BURNT VERSUS GREEN CANE HARVESTING: AGRICULTURAL ENGINEERING CHALLENGES

By

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Abstract

The Agricultural Engineering Section of the International Society of Sugar Cane Technologists (ISSCT) held a workshop between 12 and 17 October 2003 in Thibodaux, Louisiana, United States of America. The papers presented at the workshop were grouped under the following general headings: burnt versus green cane harvesting, land preparation and planting, trash management, crop maintenance and machinery costing and benchmarking. The five-day workshop program included two field tours in Louisiana as well as a post-workshop one-day tour of the Florida sugar industry. In this paper, the main issues emerging from the deliberations are discussed, and the issues that remain to be resolved are highlighted. The conclusions drawn were that modern chopper harvesters, under normal field and crop conditions, are capable of handling all but very heavy green cane crops. It was generally accepted that losses and extraneous matter levels are higher in green cane for both manual and mechanical harvesting systems. Furthermore, both manual and mechanical harvesting costs are higher in green cane compared to burnt cane. Best management practices for mechanical cane harvesting and planting were presented. While there are clear agronomic and environmental benefits in many environments from green cane harvesting, further research is required to study the impact that crop residues have on ratoon crops under cool or wet conditions. Alternative post harvest residue handling equipment and systems also need further evaluation, particularly as residues are a potentially important energy source. The principles and standards for a uniform machinery costing protocol based on the classical costing approach were presented and accepted. This would be beneficial when reporting machinery costs at workshops and congresses.

Introduction

The ISSCT Agricultural Engineering Section held its 7th Workshop in October 2003, in Thibodaux, Louisiana, USA to discuss the practical, agronomic, economic and social implications of green cane harvesting, trash management, crop maintenance, planting and machinery costing, and benchmarking in sugar producing industries around the globe.

The workshop was attended by 54 delegates representing 13 sugar producing countries and included delegates from Australia, Argentina, Colombia, England, Guatemala, Guadeloupe, Guyana, India, Mauritius, Reunion, South Africa, United States of America and Zimbabwe. The President and General Manager of the American Sugar Cane League (ASCL), Mr Charlie Melancon, welcomed the delegates at a formal reception held on Sunday 12 October. The Workshop was officially opened on Monday 13 October by Mr John Gay,
Chairman of the Board, ASCL, who presented an historical overview of the Louisiana sugar industry and the role that the ASCL plays in that industry.

Formal sessions

The formal sessions were held at the Howard Johnson Lodge in Thibodaux. A total of 32 verbal and 4 poster presentations were made under the three session topics, namely:

- Green cane versus burnt cane harvesting.
- Land preparation, planting, crop maintenance and trash management.
- Machinery costing and benchmarking.

Each topic was introduced by a Committee member or invited speaker, followed by presentations by the delegates, with adequate time for questions and discussions. The papers covered a good mixture of practical and technical papers and were generally of a high standard. This paper summarises the issues presented and discussed during the formal sessions.

Green cane versus burnt cane harvesting

It is estimated that less than 20% of the world’s more than 1000 million tonnes of sugarcane is harvested mechanically. Harvesting systems vary widely and the choice of one system over another will depend on labour availability, labour cost, topography and climatic conditions. Many sugarcane industries are still seeking an interim step between manual and fully mechanised harvesting systems. In industries where terrain, field layout or mill receiving facilities preclude the economic use of chopper harvesters, much research is being conducted to develop appropriate whole stalk harvesters.

India has about 4.02 million hectares under sugarcane cultivation and produces about 300 million tonnes of cane annually. Sugarcane is harvested manually at a cost varying between US$1.50 to US$2.40 per tonne, with a significant proportion of the crop being harvested unburnt. Due to labour shortages at certain times of the year various whole stalk and chopper harvesters have been imported, with limited adoption because of the small size of fields and cultural practices. The cost of mechanical harvesting was quoted as between US$2.4 and US$4.5 per tonne, depending on machine type. Research is continuing to develop harvesters suitable for Indian conditions.

