, P/Bag X02, Mount Edgecombe, 4300, South Africa*

²*Union Co-operative Ltd, PO Box 1, Dalton, 3236, South Africa*

³*University of Florida, Citrus Research and Education Center, 700 Experiment Station Road, Lake Alfred, Florida, 33850, USA*

Abstract

The yield responses of sugarcane to lime and gypsum at two sites in the KwaZulu-Natal Midlands of South Africa are presented and discussed. At Dalton, on a Magwa form soil with an initial aluminium saturation index (ASI) of >80%, over a plant and four ratoon crops variety N12 gave no significant response to dolomitic lime. By contrast, variety N16 gave consistent yield responses to lime at rates of up to 10 t/ha, and also to applications of 5 t/ha lime plus 5 t/ha gypsum, which gave the highest overall yield. At Paddock, on a Nomanci form soil with an initial ASI of about 80%, N16 gave consistent responses to dolomitic lime applied at 7 t/ha in the first to fifth ratoon crops, while N12 responded similarly from the third ratoon onwards. NCo376 gave yield responses to rates of 14 t/ha from the second ratoon onwards. The results confirmed the revised Fertiliser Advisory Service method of recommending lime to ensure that yields are not limited by soil acidity. In addition, there appears to be merit in applying gypsum as well as lime to acid soils. The implications for future research work on liming are discussed.

ASSESSING ORGANIC AMENDMENTS USED BY SUGARCANE GROWERS FOR IMPROVING SOIL CHEMICAL AND BIOLOGICAL PROPERTIES

R VAN ANTWERPEN¹, RJ HAYNES², JH MEYER¹ AND D HLANZE¹

¹*South African Sugar Association Experiment Station, Private Bag X02,
Mount Edgecombe, 4300, South Africa*

²*University of Natal, Pietermaritzburg, Private Bag X01,
Scottsville, 3209, South Africa*

Abstract

Sugarcane has been produced as a sole crop for at least 30 years in the Midlands area of KwaZulu-Natal and for more than 75 years on the coast. On poor soils a yield decline or plateau has been observed, despite the release of new sugarcane varieties with increased yield potential. Soil surveys conducted in the sugar industry have shown a steady deterioration of soil chemical, physical and biological properties as the period under sugarcane cultivation has increased. Proactive growers have used a range of organic amendments to improve and sustain soil quality, including filtercake, flyash, pine bark, cane trash, poultry and cattle manures, and the incorporation of a fallow crop (green manuring). A survey conducted in 2001 to determine the efficacy of these amendments, in particular on the biological properties of soils, found that filtercake and green manuring had the greatest effect on improved soil biological properties, as indicated by microbial biomass carbon and metabolic quotient.

POULTRY MANURE IS A VALUABLE SOURCE OF ORGANIC MATTER, NUTRIENTS AND LIME

A JUDGE AND RJ HAYNES

University of Natal, Pietermaritzburg, Private Bag X01, Scottsville, 3209, South Africa

Abstract

The effects of applications of poultry manure on soil properties are read 3-4.5% respectively and also a substantial P, K, Ca and Mg content. Layer poultry viewed and discussed. Poultry manure has a high pH (7.5-8.5), a C and N content of 25-40% manure has a high CaCO₃ content due to its presence in feed rations. Repeated applications of poultry manure to soil characteristically increase soil organic matter content, and this tends to improve soil physical properties. The bulk of the N in manure is in uric acid, which is rapidly converted to ammonium. Substantial losses of manure-N (30-50%) through NH₃ volatilisation can occur during storage, handling and application, so it is important to use practices that conserve manure-N. The P content of poultry manure is about half that of N and, as a result, when manure applications are based on recommended fertiliser N rates, large amounts of P can accumulate in the surface soil. Increases in pH and exchangeable Ca, Mg and K also occur in the topsoil. Repeated, long term applications of poultry manure can also result in an increase in pH and exchangeable Ca, Mg and K, and a decrease in exchangeable Al in the subsoil (e.g. 10-60 cm) below the depth of manure incorporation (e.g. 0-10cm). The main mechanism for this appears to be the leaching of cations and slow downward movement of alkalinity. It is concluded that poultry manure is a valuable soil amendment and that its application can improve soil organic matter content and soil nutrient status.

INVESTIGATION INTO THE FLOWERING OF SUGARCANE VARIETY n29 GROWN UNDER DIFFERENT NUTRIENT REGIMES

MJ BRUNKHORST

South African Sugar Association Experiment Station, Private Bag X02,

Mount Edgecombe, 4300, South Africa

brunkhorst@sugar.org.za

Abstract

Little research has been conducted on the effect of nutrition on flowering of sugarcane plants used for breeding new varieties. Some problems with panicle emergence and survival being experienced at Mount Edgecombe are presumed to be due to incorrect nutrition of the cane plants. A preliminary investigation by the author revealed that nutrient balances within the plant could play an important role in the flowering of potted sugarcane plants. This prompted a further investigation into the impact of nutrition on panicle and seed production in the crossing programme at Mount Edgecombe.

