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2015 RD&E COMMUNIQUÉS

FEEDBACK TO REGIONAL RD&E COMMITTEES

South African Sugarcane Research Institute
Mount Edgecombe

UNLOCKING THE POTENTIAL OF SUGARCANE

Website: http://www.sugar.org.za

South African Sugarcane Research Institute is a division of the South African Sugar Association

INTRODUCTION

The SASRI Research Programme

The SASRI research programme is tailored to address the immediate agro-technical needs of Stakeholders, while also maintaining a strategic focus on innovation to promote and support the long-term sustainability of the SA sugar industry. The programme is designed to be responsive to the needs of Stakeholders and, as such, adaptive[1] research and technology development[2] form a significant component (approximately 66%) of the research programme. However, the quest for innovative solutions to broader industry issues also lies at the heart of the SASRI research programme and, consequently, strategic[3] and exploratory[4] research comprise approximately one-third of the programme.

Grower Agro-Technical Needs: Role of RD&E Committees

The South African sugar industry's regional RD&E Committees play a vital role in guiding adaptive[1] research and technology development[2] within SASRI's annual Programme of Work for research. Through these committees, the institute is able to ensure that the research activities remain responsive and relevant to stakeholder needs.

Annual RD&E Committees Workshop: Outcomes

This document serves to provide feedback to regional RD&E Committees on the way in which the issues brought to the attention of SASRI in early 2015 have been progressed to-date. These are the issues submitted through Extension in late 2014 and early 2015 and which were the subject of discussion and prioritisation during the Annual RD&E Committees Workshop held at Mount Edgecombe on 12 March 2015. Since that Workshop, the issues have been subjected to several rounds of discussion by SASRI researchers, extension specialists and knowledge management experts, with a view to developing the SASRI Programme of Work for the 2016/2017 Season.

2015 RD&E Issues: Communiqués

Contained within these pages are informative and helpful communiqués from SASRI specialists on the issues raised, as well as an indication on the way in which each has been addressed. This may be in the form of a new research or technology development project or an intended knowledge exchnage activity to improve communication between SASRI and the communities it serves.

The information is presented in the form of a table, with the second column detailing the original issue raised by the relevant RD&E Committee and the third column presenting the communiqué.

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[1] **Adaptive research** is needs-driven and aims to solve problems of immediate consequence to Growers.
[2] **Technology Development** focuses on the search for new technologies of value to Growers based on the existing scientific knowledge holdings at SASRI.
[3] **Strategic Research** is directed towards meeting perceived medium- to long-term development needs of the Industry, which are strongly informed by international scientific progress and potential local industry innovations.
[4] **Exploratory Research** establishes the boundaries within which innovation is possible.

Acknowledgement

SASRI would like to thank the representatives of the grower and miller communities who give of their time to serve on regional RD&E Committees. Without this commitment and generosity, SASRI's delivery of meaningful R&D outcomes to the industry would be severely compromised.

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2015 COMMUNIQUÉS TO REGIONAL RD&E COMMITTEES

IRRIGATED NORTHERN REGIONS (Mpumalanga Lowveld, Swaziland, Pongola, Umfolozi)