Labour cost and availability is also a problem on Reunion Island. A tractor drawn whole stalk green cane harvester has been developed to address this problem. The machine gathers the cane in bundles, and is capable of operating in small fields and on relatively steep terrain. It harvests between 9 and 11 tonnes per hour, apparently with minimal damage to cane stools. The estimated harvesting cost is US$7.81 per tonne.

The consensus of the workshop was that, regardless of the country involved, harvesting of sugarcane without burning presents some additional challenges. In many environments, there are still many issues that have not been resolved satisfactorily, with certain local industry conditions often exacerbating issues. A direct physical impact of harvesting without prior burning is slower harvesting rates for manual and mechanical harvesters respectively. Although with mechanical harvesters there is the potential for dramatically reducing harvest-to-crush delays, there is also a risk of higher cane losses, and the quality of cane being delivered to factories is often poorer because of increased extraneous matter. No mechanical harvesting system, for either green or burnt cane harvesting can selectively remove damaged or dead cane stalks or water suckers.

Tests carried out in Sudan showed that chopper harvester output in green cane was reduced by between 38% and 50% and fuel consumption increased by between 75% and 128% compared with harvesting burnt cane. Green cane losses ranged from 2.9 to 7.3 t/ha compared with 1.3 to 1.4 t/ha in burnt cane. However, as operators gained more experience, these differences became smaller. This research demonstrated the issues relating to harvesting large green crops.

Studies on the effect of trash in cane on mill processing in Louisiana reflected results from elsewhere in demonstrating lower mill throughput because of the increase in fibre %. This results in a longer milling season. Increased trash levels also reduce extraction rates and result in lower juice quality, thus reducing recoverable sugar. Increases in wear and tear on machinery as well as the overall processing cost per tonne of cane are also noted. Louisiana data indicates that acceptable trash levels in cane can be achieved by adjusting
harvester forward speeds in line with crop conditions, and also by ensuring cutting and extractor blades are kept in good condition.

A Papua New Guinea sugar estate has moved to green cane trash blanketing on the basis of demonstrated advantage for the control of both pests and diseases, as well as to enhance environmental sustainability. To facilitate this change, while minimising the detrimental aspects of green cane on harvesting losses and cane quality, harvesting best practice (HBP) protocols have been introduced. These were seen as necessary to reduce direct and indirect losses, as well as maximising the quality of cane being delivered. In order to maintain good row profile and minimise remedial tillage after harvest, the plantation is moving to dual row cropping and minimum tillage systems incorporating controlled traffic.

Participants at the workshop noted there had been some significant improvements to the gathering and feeding mechanisms and the cleaning systems of modern chopper harvesters. In Argentina, where 85% of the cane is mechanically harvested, tests have shown that the latest chopper harvesters have increased harvesting rates and lowered fuel consumption and extraneous matter levels in cane samples when operating in green cane, relative to superseded models. It was also shown that trash levels could be maintained at acceptable levels without excessive cane losses by operating the primary fan speed at around 900 rpm on this machine.

Base cutter pressure is related to the blade operating height above or below the soil surface. In Argentina, three different base cutter operating pressures were tested in a replicated factorial trial with different cane varieties. High base cutter pressure settings result in the blades operating well below the soil surface. This results in lower cane losses but increases extraneous matter levels. The effect of this aggressive operation on ratooning and future farm productivity can be severe. Apart from the effect of base cutter height, soil type and soil moisture, cane variety and management practices were all demonstrated to affect ratoonability, levels of extraneous matter and cane losses.

Other Argentinean trials looked in detail at both cane quality and cane loss associated with burning and green cane harvesting. It was found that losses of sugar from the cane after burning were higher than in green cane, due mainly to the effect of burning and billeting. However, total losses were marginally higher in green cane because of cleaning losses in the harvester. Research is continuing to minimise cane losses by reducing the extractor fan speed and reduce extraneous matter levels by optimising the extractor fan speed and reducing harvester pour rates.