Potted plants of variety N29 were grown in 10 fertiliser regimes involving two calcium, magnesium and micronutrient (CaMgMicro) treatments (-/+) by five macronutrient treatments. Four macronutrient treatments involved the removal of N, NK, NP, or NPK from the fertiliser used during plant establishment, while in the fifth treatment plants received NPK until anthesis. The fertiliser treatments significantly influenced the flowering and seed set of N29. No significant difference was observed between treatments for panicle initiation. Weekly application of nitrogen or CaMgMicro until anthesis significantly increased flowering, and a significant phosphorus by CaMgMicro interaction was observed. The application of potassium when CaMgMicro was not applied delayed flowering significantly. Weekly application of nitrogen until anthesis significantly reduced the percent pollen stained as well as the number of viable seeds per gram of fuzz. However, stalks receiving nitrogen or CaMgMicro until anthesis produced significantly heavier panicles, and significant interactions involving phosphorus, potassium and CaMgMicro were observed. Significantly more viable seeds were obtained per panicle or per gram of fuzz where potassium or CaMgMicro were not applied until anthesis. In addition, more viable seeds per panicle were obtained when no CaMgMicro was applied.

**RELATING REMOTELY SENSED MULTI-TEMPORAL LANDSAT 7 ETM+
IMAGERY
TO SUGARCANE CHARACTERISTICS**

CJ GERS

*South African Sugar Association Experiment Station, P/Bag X02,
Mount Edgecombe, 4300, South Africa*

Abstract

This paper explores the relationships between normalised multi-temporal Landsat Enhanced Thematic Mapper Plus satellite imagery and sugarcane age, variety and yield at Umfolozi. Five Landsat images were obtained for the Umfolozi mill supply area for the 2002-2003 growing season, as well as field boundary and agronomic information for large scale grower fields. The satellite images were normalised using the COST image-based atmospheric correction model, following which the spectral reflectance values for each field were extracted and stored in a relational database. The results show that thermal age groups of sugarcane can be identified from the at-satellite reflectances. Sugarcane varieties could not be distinguished by the at-satellite reflectances. No meaningful relationships between yield and the single-date at-satellite reflectances were found.

AGRICULTURE SESSION 10:

Water management

**A MODEL FOR THE EVALUATION OF IRRIGATION AND WATER MANAGEMENT
SYSTEMS
IN THE LOWVELD OF ZIMBABWE
I: MODEL DEVELOPMENT AND VERIFICATION**

NL LECLER

*Zimbabwe Sugar Association Experiment Station, P/Bag 7006,
Chiredzi, Zimbabwe*

Currently at: South African Sugar Association Experiment Station, P/Bag X02,

Mount Edgecombe, 4300, South Africa

E-mail: Neil.Lecler@sugar.org.za

Abstract

In order to assess the performance of water management procedures and irrigation systems used in the sugar industry in the Lowveld of Zimbabwe, a sugarcane yield and irrigation systems simulation model was developed. The model was used to predict how field derived 'Irrigation Engineering Performance Indices' (IEPIs) of irrigation systems performance, such as the coefficient of uniformity, CU, impacted crop yields and water budgets. This enabled the impacts of the IEPIs on irrigation efficiency and water productivity to be determined in relation to soils, climate, irrigation system type and irrigation scheduling strategy. In this paper the development of the systems simulation model is described. Results of a verification study of the model showed an index of agreement, 'd', of 0.96 between observed and simulated relative Estimated Recoverable Crystal (ERC) yields. This is very close to a value of 1.0, which would indicate perfect agreement between observed and simulated relative ERC yields. The root mean squared error was 0.056, indicating that on average the predicted relative yields were within 6% of the observed relative yields. The model was prone to slight overestimation of yield declines caused by mild soil water stressing and slight underestimation of the yield declines caused by more severe soil water stressing. The correlation coefficient (Pearson's r) of 0.94, nevertheless indicated a very high degree of correspondence between the observed and simulated relative yields. Application of the model is presented in a companion paper.