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1	**Yield Losses Associated with Thrips, Sugarcane Yellow Leaf Aphid and Rust** With the seeming increase in activity of the three organisms the past three seasons, and the increasing use of chemical control to minimise the effect on yield and quality becoming a costly addition to the growing of cane in the Lowveld, we have done some local research on the yield losses experienced from the pests and disease. In our estimation the losses are significantly lower than reported in the SASTA paper by Way et al (2010) in irrigated cane. Unfortunately chemical reps use the information in that paper to justify their recommendations to spray-sometimes indiscriminately. We would like to have a way to measure the expected yield losses. These pests and diseases occur somewhat "at random" and the process to do research on them can become a long drawn out sequence of failures. We would like to suggest that we have an indirect way of determining when control would be advisable. Would SASRI consider doing a trial in the Lowveld with one or two popular varieties where 1-5 leaves of three month old cane is removed, apart from the spindle leaf- and the effect on eventual yield then monitored.? This would probably require at least 25 meters of cane row to ensure comparable data? Using	Knowledge on the population cycle of thrips is now well established and although that of yellow sugarcane aphid (YSA) has yet to be determined, surveys have shown that both pests are prevalent throughout the industry. A further thrips yield loss project in irrigated cane has just been completed. The yield loss estimate from this project, which involved a field trial with a plant and ratoon crop, was based on differences in yield between the ratoon crop, which showed very low levels of thrips infestation, and the plant crop, which was heavily infested. The imidacloprid insecticide used in the trial has the confounding effect of directly enhancing sugarcane growth. This confounding effect was compensated for by subtracting the yield enhancement effect from the total yield improvement in the insecticide treated plots. The yield loss from this trial was an average 9.6% TCH (range 5.7 to 11.9) and 8.6% TSH (range 5.8 to 12.8). This information will be useful in calculating monetary benefits of applying insecticide treatments, thereby ensuring that insecticide control actions are cost effective. The project showed that it is more beneficial to use imidacloprid in stressed cane, where it had a greater impact on thrips numbers and yield, than in non-stressed. Tons cane/ha and thrips numbers were negatively correlated, indicating a direct impact of thrips on cane yield. Should alternative insecticides without the growth enhancement effect of imidacloprid become available, further yield loss field trials will be warranted to more accurately determine yield loss. SASRI does not believe that mechanical removal of young leaves to simulate loss of photosynthetic area to sugarcane thrips damage will accurately reflect yield loss due to the pest. Indeed, it may overestimate the loss, as entire leaves will be removed rather than just some of the leaf area. Moreover, cane recovers from thrips damage as the plant ages and leaf removal will not take this into account. Finally, the physiological effects on the plant of leaf removal versus thrips damage are unknown. A new project commenced in November 2014 to investigate yield loss due to YSA, but it should be noted that success in estimating yield loss is dependent on the occurrence of pronounced YSA infestations in the project field trials. This project will also provide preliminary information on the effectiveness of pymetrozine as an insecticide for use against YSA. A second project is also underway to determine varietal differences in leaf damage due to both sugarcane thrips and YSA. This project (and an earlier one conducted by SASRI Plant Breeding) has already found pronounced differences in the degree to which present commercial varieties (a total of 40) suffer thrips leaf feeding damage when grown alongside each other in small-plot field conditions. Similarly, clear differences in leaf damage produced by aphid feeding have been recorded in an aphid-infested released variety trial containing 20 varieties. The differences in thrips and YSA damage between commercial varieties will be confirmed over the course of the next season (2015/16) in further field trials, as well as by SASRI Extension, Pest and Disease specialists in grower fields. Once confirmed, this