The concept of secondary cleaning of the cane at the mill was discussed during the workshop sessions. Apart from offering the potential to collect more biomass for energy production, reducing the level of cleaning attempted on the harvester can demonstrate very substantial reductions in cane loss from the harvester cleaning system.

A major limitation to the adoption of mechanical harvesting in the super-humid regions of Mauritius, where annual rainfall exceeds 2500 mm, was the use of wheeled chopper harvesters. The introduction of chopper harvesters on tracks and the redesigning of lightweight trailers fitted with low pressure tyres has led to improved harvester and haulage capacities, reduced cane stool damage and reduced overall costs.

With increasing environmental pressure to restrict burning, there is a real need to further improve machine performance, reduce the amount of extraneous matter being delivered to the factory and to reduce cane losses when operating in green cane.

Strict regulations on pre-harvest burning of sugarcane in many countries, including the United States of America, Brazil and Colombia, are now being enforced. An outline of existing laws in Florida, Hawaii, Louisiana and Texas was presented at the Workshop. The increasing interfacing of agricultural land with residential communities, as well as the increasing public concern with health, is forcing industries to scrutinise their agricultural practices more closely.

There is also a need to develop best management practices for individual local conditions in order to ensure economically and ergonomically sustainable cropping systems. A mechanical harvesting best practice manual has been developed in Australia and is commercially available.

The manual was published to highlight current knowledge of green cane harvesting, to increase the understanding of the harvesting process and improve operations in the field. The aim of the manual is to highlight harvesting best practices and show how these factors can affect profitability.
The move over many years towards green cane harvesting has resulted in machinery manufacturers and operators focusing on high machine output by increasing power for more aggressive stalk knockdown. Unfortunately this focus has resulted in damage to both cane stalks and cane stools. Research undertaken in Australia to better understand the machine/crop interactions has resulted in modifications to harvester gathering and feed systems to better handle large recumbent green cane crops as well as to reduce stool damage and cane losses. Results of this work are being incorporated into harvester designs.

The higher the degree of mechanisation, the higher the risk of soil compaction, particularly if no attempt is made to match the track width of all machinery and row spacing of the crop. Recent research in Colombia has demonstrated that uncontrolled traffic of mechanised and semi-mechanised harvesting equipment resulted in cane yield losses of 30 t/ha, mainly due to stool damage. They found that direct stool damage by infield machinery is reduced to a minimum when fields are planted at least 1.75 m row spacing. They also found that this strategy limited compaction to the top 0.25 m soil depth.

Precision farming issues were also addressed at the workshop. A paper described the evaluation of a ‘Greenstar auto steer’ system conducted in Florida. The auto guidance system was mounted onto a chopper harvester and tested under local conditions. The result showed that the harvester followed the row within its advertised accuracy of ±100 mm in a straight-line application, which demonstrates the system potentially offers significant advantage for mechanisation in sugarcane. One obvious immediate advantage is for operating at night or in green cane.

Approximately 20% of the crop in Mauritius is currently being harvested mechanically. A recently conducted survey revealed that 74% of the total cane area is suitable for mechanical harvesting. It is expected that about 31% of the area under cane will be mechanically harvested by 2007, of which 83% will be harvested green. Currently 65% of the total cane area is harvested green. Mechanised harvesting will be performed mainly on corporate and large planter estates.

The ISSCT preferred harvester testing protocol was reviewed at the workshop. It was agreed that certain sections of the protocol need clarification, while others require revision. A proposed new protocol will be drawn up and circulated to the delegates before being resubmitted to ISSCT.