**A MODEL FOR THE EVALUATION OF IRRIGATION AND WATER MANAGEMENT
SYSTEMS
IN THE LOWVELD OF ZIMBABWE
II: MODEL APPLICATION**

NL LECLER* AND B GRIFFITHS

*Zimbabwe Sugar Association Experiment Station, P/Bag 7006,
Chiredzi, Zimbabwe*

**Currently at: South African Sugar Association Experiment Station, P/Bag X02,*

Mount Edgecombe, 4300, South Africa

E-mail: Neil.Lecler@sugar.org.za

Abstract

A computer simulation model was developed to evaluate the performance of irrigation and water management systems. The development of the model is described in a companion paper. In this paper the application of the model to evaluate a selection of the various water management and irrigation systems prevalent in the Lowveld of Zimbabwe is presented. Most of the drip irrigation systems were performing below potential due to excessive infield variations in applied water. The performance of furrow irrigation systems was limited by the large variations in water applied to individual furrows, and water applications that were, on average, excessively high relative to soil water holding characteristics. Simulations showed that sub-surface drip irrigation systems have a slight edge on other irrigation systems in terms of *potential* efficiency, *viz.* average water savings ranged from approximately 2.2 to 1.5 ML/ha relative to floppy irrigation systems, and 3.5 to 2.3 ML/ha relative to typical furrow irrigation systems, depending on how water applications were scheduled. Using existing water management guidelines, large amounts of deep percolation were simulated for all systems, especially furrow irrigation. The danger of increased development of soil salinity problems due to raised water tables, especially under furrow irrigation, was highlighted. A key finding was that there was potential for the Lowveld sugar industry to use up to 30% less water per hectare on an annual basis if *ZIMsched*, a specialist irrigation scheduling tool, was used to derive more appropriate water management guidelines. However, simulations showed that with the more precise irrigation scheduling there could be a slight crop yield penalty when the distribution uniformity of applied water was poor. The potential water savings should be stored, and used to support the industry during the drought years. If water savings are not made nor stored for future use, or a portion of the sugar industry's allocated water or water savings are re-allocated to another user, there is every chance that a similar disaster to that which occurred after the 1991/92 drought, could recur, and again bring the industry to near collapse due to a shortage of water.

WATER USE EFFICIENCY OF IRRIGATED SUGARCANE AS AFFECTED BY ROW SPACING AND VARIETY

F OLIVIER AND A SINGELS

*South African Sugar Association Experiment Station, P/Bag X02,
Mount Edgecombe, 4300, South Africa*

E-mail: Francois_Olivier@sugar.org.za

Abstract

To meet the challenge of a limited and costly water supply, South African sugarcane growers will have to find ways of increasing the efficiency of irrigation to maintain high cane and sucrose yields. The term 'water use efficiency' (WUE) is generally used as a measure of the overall effectiveness of water (either rainfall or irrigation, or both) for crop production. WUE can be defined as cane yield per unit of crop water use (evapotranspiration). Irrigation water use efficiency (IWUE) is another term commonly associated with WUE, and can be defined as the cane yield response per unit of irrigation water applied. More efficient irrigation systems, accurate irrigation scheduling and agronomic practices such as mulching, variety choice and row spacing are potential means of increasing water use efficiency. WUE and IWUE values are required for water resource planning and for the assessment of irrigation management practices. Improved water use efficiency would also reduce negative environmental impacts by reducing runoff, erosion, drainage and leaching of agricultural chemicals.

The objective of this study was to determine the WUE and IWUE of surface drip irrigated sugarcane as influenced by the amount of irrigation applied, the variety planted and the row spacing arrangement. The information obtained will be used to develop irrigation recommendations, as well as to test crop models. Preliminary results are reported here.

SUITABILITY OF CENTRE PIVOT IRRIGATION FOR SUGARCANE PRODUCTION IN SWAZILAND

OE MAGWENZI¹ AND SV NKAMBULE²

¹*Swaziland Sugar Association Technical Services, PO Box 367, Simunye, Swaziland*
E-mail: oswaldmagwenzi@ssa.co.sz

²*Ubombo Sugar Limited, PO Box 23, Big Bend, Swaziland*
E-mail: Snkambule@illovo.co.za

Abstract

Centre pivot irrigation is on the increase in Swaziland, with approximately 6% of the sugar industry (3500 hectares) already using this method. The main reasons for the rapid adoption of the centre pivot system are low cost per hectare, low labour and energy requirements, ease of operation, high application and distribution efficiencies and the prospect of increasing or maintaining yields while using less water. Although used mainly by large scale growers, centre pivot irrigation has also proved suitable for small scale farmers in organised associations. At present, two small scale projects have 300 ha of sugarcane under centre pivot irrigation.

This paper outlines technical, agronomic, economic, managerial and environmental factors that determine the suitability of the centre pivot system for sugarcane. The paper concludes that centre pivot irrigation has the potential to increase productivity through more uniform water application (coefficient of uniformity >85%), efficient water application (application efficiency >80%) and low-pressure requirements (operating pressure <400 kPa). However, to realise these benefits a systematic process of matching the system to a given site is required, complemented by good management of the system after installation. The main constraints identified include application rates that exceed the infiltration capacity of most soils in Swaziland, and the limitations imposed by the need to irrigate out-fall areas on existing rectangular fields. Centre pivot irrigation requires relatively flat land that is free of obstacles and, to maximise irrigation efficiency and cost effectiveness, fields should be limited in size to between 40 and 70 hectares.