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	data generated in this manner, better recommendations could be made regarding the control of these pests and disease.	information will be used to advise growers on preferential variety choice in situations where thrips and/or aphids are of major concern. In terms of chemical control, Allice™ has been registered for use on thrips in ratoon cane and application has been made for registration for its use against YSA. However, it should be noted that it is not legal to use Allice™ against YSA until it has been registered and SASRI cannot yet recommend its use against this pest. No economic threshold has yet been developed for its application. Abacus® is registered against brown and tawny rust and Amistar® Xtra is registered against brown rust. It is important that growers adhere to the label recommendations. New chemistries for use against thrips, aphids and rust will continue to be tested as they become available. Many of these new agrochemicals are now 'Blue Label' products, with substantially reduced environmental concerns. Sporadic outbreaks of brown rust do occur on varieties such as N14 and N25 in the Lowveld in late autumn / early spring when cooler temperatures favour the development of the disease. The symptoms rarely persist and fungicide applications are usually not warranted. Tawny rust has been less prevalent in the Lowveld than in Pongola and Umfolozi. Further yield loss trials are planned for 2015, as infection was uneven and limited in the plant and first ratoon crops of the irrigated trial at Pongola.
2	**Monitoring the population shift of Eldana and control measures of the same** Several instances of Eldana infecting young cane have been observed in the past season. There is a strong suspicion that Eldana has adapted to the shorter harvesting cycle in the Lowveld, and since cane is normally rich in nitrogen fertilizer and grow luxuriously, it becomes a very attractive host to Eldana. The current chemical control measures are not very effective and we would like to have recommendations for better – systemic activity-chemicals to control Eldana. **Description:** Change in eldana population dynamics - present in young cane.	Three points are raised: 1. Eldana adapting to shorter cycle crops. 2. Current insecticide use considered not to be effective. 3. Requirement for systemic insecticides. Adaption is a complex and long term biological process that is unlikely to have occurred in this case. Eldana development is primarily driven by factors such as heat units, crop nutrition and crop stress as well as base population levels in a field or region. The "adaption" mentioned here is likely to be a manifestation of some or all of the above processes in affected crops. Careful analysis of crop nutrition (particularly N), crop stress, historical eldana levels as well other factors such as the inappropriate use of ripeners (or drift) may well shed light on the causes of observed eldana levels. Such an analysis could most easily be conducted by local P&D staff. Insecticide efficacy or the lack of it has many causes ranging from incorrect rates or application frequency to resistance. It would be most useful if a more detailed interrogation is conducted of instances where insecticide use has not produced the desired result. A critical outcome of such an investigation would be the indication of the possible development of resistance. Again, such an analysis could most easily be conducted by local SASRI P&D staff. Generally, systemic insecticides are not considered to be very cost effective in stalk borer control strategies. This is related to the dose required to ensure larval mortality in stalks. Having said this, systemic

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	Background: • Increase in eldana in young cane throughout industry. • Is this related to increased carryover over, varieties etc? • Need to monitor, develop control measures. • Noted in Irrigated North and other areas. **Desired Outcome:** • Verification of population dynamics and any potential shifts. • Establishment of an Eldana IPM system. • Assessment of risk moving forward.	insecticides may influence eldana in very young crops (1-2 months old), but beyond this, the dose issue becomes a problem. Heavy infestations in young cane are usually indicative of inadequate eldana management practices. While insecticide use could be considered in such situations, it should be done so as an unusual "emergency use" and should be coupled with strategies aimed at addressing any management shortcomings that may have encouraged the initial eldana problem. At present treating the autumn moth peak is not legal with Fastac®.The Fastac® label states: *'Follow a preventive spray programme, by applying the first application, starting in August. Follow up at two week intervals up to a maximum of eight applications' i.e. control is August through November. Thus, treating the March, April, May moth peak in older cane can be considered to be currently 'off label'*. Likewise the Steward® label states: *'Start applications in August. Four applications to be made at a monthly interval period'* i.e. control is August through November. On the other hand, the Coragen® label states: *'Start applications in August. Four applications can be made at a 2 monthly interval period. Longer residual effect of treatments will thus be possible into the February/March period'* i.e. control can begin in August and continue through to the autumn moth peak. The spraying strategies outlined in the product labels are currently legal. However, it has become apparent that all of the pesticide labels for eldana control chemicals are not compliant with the Insecticide Resistance Action Committee (IRAC) guidelines. In the near future, product labels should be re-written to include IRAC compliance, and also with an emphasis on levels of damage and infestation (rather than time of year – August) as a trigger for the commencement of a spray programme. Additionally, the labels should also support compliance with LPD&VCC rules which now include insecticidal control as a gazetted enforceable remedial measure. In this instance, a full project is not considered to be necessary. However the suppression of eldana populations in "young" cane will be addressed in future trials implemented in the SASRI Long Term Agrochemical project 00CP04.
3	**Mechanical harvesting-management of high trash loads and best management practises of the same** With the increasing use of mechanical harvesters in the area, and the high loads of infield trash generated during the harvesting process, a set of BMP's	**1. INTRODUCTION: GENERAL GUIDELINES AND SUMMARY RELATING TO CROP RESIDUE (MULCHING) MANAGEMENT** The long term benefits of a crop residue blanket are typically (Donaldson *et al*., 2008) as described below. • Improved yields: - 9-24 t/ha (Mbatha *et al*., 2011); and - 15-16% (Chapman *et al*., 2001). • Improved moisture conservation for both rain-fed and irrigated systems: - 90 mm/annum (Thompson, 1966);