Land preparation, planting, crop maintenance, and trash management

There are many factors to be considered when switching from burnt to green cane harvesting. The more important advantages of green cane harvesting are well documented. However, some of the benefits are countered by the suppressive effect of trash on ratoons, the harbouring of some diseases and insect pests and the difficulty of undertaking remedial tillage under a trash blanket. Addressing these issues will require inputs from agricultural engineers, agronomists and economists. Millers must also accept that, with green cane harvesting, extraneous matter levels (and therefore fibre) will increase, but that there are also gains to be made in the form of a fresher cane supply.

It has been widely recognised that traditional tillage systems can destroy soil structure and organic matter, and increase erosion potential. In Australia, as in many other countries, the adoption of minimum or no-tillage planting and crop rotation systems as part of an improved sustainable cropping system, is seen as a major advance. Crop rotation is also seen as a desirable practice to improve soil health and control pests and diseases. In Australia, research has shown that profitability has been improved by integrating legume based rotations, minimum tillage and a controlled traffic farming system. This system is likely to be more resilient and environmentally friendly.

Much research has been carried out around the world to develop improved mechanical planters and no-tillage whole stalk and billet planters. In Australia, poor metering systems and poor billet quality have been identified as major problem areas with mechanical billet planting, resulting in higher than normal seeding rates to ensure acceptable cane stands. Traditional planters often require fine seedbeds which are costly to prepare. On the other hand, planters with disc furrow openers can be used for minimum till and no-till planting with minimum soil disturbance. Advantages of disk openers on planters include lower draft, reduced moisture loss and improved set soil contact leading to improved germination rates.

Due to the high cost of labour in Florida, several single and multi-row billet planters were tested to compare planting uniformity with the traditional hand (dropping off trailers) planting system. Results show that
'along the row' planting rates vary considerably between machines with the desired rate of 10 t/ha being only a gross mean. Problems in uniformity are due to the heterogeneous nature of the billets and their poor 'flow' characteristics. Research into rate controllers is continuing as one method to help alleviate the problem.

In Australia and Florida, the quality of billets used for mechanical planting has been improved by research into better harvester maintenance and adjustment. In Florida, best practice protocols, based on Australian protocols, have been developed to ensure that good quality billet seed is used in re-establishing fields. Harvester forward speed should be reduced and all blades should be kept sharp, billets should have 3–4 eyes, chopper blades should run bevel to bevel, single chopper drums and smooth feed rollers should be used, and underslung cutter boxes are preferred to leg boxes.

In Colombia, improved field layout design enhanced mechanical harvesting machinery performances by reducing time lost by up to 30%. The Colombian results further quantified observations from elsewhere showing that direct stool damage by infield machinery is reduced to a minimum when cane fields are planted at row spacings which better match the harvester and infield transport track widths, thus assisting in controlling traffic paths. Trials have shown that uncontrolled traffic systems can reduce cane yield by as much as 30 t/ha. Improved field layout and design have resulted in lower machine repair costs and significant irrigation water savings.

An alternative planting system is being tested in Australia in an effort to improve cane yields and to avoid the negative effect of soil compaction. In the standard 1.5 m row spacing, up to 90% of the field area is compacted by harvesters and infield transport at harvest. One system being researched incorporates permanently raised 2.3 m wide beds into which three rows of cane (0.55 cm apart) are planted using a specially modified whole stalk mechanical planter. Modified 2.3 m track chopper harvesters, equipped with wider spaced crop dividers and larger diameter base cutter, and 2.3 m track haul-out vehicles are used for the harvesting operation. At ploughout, the cane is chemically eradicated and the raised beds are planted with a soybean fallow crop using a five row drill. Results from one site showed that, under dry conditions, the establishment of the centre cane rows was slow and stalks were thinner. Other systems being evaluated with greater success are dual row systems with distances between rows ranging from 0.5 to 0.8 m and overall spacing between beds ranging from 1.8 to 2.1 m.