CHARTS AND CALENDARS FOR IRRIGATION SCHEDULING OF SUGARCANE IN THE ZIMBABWE LOWVELD

NL LECLER

*Zimbabwe Sugar Association Experiment Station, P/Bag 7006,
Chiredzi, Zimbabwe*

Currently at: South African Sugar Association Experiment Station, P/Bag X02,

Mount Edgecombe, 4300, South Africa

E-mail: Neil.Lecler@sugar.org.za

Abstract

Many emergent farmers growing irrigated sugarcane do not have easy access to computers. To provide such farmers with appropriate agronomic and water management decision aids, charts showing when irrigation water should be applied were produced and are described in this paper. The charts can be used with most types of irrigation systems and on all soil forms found in the sugar industry. A simple but robust methodology to determine and account for effective rainfall was also developed. The information in the irrigation scheduling charts, together with other appropriate agronomic recommendations, could help growers to derive more inclusive 'sugarcane growing' management calendars, which include fertiliser and herbicide recommendations. Although not as accurate for water management as the use of credible computer simulation models and near-real time weather data, these schedules and the methodology for accounting for rainfall, could be better suited to many growers.

FACTORY SESSIONS

FACTORY SESSION 1:

Engineering

MILL FEEDING: BACK TO BASICS

A WIENESE

Sugar Milling Research Institute, University of Natal, Durban, 4041, South Africa

E-mail: awienese@smri.org

Abstract

This paper describes a few of the classic theories on mill feeding and reinforces some of the general principles on this subject. It is evident that a change in mill throughput can be achieved by changing the mill speed or the work opening. The latter is independent of the set opening and can only be changed by altering the feed characteristics. One of these characteristics is the feed opening. For a particular mill configuration there is a feed opening which results in the maximum throughput at the same speed. However, this maximum can be limited due to insufficient roller roughness causing slippage. The feed opening affects mill torque and the forces acting on the mill housing.

FACTORS AFFECTING THE SAFE AND EFFICIENT OPERATION OF BAGASSE/COAL FIRED WATERTUBE BOILERS

H VERBANCK, K MCINTYRE AND Q ENGELBRECHT

John Thompson Boilers, PO Box 129, Bellville, 7535, South Africa

Email: info@johnthompson.co.za

Abstract

The paper covers various aspects relating to the operation and maintenance of bagasse/coal fired watertube boilers which, if properly implemented, will ensure that the boiler operates safely at optimal performance while maintenance and operating costs are minimised. The current philosophies on instrumentation and controls are discussed. This includes combustion and drum level control loops as well as interlocks and safety devices. Operating problems due to unbalanced steam line pressure drops are covered, and recommendations are given for the design of steam lines. The importance of training courses for operating and maintenance personnel is emphasised, including the day-to-day aspects of proper boiler operation. An overview of present and proposed legal requirements for operating, maintaining and repairing boilers in South Africa is also given.

Basic principles of lightning protection pertaining to a factory environment

F CALBOUTIN

Frank Calboutin and Associates, 17 Westridge, Umhlanga Rocks, 4319, South Africa

frank@cybertrade.co.za

Abstract

In the industrial and administrative environment the installed base of distributed controls, measurement devices, and data networks, that utilise sophisticated electronics, has increased greatly over the past decade. Factories have become more reliant on electronic instruments and controls for efficient operation. The equipment used is interconnected via a web of communication, control and power cables. These cables often radiate out to remote locations such as weighbridges and pump stations, and act as receptors of surges caused by indirect lightning strikes, thus endangering the control system. On the administration side, offices contain a plethora of equipment such as computers, printers, scanners and telephone systems, usually connected via copper cable networks. Although this equipment may not be in use in control functions, it plays a vital role in the operational system.

All electrical and electronic equipment is susceptible to disruption by lightning electromagnetic pulses, by electrostatic discharges, and by switching electromagnetic pulses. This paper describes how progressive protection can minimise lightning and other surges entering electronic systems, and the importance of choosing the right protection. The holistic view taken considers three areas of protection. These are the building, where practical, the co-ordination of surge protection devices within the building, and the correct earthing principles.