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	needs to be developed on how to manage the situation. Should trash be raked, how does it affect the weed spectrum, irrigation scheduling etc. Before embarking on an intervention, need to speak to Lowveld about future plans. This will influence the approach. Recommend that Peter Tweddle and Peter Lyne play a leading role in this. **Lowveld clarification:** The benefits of the green trash blanket is being offset by slower ratoon regrowth, poor ratoon populations and pest (trash worm) infestations leading to apparent yield suppression (4 months after harvest) at this stage of observation. High levels of residue of between 20 and 30 tons per hectare are as a result of mechanical harvesting and high biomass yields being left in the field after harvesting. Poor rationing appears evident following cold temperature periods. Future plans are to remove a portion of the residue from the field. Other experiments are to change the mechanical harvester settings to not remove any of the leaves and introduce a leaf separator at the mill itself. A Brazilian leaf stripper is being imported for this purpose. This communique is to clarify these observations and provide guidelines to best manage the operations i) prior to planned separation operations at the mill ii) after planned removal of the majority of residue from fields (considerations such as weed control etc.)	- 68% of soil moisture conserved during early growth period (Chapman *et al*., 2001); and - the costs of irrigation reduced by 10% (Núñez *et al*., 2008). • Improvements in soil conservation: soil surface protection, improved infiltration, reduced runoff and soil erosion. • Improved weed control/reduced herbicide use: - crop residue blanket suppressed weeds by 83-92% (Lorenzi *et al*., 1989); and - the costs of weed control were reduced by 35% (Núñez *et al*., 2008). • Increases in soil organic matter and microbial activity. • Minimal pollution when compared to burnt cane. Crop residue blankets may present challenges under certain conditions and as described below. • High residue levels in conjunction with: - continuously wet soils, valley bottoms or periodically low water tables of <500mm (Donaldson *et al*., 2008), - exceptionally wet periods before crop canopy has been established (van Antwerpen *et al*., 2006), - cold temperature periods of less than 2°C and in frost prone areas (Donaldson *et al*., 2008; Murombo *et al.*, 1997). • Challenges encountered by growers with crop residue blanket retention include: - higher harvesting costs in both manual and mechanical operations; - harvester productivity reduced by 43% (Núñez *et al*., 2008); - chopper harvester throughput decreased by 17% and fuel consumption increased by 12% (Ma *et al*., 2014); and - payloads of the extraction and haulage vehicles decreased by 2.3 % per % increase in crop residue (Kent *et al*., 2003); • Fire hazards relating to high crop residue retention levels are a concern, particularly if a fire occurs during young cane regrowth; • Residue movement in high winds: Residues are light and can be easily picked up and moved across fields or deposited along wind breaks, fence lines etc. Olivier (2015) reports "*Crop responses to the presence of a trash layer have been investigated in a number of irrigated field trials conducted in Pongola and Komatipoort. The major advantage of a trash blanket is the significant reduction in irrigation requirement. For overhead irrigation, average savings of 15% (183 mm) were achieved, while somewhat smaller savings of 6% (77 mm) were possible with drip (above-ground) irrigation. These savings were mainly brought about by a reduction in the surface evaporation loss, especially in the period leading up to full canopy cover (first 3 to 4 months of the growing season). Increased drainage was observed under trash covered crops which emphasises the importance of adjusting the irrigation scheduling practice so that these savings can be realised. Crop coefficients for calculating crop water requirements of partially covered fields (only cane tops) as well as fully trash covered fields are available. The Canesim crop model is*