There are several new types of equipment available commercially for use in managing crop residues. Some of the equipment can be used to incorporate trash and tops into the inter-row, while other machines such as a modified road brush, can be used to remove the trash from the top of the cane rows. In areas where burning is prohibited, or where crop residues cause slow emergence or yield decline, this type of equipment provides growers with alternative management practices. Trials conducted in Louisiana showed that the highest yields were obtained where the residue was mechanically removed from the top of the row and incorporated into the inter-row. The lowest yield occurred when the residue was not removed.

In Guyana an inter-row implement has been developed to off-bar, para till and scarify to level deep ruts and relieve the effects of soil compaction caused by the introduction of mechanical loading equipment operating on 8–12 m wide cambered beds.

In Colombia, where fresh trash residues can vary between 50 and 150 t/ha, excess moisture on the soil surface can cause stool rotting and stunted stalk growth during wet weather conditions. The results of trials in which several alternative trash management systems were tested showed that, under Colombian conditions, it is essential to use green cane trash management systems that allow for mechanised cultural practices, otherwise cane production is adversely affected.

The use of a modified forage harvester to finely chop the trash residue and the hilling-up of cane rows is seen as the best option when practising green cane harvesting under Colombian conditions. The increasing adoption of green cane harvesting in Argentina has led to the development of a range of multi-purpose trash working implements which can apply fertiliser under the trash residue, either near the soil surface or incorporate it at greater depth.

These implements are equipped with a combination of discs, coulter, ripper shanks (some fitted with wings) and various types of press wheels. Operating costs of post-harvest green cane cultural/fertiliser equipment is competitive with that used for conventional operations in burnt cane.
The concept of recovering most of the above-ground biomass during the harvesting operation is not new. The results of trials conducted in Florida, where combine harvester extractor fans were turned off, showed that the trash content averaged about 20% compared with 8% when extractor fans were in use. Truck payloads were reduced by as much as 38% when the fans were turned off. Harvester forward speed with the extractor fans off was 10% slower than when the fans were on, and harvester output was 13% lower when the fans were off. The lower harvester output can be ascribed to the increase in total cane and residue mass passing through the machine. Juice quality was similar for both harvesting approaches. The delegates agreed that enormous potential exists for maximising the value of total biomass of the sugarcane crop.

Interesting research work is being conducted in Mauritius on the effect of crop residue on irrigation practices. Results indicate that, in treatments which received no irrigation, there was sufficient soil moisture in the presence of trash to establish a good crop stand in the early stages. There was no significant difference in the number of tillers after nine weeks between zero, 35 and 70 mm irrigation regimes. Furthermore, by delaying the irrigation, the risk of ‘damp soil’ diseases and outbreaks of armyworm will be minimised. Delaying irrigation is expected to reduce the rate of trash decomposition, which in turn will limit the growth of weeds.

A mini precision farming workshop was scheduled as part of this session. Precision farming is based on the concept that variability in soil fertility, soil depth, microclimate and weed species all occur naturally and are site dependent, and all of these factors have a direct influence on crop production.

The precision farming concept is really a combination of several relatively new technologies such as micro-computers, global position systems (GPS), geographic information systems (GIS), information gathering hardware and software, and the automatic control of farm machinery. The system has the potential to improve yields, and low-yield areas can be better managed to increase yields. The use of variable rate technology allows for more effective and more economic nutrient use, as well as being environmentally friendly. Although variable rate technology is well developed, the same cannot be said for cane yield monitors on sugarcane harvesters. The use of auto steer guidance equipment was shown to be most useful in maintaining accurate steerage in green cane harvesting and avoiding cane stool damage. Delegates agreed that precision farming should be part of an overall plan to make industries more productive, competitive, sustainable and environmentally friendly in the future.

Machinery costing and benchmarking

The management of agricultural machinery in a hyper inflationary environment, such as that found in Zimbabwe, is difficult. Using sensitivity analysis to review conventional costing systems, it was found that machinery costs were highly sensitive to fluctuations in utilisation levels, interest and inflation rates. Repair and maintenance costs were highly distorted, making it virtually impossible to use these as a guide in directing machinery replacement policy, as well as making it difficult to make cost comparisons of alternative sources of machinery.