FACTORY SESSION 2:

Instrumentation for Quality Control

EVALUATION OF AN ETHANOL DETECTOR FOR STALE CANE IDENTIFICATION AT NOODSBERG

RC LOUBSER¹, MA GOOCH¹, P SHARMA² AND W RICHARDS²

¹*Sugar Milling Research Institute, University of Natal, Durban, 4001, South Africa*

²*Noodsburg Sugar Factory, P/Bag 501, Dalton, 3236, South Africa*

Abstract

Previous work has shown that there is a relationship between the degree of deterioration of cane and the amount of ethanol present. The use of an ethanol detector for identifying stale cane was investigated at Noodsberg. This tool will enable the cane quality controller to identify areas where cane delays occur and implement appropriate action.

The detector uses the infrared absorbance of ethanol to measure the concentration of ethanol present in the air drawn through the instrument. Although this technique was shown to work exceptionally well in the laboratory, in a factory many practical problems can arise. The cane must be shredded, since little or no ethanol is released through the rind of the cane. Shredding releases moisture that, if not separated from the air sample, will accumulate on the optics and cause drift in the readings. The measurement is actually ethanol per unit volume; consequently, any pressure drop in the sampling system will cause a drop in the reading. Small pieces of fibre accumulating in the piping may allow fermentation of the sugar and lead to false ethanol readings. Temperature has a marked effect on the evaporation rate, and hence the ethanol present in the air sample. Compensation functions had to be included.

This paper examines the test data that was collected to verify the detector's ability to indicate ethanol in cane. The techniques used to prepare the air sample for the detector in continuous operating conditions are also discussed.

The application of the detector will allow the prediction of problems in the processing of deteriorated cane and also give an early alert to cane quality monitors so that speedy corrective action can be taken along the supply chain.

TRANSITION FROM LEADED POL TO NIR POL IN THE SOUTH AFRICAN SUGAR INDUSTRY

BM SCHOONEES

Sugar Milling Research Institute, University of Natal, Durban, 4041, South Africa

bschoonees@smri.org

Abstract

The South African sugar industry is facing a change from the conventional, lead-based pol analyses to the use of a lead-free pol method in the 2003/04 season. The new method involves the use of a near infrared (NIR) light source which does not require the test solution to be of low colour. Lead clarification can therefore be replaced by a simple filtration step to remove solution turbidity. Lead sub-acetate clarification is known to complex non-sucrose components such as fructose, glucose, dextrans and colourants in solution; the simple filtration needed for NIR pol, using a suitable filter aid, does not alter the chemical composition of the test solution. The effects of seasonal trends in terms of the concentration of these non-sucrose components on the NIR pol values of various products are not yet fully established and difficult to predict.

The phased transition from the use of conventional pol to NIR pol is therefore being scrutinised to identify any possible pitfalls. An attempt is also made to approximate the effect of NIR pol on important South African factory performance measures, and to present some guidelines on the interpretation of NIR pol values.

CLEAR JUICE TURBIDITY MONITORING FOR SUGAR QUALITY

SC MKHIZE

Sugar Milling Research Institute, University of Natal, Durban, 4041, South Africa

E-mail: smkhize@smri.org

Abstract

A considerable amount of South African raw sugar is sold to export markets. Consistently good filterability of this sugar is important for satisfying the requirements of customers. To the refiner, the filterability of raw melt is important as this affects refinery throughput. Analysis of filtration-impeding impurities in raw sugar has shown that, among other things, poor juice clarification could be related to poor filtering sugars. To this end, a South African Sugar Association sponsored investigation into sources of high turbidity in clarified juices and their relation to poor filtering sugars was begun.

Results from the 2002 season show that both process variables and cane quality were causes of high juice turbidities. In particular, flow disturbances, poor pH control, and poor and frequent start-up and shutdown incidents were major process variable contributors to poor turbidities. Some of the worst start-up and shutdown incidents would have resulted in carryover. Poor cane quality consistently resulted in high juice turbidity. While cane quality is largely a field issue, evidence suggests that slowing down of the factory does improve juice turbidity. This strategy would be particularly beneficial when employed to minimise the frequency of the shutdown and start-up often associated with poor cane supply. It is planned to correlate juice turbidity to sugar filterability and to relate these to various aspects of cane quality. Filterability of raw sugar is generally only measured at the Sugar Terminal and then only on composited samples. More frequent measurements are needed for process monitoring and, to this end, filterability test equipment is being manufactured for use at mills.

FACTORY SESSION 3:

Heaters and Evaporators

CLEAR JUICE HEATERS – DO WE NEED THEM?

SD PEACOCK¹ AND DJ LOVE²

¹*Tongaat Hulett Sugar, Durban, South Africa*

²*David Love Process Engineering cc, Durban, South Africa*

Abstract

Current practice is to install clear juice heaters ahead of first effect evaporators to ensure that the juice entering the evaporator is above its boiling temperature, allowing flashing to occur on entry. The alternative, of allowing the juice heating to take place in the evaporator, is sometimes rejected on the basis that heating transfer performance of an evaporator is very poor when operating in the juice heating regime. To allow this alternative to be evaluated on a quantitative basis, available data on the relative heat transfer performance of juice heaters and Kestner evaporators have been collated, providing estimates of the difference in heating surface area required. By combining this information on heating surface area requirement with equipment costs, it is possible to make a rational assessment on whether it is advisable to dispense with clear juice heaters by installing extra heating surface area in the first effect evaporators.