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		also capable of calculating water requirements of trash blanketed crops. *Trash layers have a negative influence on the rate of canopy development, tillering and radiation interception* (also, see 2. below for additional details)*. Generally soil temperatures were found to be between 3 to 4˚C lower under a trash blanket compared to a bare soil surface which could explain the delayed emergence of tillers. Peak tiller population was reduced by an average of 25% (10 tillers m^{-2}) which resulted in a delay of between 8 to 20 days in the time to reach 50% canopy and a reduction of 5% in radiation intercepted. Tillers naturally compete for radiation, nutrients and water which lead to tiller death late in the growing season. Final tiller population and stalk length of trash covered fields were found to be similar to that of fields without trash. Final cane yield of trashed fields was on average 9% lower than bare crops, but was not statistically significant.* *The trash effect on the soil water balance, soil temperatures, tillering and canopy development is strongest during the partial canopy period and diminishes with age as the canopy starts to shade the soil surface. Very little or no stalk growth occurs during this partial canopy period suggesting limited impact on later growth and yield.* *Crop response to trash is strongly dependant on variety. Some varieties do not tolerate trash conditions very well as emergence, tillering and canopy development is very poor under these conditions. Current knowledge on how South African varieties react is increasing for the coastal, midlands and irrigated regions of the Industry as a result of the research being conducted by Dr Sanesh Ramburan (SASRI Variety Scientist) in Project 07RE03 (Variety and Trash Interactions).* *Frost damage is a danger to crops with trash blankets especially in colder years and in lower lying areas. Minimum air temperature tends to be 1 to 2 ˚C lower above a trash blanket compared to bare soil increasing the probability of frost occurrence.* *Under the hot and humid conditions experienced in the Lowveld, the trash blanket is broken down very quickly and very little is left by the time of harvest. Trial results have shown that a layer consisting of only cane tops can cause similar savings in crop water requirements to that of a full trash blanket. Excess trash material could thus be removed from the field, leaving just enough material to maintain cover of the soil surface for the partial canopy period*." **How much trash?** An effective trash blanket reportedly consists of **approximately 10 tons per hectare** equating to about a 60 tons per hectare yield for South African conditions (Donaldson *et al*., 2008). Kent (2013) reported the following: "*Several models have been developed to predict the benefit of leaving trash in the field (Thorburn et al., 2005; Purchase et al., 2008). Manechini et al. (2005) reported an attempt to experimentally determine the amount of trash to be left in the field. Of the 6.7 t/ha to 14.9 t/h total trash in the field, they found that **7.5 t/ha to 9.0 t/ha** was required for weed control and that the amount of trash required to preserve yield varied considerably with cane*