It was shown that, in developing countries such as Kenya, Guyana, Indonesia and New Guinea, the use of small-scale contractors on large sugarcane estates can be cheaper and can provide a more satisfactory service than in-house equipment fleets or large-scale contractor organisations. However, a gradual phasing-in of contractors over a long period may be necessary to build up the required capacity. The use of small-scale contractors could benefit the estate as well as the local community.

The Discounted Cash Flow (DCF) method of costing agricultural machinery can be used to determine the cost of mechanised operations. The DCF method takes into account factors such as the effects of inflation, interest and the time value of money, as well as the implications of various income tax considerations. The DCF method can further assist in evaluating capital equipment replacement decisions. As these factors are not fully accounted for when using the popular ‘Classical’ machinery costing method, the use of the DCF method results in a more accurate account of machinery costs and cash flow.

Machinery and equipment costs form a major proportion of total sugarcane production costs. It is estimated that, in some industries, these costs can be as high as 40%. At the previous Agricultural Engineering Workshop held in Malelane, South Africa, it was agreed that a standard costing method was essential and would be beneficial when reporting machinery costs at workshops and congresses. A machinery costing and
performance standards protocol, based on the "Class II" costing method, was tabled at this workshop. The proposed protocol was accepted unanimously by the delegates, and the Chairman was asked to prepare the final draft and distribute it to the delegates prior to mailing it before the ISSCT.

Another issue that was raised at the previous Workshop was that of benchmarking methods and standards. It is often extremely difficult to make meaningful cost comparisons between farming enterprises that are similar, and even more so between communities or industries that are dissimilar. It was therefore proposed that a set of standard processes and procedures be drawn up for use when carrying out a benchmarking exercise to ensure portability and effective comparisons between systems.

Workshop sessions

At the end of each formal session time was set aside for informal ‘workshopping’ sessions. The aim of the workshopping sessions was to give delegates an opportunity to raise issues not covered during the formal sessions, or to air their views on matters raised during the day’s proceedings. These sessions were structured under the following headings:

- Mechanical issues.
- Labour issues.
- Cane quality issues.
- Agronomic issues.
- Best management practices.
- Future research requirements.

The general conclusions drawn from these workshopping sessions are summarised below.

Industry decisions

It was widely agreed that industries wishing to move to green cane harvesting systems should undertake a comprehensive and complete economic study to assess the impacts of such a decision. Issues that may impact on the final decision are:

- Labour availability
- Labour performance
- Availability of suitable machinery
- Harvesting and transport machinery performance including cane loss
- Variety choices, performances and ratoonability
- Climatic issues (rainfall, altitude, aspect and frost)
- Cane payment system
- Milling capacity
- Marketing
- Sustainability
- Social and political issues
- Environmental policies
- Carbon credits

It is also vitally important that industries establish their current cost of operations. In this way, industries can clearly identify all the issues that will change or be affected, so that an accurate economic estimate of costs can be made when such a change is implemented. Furthermore, a comprehensive plan of action must be implemented in which issues are prioritised in order to achieve the final goal.

Green cane harvesting benefits

Numerous advantages of green cane harvesting were identified, including improved water infiltration rates, reduced water and soil runoff, slower cane deterioration and better weed control. Industries should therefore seek to take maximum advantage of these potential gains, which may overcome some of the negative issues associated with green cane harvesting.

The potential to integrate co-generation with a move to green cane harvesting was also seen as advantages because of both the increased residue supply and the potential to reduce trash levels in the field in a controlled way.
Research requirements

There remain many issues, such as choice of cane variety and trash management, concerned with green cane harvesting that still require further research. Some of these issues are applicable to certain situations while others have more of a global nature. The delegates suggested that there should be much closer co-operation between research groups and organisations when drawing up research programs rather than working on these issues individually. This would not only speed up research outcomes, but probably also reduce research costs.