TESTS ON A PLATE EVAPORATOR PILOT PLANT AT MALELANE

RC LOUBSER¹, P SAHADEO² AND I SINGH²

¹*Sugar Milling Research Institute, University of Natal, Durban, 4001, South Africa*

²*Malelane Sugar Mill, Transvaal Sugar Ltd*

Abstract

A pilot plate evaporator plant using the new AlfaVap 700, together with a controller test rig, was installed at Malelane Sugar Mill. The plate evaporator was first installed in parallel to the first effect then the second and fourth effects. Measurements were taken to determine the heat transfer coefficients. It was found that the values measured in the second effect exceeded those for Roberts vessels operating under similar conditions, while results for the first and fourth effects compared favourably with design values for Roberts vessels.

Although provision was made for chemical cleaning, this was never found to be necessary. For completeness of the study, a chemical clean was performed after the fourth effect test was completed.

In the study it was found that heat transfer coefficients comparable to or better than those achievable with a shell and tube design can be expected using plate heat exchangers. None of the fouling problems previously experienced with plate evaporators were detected while testing the new AlfaVap 700 pilot plant.

A REVIEW OF THE MECHANICAL CLEANING OF EVAPORATORS

GRE LIONNET¹ AND LA BLAIKIE²

¹*Tongaat-Hulett Sugar Ltd, Private Bag 3, Glenashley, 4002, South Africa*

²*Tongaat-Hulett Sugar Ltd, Private Bag, Amatikulu, 3801, South Africa*

Abstract

Although many sugar factories in Southern Africa still clean their evaporators mechanically, this topic is not well documented in recent literature. This paper describes the basic procedures used by Tongaat-Hulett factories, and highlights some of the practical steps that have been found useful. The equipment used is described, and cleaning rates in terms of tube area cleaned per operator is given. General costs are estimated.

FACTORY SESSION 5:

Refinery Operations

DEVELOPMENT AND PROCESS DESIGN OF THE NEW MELTER STATION AT AL KHALEEJ SUGAR REFINERY

J AL GHURAIR AND AS VAWDA

Al Khaleej Sugar Refinery

P. O. Box 17077, Dubai, UAE.

Abstract

The expansion of the Al Khaleej sugar refinery in Dubai necessitated the redesign of the melter station. This paper reports on the design and operation of a novel low temperature and low retention melter commissioned in April 2001. A simple mathematical model based on material and heat balances was developed to predict the performance of the melter. Several process flows were modified to achieve better process and energy efficiencies. Details of the stirrer design, recycle arrangement, screening and, most significantly, the use of two direct contact heaters in series, are discussed. Solutions to design and operating problems are also described.

OPTIMISATION OF REFINERY PRESSURE LEAF FILTER PERFORMANCE BY DOSAGE OF FILTER AID INTO THE FILTER FEED STREAM

I SINGH, P SAHADEO AND N KALIDASS

Transvaal Sugar Ltd, PO Box 47, Malelane, 1320, South Africa

Abstract

The Malelane refinery decolourisation process comprises a primary carbonatation step followed by filtration through pressure leaf filters and a secondary light sulphitation step, again followed by filtration through another set of pressure leaf filters. Although the resultant refined sugar colour obtained with this process is adequate, the levels of turbidity and insoluble solids in refined sugar have been problem areas. Analysis of the filtered residue in refined sugar pointed to calcium sulphite as the main cause of turbidity and insoluble solids. The source of the residue was traced to break-through of minute amounts of calcium sulphite during the filtration process.

Conventional pre-coating practise involves making a suspension of filter aid in condensate and then depositing a layer of filter aid onto the filter membrane by recycling flow through the filter. The filtration process only commences once this primary media is established. This paper reviews steps taken at Malelane refinery to optimise performance of the pressure leaf filters by:

- An initial high dose of filter aid directly into the filter feed stream to build up a primary filtering media on the filter cloth surface.
- A continuous lower dosage of filter aid is maintained to ensure porosity of the cake as it builds up during the filtration cycle.

The benefit of this technique is that it is a 'quick fix' that provides a simple, low cost dosage plant, significantly longer filter cycle time and improved refined sugar quality.

**EVALUATION OF CHEMICALLY REGENERATED ACTIVATED CARBON
(SPARAC)
FOR SUGAR DECOLOURISATION**

B BARKER¹, SB DAVIS¹ AND M SCHOLTEN²

¹*Sugar Milling Research Institute, University of Natal Durban, 4041, South Africa*

²*Norit Nederland BV, Nijverheidsweg-Noord 72 3812 PM Amersfoort*

E-mail: bbarker@smri.org

Abstract

Norit Carbon has developed a chemically regenerable activated carbon (SPARAC) that is suitable for sugar decolourisation. Previous evaluation of this activated carbon showed promising results, and Norit developed another grade of SPARAC that had faster adsorption kinetics. This carbon has been evaluated in terms of its colour removal performance after successive regenerations. Decolourisation trials were performed at the SMRI using brown liquor and a pilot plant supplied by Norit. The effects of suspended solids, different regeneration techniques and different throughputs on carbon performance were investigated. Results show that, although there is a large-drop off in carbon performance after the virgin cycle, fairly constant performance is obtained after further regenerations. The design of a larger scale pilot plant, based on the test data, is also discussed.

FACTORY SESSION 7:

Boiling House Operations

C-MASSECUITE PROCESSING IN THE LABORATORY: SOME PRELIMINARY RESULTS

FS MNCUBE¹ AND DJ LOVE²

¹*Tongaat-Hulett Sugar Ltd, Durban, South Africa*

²*David Love Process Engineering cc, Durban, South Africa*

Abstract

It is widely accepted that simulating full scale boiling of C-massecuite on a small experimental scale is particularly difficult if not impossible due to the very high viscosities encountered. Recent work using the new pilot scale pan in the THS laboratories has demonstrated that it is possible to produce high brix C-massecuite on a small scale. To extend this test facility, a set of six batch laboratory crystallisers has been refurbished and fitted with the necessary controls to undertake cooling crystallisation of massecuite produced by the pan. These crystallisers can be programmed to operate with any desired cooling profile. Each crystalliser doubles as a Nutsch filter, allowing the progress of crystallisation to be monitored by sequential Nutsching of the individual crystallisers at intervals over the total crystallisation period. Preliminary results indicate that target purity can be achieved with this combination of boiling and cooling crystallisation in the laboratory.

Evaluation of THE STG high grade continuous centrifugal at Huletts Refinery

M MOODLEY¹, M PILLAY¹, PM SCHORN¹, G MITCHELL² AND RE GELLING²

¹*Tongaat-Hulett Sugar Ltd, Private Bag 3, Glenashley, 4022, South Africa*

²*Tongaat-Hulett Sugar Refinery, PO Box 1501, Durban, 4000, South Africa*

E-mail: Mano.Moodley@huletts.co.za

Abstract

Due to the benefits reported on the use of continuous centrifugals in refineries elsewhere in the world, it was decided by Tongaat-Hulett Sugar Ltd to evaluate the Schultz, Tait and Greig (STG) continuous centrifugal at their sugar refinery in Durban, South Africa. This paper deals with the installation, commissioning and evaluation of the continuous centrifugal. Results of tests done on first and second refined massecuites are presented. Some problems experienced during the trial are discussed, and the benefits of using continuous centrifugals in the refinery are given.

FACTORY SESSION 8: Cane supply

MODELLING SUPPLY CHAIN MANAGEMENT IN THE SUGAR INDUSTRY

S GAUCHER¹, P-y le gal², L-G SOLER¹

¹*Institut National de la Recherche Agronomique, 65 Bd de Brandebourg, 94205 Ivry sur Seine, France*

²*CIRAD and Centre for Rural Development Systems, University of Natal, P/Bag X01, Scottsville, 3209, South Africa*

E mail: pierre-yves.le_gal@cirad.fr

Abstract

Greater competitiveness and deregulation in agribusiness and the food industry require new forms of co-ordination between farmers and their clients to increase the efficiency and profitability of the supply chain. Various co-ordination processes are used by processing firms to control the quantity and quality of their raw material. In the sugar industry, millers plan their cane supply to ensure that the mill operates at optimum capacity throughout the entire season. They may also take into account variations in cane quality within the supply area and at different times during the season to maximise sugar production. These decisions will impact on the choices growers make with regard to their harvest capacities and management and, depending on the cane payment system in place, on their incomes as well. Other stakeholders in the supply chain, such as contractors and hauliers, also directly affect its management and results. Any modification to the structure of the supply chain or the management rules should take into account stakeholder strategies and ways of operating. A modelling approach based on two complementary models has been developed to simulate on a weekly basis the planning and operation of mill supply throughout the season. The first model compares weekly and total sugar production for a season. The second model focuses on the simulation of logistic chains, and enables the impacts of technological and structural changes on daily harvest and transport capacities to be assessed. Both models can be used to support discussion and negotiation between growers and millers regarding evolutions in the supply chain management.