Best practices

It is believed that, in many industries, there are many well established best practices that have already been identified or are already in place. It may be possible for other industries to apply some of these practices, be it with minor modifications to suit their circumstances and situations. Best management practices may result in poorer/unsuitable land going out of production, but good productive land will stay in sugarcane production.

Dissemination of information

Many delegates believed that ISSCT should take leadership in dissemination of knowledge and research interchange. The positive interchange of information at the workshop was seen as a major benefit to all participants and was identified as critical for the success of the green cane system. Furthermore, this may avoid making the same mistakes over and over again.

It was generally agreed by the delegates that the workshopping sessions were useful in that they expanded on numerous issues pertaining to the day's proceedings. A summary of these sessions will be forwarded to the delegates in due course.

Business meeting

An ISSCT business meeting was held at the end of the formal sessions. A short promotional presentation on the 25th ISSCT Congress to be held in Guatemala during January/February 2005 was shown and discussed with the delegates.

The delegates unanimously proposed that the next workshop should be hosted by Argentina. Also discussed during the business meeting was the proposed theme and topics for the Agricultural Engineering sessions at the ISSCT Congress to be held in Guatemala in 2005.

Finally, delegates wishing to be considered for membership of the Agricultural Engineering Section Committee were asked to submit their names to the Chairman. The Chairman will forward the names of potential committee members to the ISSCT Technical Program and Executive Committees for consideration.

Field tours

The purpose of the field trips was to expose delegates to the widest possible range of agronomic field practices, harvesting, infield loading and cane transport systems as well as mill receiving facilities in use in the Louisiana and Florida sugar industries.

On a half-day tour in Louisiana delegates visited the United States Department of Agriculture research farm near Houma, where they were shown how field trials are mechanically harvested and weighed. Delegates were also shown a commercial harvesting operation being carried on a private estate where single and two-row chopper harvesters were being used.

A visit to the Cameco Industries’ Rebecca farm made up the last stop of the day. During a full day tour, delegates were shown a single row combine harvester with modified gathering fronts to minimise pickup losses in sprawled cane, various trash handling and management equipment and systems, and a billet transloading operation. The MA Patout Enterprise sugar factory, located near Jeanerette, was visited and delegates were shown a whole truck tippler offloading system and were given a guided tour of the cane cleaning facility and the only diffuser sugar extraction system presently in use in Louisiana. The tour also included a visit to the factory’s cane quality testing facility.

A post-workshop one-day tour of the Florida sugar industry was arranged by the Florida Sugar Cane League. During this tour, mechanical harvesting, a manual and three mechanical planting systems were demonstrated. Other stops included water management and water quality control, a tractor and cane harvester fitted with auto steer and a variable rate fertiliser applicator. Finally, there was a drive-past visit to the
Oakeelanta Corporation’s co-generation plant, which is fuelled by bagasse, wood chips and cane trash, and the company’s sugar packaging plant.

Conclusions

Although many issues have been solved in some industries, the move to green cane harvesting and many of the associated economic and cultural practices remain a challenging prospect for many other sugar industries. The most important issues that have to be addressed are improving harvesting rates and reducing extraneous matter levels of the cane delivered to the factory. In the absence of a quantum leap in harvester cleaning system technologies, secondary cleaning systems are seen as one way to achieve this while minimising cane loss. There is a need for plant breeders to develop erect, loose leaved or self-trashing varieties to facilitate easier harvesting operations. Further research is required to study the impact that crop residues have on ratoon crops especially under cool or wet conditions as well as alternative post harvest equipment and management systems.

An important conclusion reached at the workshop was that no individual farming practice should be dealt with in isolation. Rather, an all encompassing approach should be adopted which will deal with issues concerned with management of crop residues, soil compaction, soil health and long term industry sustainability and environment protection.