MAGI: A simulation tool to address cane supply chain management

P-Y le gal¹, c le jars² AND s auzoux³

¹*CIRAD and Centre for Rural Development Systems, University of Natal,
P/Bag X01, Scottsville, 3209 South Africa*

²*CIRAD-CA, Station La Bretagne, BP20, 97408 Saint-Denis Messageries Cedex 9, La Réunion*

³*CIRAD-CA, TA 70/09, 34398 Montpellier Cedex 5, France*

E-mail: pierre-yves.le_gal@cirad.fr

Abstract

The management of cane supply from growers' fields to the mill involves many stakeholders and many tasks to be carried out along the chain, the successful combination of which impacts on the efficiency and profitability of the mill area. A simulation tool called MAGI has been developed to assist millers and growers in designing and assessing new ways of organising supply management. The issues addressed by MAGI include the restructuring of mill areas (industrial and agricultural capacities, chain structure), changing delivery allocation rules and season duration, and dividing the mill area according to variations in cane quality. MAGI simulates the mill supply over the season on a weekly basis. It takes into account agricultural and industrial capacities, cane production by homogeneous units at the mill area level, and some mill operating variables such as length of milling season and mill opening and closing dates. Each production unit is characterised by its cane area, cane yield, harvest-transport capacity and sucrose curve obtained from the mill database. Scenarios of supply are compared according to weekly and total sugar production over a season. The impacts of unforeseen events such as delivery failures or mill breakdowns on sugar production can also be assessed. Currently based on the Réunion situation, MAGI will be improved to take into account a wider range of sugar production environments, particularly in South Africa.

ASSESSING THE POTENTIAL FOR IMPROVING MILL AREA PROFITABILITY BY MODIFYING CANE SUPPLY AND HARVEST SCHEDULING: A SOUTH AFRICAN STUDY

E GUILLEMAN¹, P-y le gal², e meyer³ AND e schmidt³

¹*Institut National Agronomique, 16 Rue Claude Bernard, 75005, Paris, France*

²*CIRAD and Centre for Rural Development Systems, University of Natal, Scottsville, 3209, South Africa*

³*South African Sugar Association Experiment Station, P/Bag X02, Mount Edgecombe, South Africa*

E-mail: pierre-yves.le_gal@cirad.fr

Abstract

In South Africa, cane is delivered to the mill uniformly over the milling season and across all supply areas. This delivery schedule does not exploit the cane quality patterns, represented by the 'recoverable value' (RV) of sugar, which show distinct regional trends, primarily due to climate differences and the resulting differences in agronomic practices. This study, which focused on the Sezela mill supply area, investigated the potential for improving mill area profitability by modifying cane supply and harvest scheduling to account for sub-region cane quality trends. Production and delivery data from mill weighbridge and cane quality databases was analysed for 2000 and 2001, to determine cane quality trends as well as the capacity and variability of cane deliveries through the season. Sub-areas likely to have similar patterns in cane quality throughout the year were delimited using weather data, and new curves for RV distribution were developed for these areas using the cane quality database. Various cane supply scenarios from these sub-areas were evaluated using a spreadsheet model developed during the project. Each scenario represented different start and end dates for cane delivery in each sub-area, and different rates of delivery during the harvest window. The results showed that, by breaking the mill supply area into homogenous zones and adapting allocation according to cane quality variations, total RV production could be increased by 1-5%. Furthermore, results showed that all growers (inland, hinterland and coastal) would improve their revenues under the scenarios tested. The implications of this new organisation for delivery allocation between growers within a sub-area, harvest operations at farm level and the cane payment system, are discussed.

**building and assessing supply management scenarios based on cane quality variations:
example of LA reunion island**

c. lejars¹, P. letourmy² AND s. laurent²

¹*CIRAD-CA, Station La Bretagne, BP20, 97408 St Denis Messagerie cedex 9, La Réunion*

²*CIRAD-CA, TA70/09, avenue Agropolis, 34398 Montpellier cedex 5, France*

E-mail: caroline.lejars@cirad.fr

Abstract

Cane and sugar yields within a sugar mill area vary with geographical location and climatic conditions. Delivery allocations policy and sugarcane supply management may take into account these variations of quality in order to improve sugar production and mill area profitability. In La Réunion Island, alternative supply scenarios based on quality variations were designed and simulated for Le Gol mill area. An analysis of sugarcane quality variations within the mill area was necessary to design new supply scenarios. The mill area was split into homogeneous quality zones by carrying out a statistical cluster analysis. A simulation tool, called MAGI, was then used to evaluate the impact on sugar production of supply scenarios based on two zoning levels. Different harvest windows were tested for each zone to increase sugar production. Delivery allocation took into account the mill crushing capacity and the storage and transport capacity between mill and transloading zone. Results show a gain of 2-5% sugar, depending on the zoning accuracy.