The workshop provided a useful opportunity for international interaction between delegates with varying backgrounds to meet and discuss common problems in a friendly and informal venue. This event again emphasised the growing need and value of workshops for ISSCT members.

Acknowledgements

The Agricultural Engineering Section Committee consisting of E. Meyer (Chairman, South Africa), C. Norris (Australia), E. Jacquin (Mauritius), C. Richard (United States of America) and J. Scandaliaris (Argentina) wishes to thank the American Sugar Cane League and its organising committee for organising and hosting the workshop. The Committee gratefully acknowledges the support of numerous Louisiana and Florida organisations, agricultural machinery suppliers and service providers for their generous support and sponsorship.

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LA RÉCOLTE DE LA CANNE À SUCRE EN VERT: LES DEFIES DE LA MÉCANISATION

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MOTS-CLÉS: Canne Brûlée, Canne Verte, Récolte, Gestion de la Paille, Plantation, Coût de Machines, Benchmarking.

Résumé

LA SECTION de machinisme agricole de l’International Society of Sugar Cane Technologists (ISSCT) a tenu un atelier de travail du 12 au 17 octobre 2003 à Thibodaux, Louisiane, Etats Unis d’Amérique. Les communications présentées à cet atelier ont été groupées sous les rubriques générales suivantes: la récolte en vert v/s brûlé, le travail du sol et la plantation, la gestion de la paille, l’entretien des cultures, les coûts des machines et le ‘benchmarking’. Lors de cet atelier de travail, deux visites ont eu lieu aux champs en Louisiane
COSECHA DE LA CAÑA QUEMADA VERSUS DE LA CAÑA VERDE: DESAFIOS EN LA INGENIERIA AGRICOLA

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PALABRAS CLAVES: Caña Quemada, Caña Verde, Cosecha, Manejo de Residuos, Siembra, Costo de Maquinaria, Padronizacion.

Resumen

La Sección de Ingeniería Agrícola de la Sociedad Internacional de los Tecnólogos en Caña de Azúcar (ISSCT) celebró un taller del 12 al 27 de Octubre de 2003 en Thibodaux, Louisiana, Estados Unidos de América. Los trabajos presentados en el taller fueron agrupados bajo los siguientes temas: cosecha de la caña quemada versus cosecha de la caña verde, preparación de la tierra y siembra, manejo de residuos, manutención del cultivo, costo de maquinaria y padrones. El programa de la reunión de cinco días incluyó dos visitas de campo en Louisiana, así como un día de visita pos-reunión a la industria azucarera de Florida. En este trabajo son expuestos los asuntos principales que surgieron durante las deliberaciones y los demás que quedaron pendientes, son destacados. Las conclusiones trazadas fueron que las cosechadoras mecánicas modernas usadas bajo condiciones normales de suelo y cosecha, son capaces de manejar todas las cosechas menos las de caña verde muy densas. En general se aceptó que las pérdidas y los niveles de materiales ajenos al cultivo son más elevados en la caña verde para ambos sistemas de cosecha, manual y mecánico. Además que los costos de la cosecha manual o mecánico son más altos en el cultivo de la caña verde comparados con los de la caña quemada. Fueron presentadas las mejores técnicas de gerenciamiento para el plantío y la cosecha mecánica de la caña, aunque existan claros beneficios agronómicos y ambientales en muchas situaciones de la cosecha de la caña verde, más investigación es necesaria para estudiar el impacto que los residuos de la cosecha tienen en el cultivo de los brotes bajo condiciones de frío o humedad. También necesitan más evaluación los sistemas y equipos alternativos para el manejo de los residuos pos-cosecha, principalmente a medida en que los residuos son importantes como fuente de energía. Los principios y normas para elaborar un protocolo uniforme de costos de maquinaria basadas en el abordaje clásico de costo, fueron expuestos y aceptados. Esto será útil cuando se expongan costos de maquinaria en reuniones y en congresos.