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		variety, climate and pests." In India a suitable trash blanket of as low as **3 tons per hectare** was reported (Prabhakar *et al.*, 2010). **Consisting of?** Ideally this should consist of the green leaf portion of the crop and the balance of dry brown leaves. The trash blanket should typically be scattered uniformly across the field or in certain instances can be on the inter row areas of the field. Excess dry brown leaves may be removed for processing or alternative revenue. In the case of burnt cane operations, a 'cool burn' will increase the amount of crop residue left in the field. The scattering of the green leaf material should provide most of the benefits of a full trash blanket. Lower topping of the low sucrose stalk top would further contribute an additional 1.5 to 2 tons per hectare (Donaldson *et al*., 2008). Under green cane harvesting, this can be achieved by allowing the topper of the chopper harvester to operate, but leaving the chopper harvester extraction fans turned off or set to low speed. This is a good option if the dry leaf material is able to be processed at the mill. Lower fan speeds also helps to reduce cane losses. Trade-offs against these benefits are that the **chopper harvester throughput is likely to be slowed down by about 17% and fuel consumption increased by 12%** (Ma *et al*., 2014). **The payloads of the extraction and haulage vehicles are likely to be reduced by about 2.3 % per % increase (0 to 10% range) in trash content** (Kent *et al*., 2003). Alternatively, the chopper harvester can be used as normal and the higher trash levels dealt with at the field level. This is not ideal if wanting to use the crop residues for cogeneration as there will be a mixture of tops (undesirable to burn but valuable as a soil mulch) and dry leaf materials (desirable for combustion although very low density) during the field collection operations. Various density improvement techniques have been trialled including: shredder fan inclusion; billet length adjustments; compaction; vibration of bins and topping of cane (Kent, 2013). **2. GROWING CANE UNDER TRASHED CONDITIONS** **2.1. CULTIVARS AND TRASHING** According to Ramburan (2015), "*Three trials were established to investigate the responses of commercial varieties to trashing. The trial conducted in the midlands region showed that ERC yields were reduced with trashing in 7 out of 8 varieties in a first ratoon crop that ratooned through summer as well as a third ratoon crop that ratooned through winter. The trashed treatments showed delayed emergence, and reduced stalk populations compared with the burnt treatment. This was associated with reduced soil temperatures under the trash blanket. There was a higher soil water content that was measured under the mulch blanket for most of the growing period, showing that trashing does conserve soil water.*

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		The trial conducted under irrigated conditions in Pongola showed that there were no significant differences in ERC yields between burnt and trashed treatments of all varieties over three ratoons harvested in October (R1, R2, and R3). When harvested for two crops (R5 and R6) in winter (July), however, all varieties showed reductions in ERC yields which were not statistically significant. Stalk populations and emergence were generally delayed with the trashed treatments. However, there were generally no differences in stalk height and stalk populations at harvest. The major benefit of trashing under irrigation seems to be associated with water and electricity savings. Cultivar responses to trashing seem to be minor, and no cultivar showed any alarmingly poor responses to trashing. *The trial conducted under rainfed conditions at Empangeni showed highly significant improvements in ERC yields with trashing in all varieties over all crops harvested. This included three crops harvested in October (R1, R2, and R3), and one crop harvested in winter (July). The ERC yield improvements ranged from 15% to 92%. In this trial, stalk populations and emergence were delayed with trashing as well. However, stalk elongation rates and final stalk heights were much greater in the trashed treatments. Soil moisture levels were consistently higher in the trashed treatments throughout the growing season. Soil temperatures were consistently lower under the trash blanket, until canopy closure, after which temperatures were comparable with the burnt treatment. All varieties showed a general delay in canopy establishment with trashing. However, this delay did not negatively affect final cane and ERC yields.* ***In summary, trashing was beneficial to ERC yields under coastal rainfed conditions, detrimental to ERC yields under cooler midlands conditions, and had no effects on ERC yields under irrigated conditions***." One of the benefits of green cane harvesting that was not quantified here was the effects on reducing risk associated with post-harvest deterioration. Large commercial fields that are left standing after burning (a common occurrence) are more prone to deterioration compared with green cane harvested fields. Growers in the midlands or irrigated areas may therefore also benefit from trashing in this way, even when yield responses are minimal. **2.2. SOIL TEMPERATURES AND RATOONING** Slower shoot emergence, fewer stalk numbers, slower canopy are commonly reported with residue layers. Final yields are often reported as being similar or of insignificant difference. • **Soil temperatures:** cooled by 2 and 4°C under a trash blanket (Chapman *et al*., 2001); at 60 mm depth were on average 4 to 5°C lower under the trash treatment in the partial canopy period (Olivier *et al*., 2009) • **Ratoon emergence:** delayed by 38% or 15d (Chapman *et al*., 2001); Initial stalk population in the trash treatment was 50% lower and peak stalk population reached 16 days after control (Olivier *et al*., 2009). Below is a selection of findings from the literature:

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		• **Murombo *et al*. (1997):** Where there was a trash blanket, the shoots took longer to emerge above the trash. In some instances, especially during the cold months, some stools rotted and hence there was no regrowth. Where there was regrowth, the shoots struggled to come through the trash. Continuous parting of the trash was necessary because the heavy trash kept sliding back over the cane. The cane emerged faster where there was no trash blanket. • **Chapman *et al*. (2001):** Green cane harvesting is now practiced by 83% of Mackay canegrowers, which is greater than the Australian average of 65%. The four experiments reported here were important in promoting the high level of trash conservation in the Mackay area (Queensland, Australia). Experiment 1 involved 8 sugarcane cultivars (H56-752, Q124, Q135, Q136, Q138 and Q159) subjected to green-no-cultivation or burnt-cultivation in a field in Mackay. Experiments 2, 3 and 4 involved first or second ratoon crops of Q124 subjected to green-trash or burnt-trash (there was no burnt-trash treatment in experiment 4) in fields in Palmyra, Dumbleton, and Marian, respectively. Experiments 2 to 4 were also irrigated. **Conserving green-trash rather than burning it increased cane and sugar yields by 15% and 16%** in five ratoon crops. Green-trash crops had fewer and heavier stalks but no other change in composition. Sugar yields of varieties varied significantly, with Q124 and Q135 having the highest yields. Varieties did not interact with trash management or cultivation. Three short-term experiments evaluated the effects of trash incorporation and raking the trash off the cane row. Results indicated that **no trash management was necessary for maximum production**. Soil compaction in the inter-row from harvesting operations may have limited cane yield in trash conservation treatments, but there was **no benefit from cultivation**, which reduced this compaction. **The trash blanket cooled soil temperatures by 2 and 4°C. This increased the time from harvest to ratoon emergence by 38% (39 to 54 days)**, after early season harvest. Damage by armyworms (*Mythimna separata*) to leaves was increased and damage to tillers by wireworms (*Coleoptera: Elateridae*) was decreased with green-trash. Trash conservation had no effect on spore counts of *Pachymetra*. Green-trash reduced evaporation of soil water and increased availability for transpiration. **Soil water loss in early growth under green-trash was only 32% of that from burnt-trash**. Water loss was similar for both green and burnt-trash in late growth. Green-trash increased cane yield equivalent to the application of 2 ml/ha of irrigation water, an important benefit in a region with inadequate water for full irrigation. Green-trash increased suckering, but sucker growth was insufficient to significantly affect sugar content.] • **Olivier *et al.* (2009, 2010):** Preliminary results from a drip irrigation trial with treatments of, (i) a trash blanket applied at a rate of 18 t/ha, 160 mm thick, and (ii) control treatment with no trash blanket: **Initial stalk population in the trash treatment was 50% lower than the control treatment and reached peak stalk population 16 days after that of the control treatment**.

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		Frost was observed in the trash treatment on three occasions during June and July which could have had a further negative effect on stalk appearance rate. **Soil temperatures observed at 60 mm depth were on average 4-5°C lower under the trash treatment in the partial canopy period as compared to the control.** Midday growing point temperature of the trash treatment between 90 and 210 days after the crop start (July to October) was 3-4°C greater than that of the control treatment. No significant differences in soil and growing point temperatures could be observed in the full canopy period. No differences were observed in the peak (51 stalks/m2) and final stalk population (16 stalks/m2). At harvest, cane stalks in the control and trash treatments were of similar length. An earlier overhead irrigation trial showed contrasting yield responses (Olivier *et al*., 2009). • **Olivier and Singels (2012):** The objective of this study was to quantify the effect of 2 different types of residue layers on crop growth, cane yield and evapotranspiration of fully irrigated sugarcane. A layer of cane tops and dead leaves (Trash) and a layer of green tops (Tops) were applied to the soil surface of sugarcane crops (plant crop and first ratoon crop of variety N14) grown on lysimeters at Pongola, South Africa. Observations of crop growth (stalk population, stalk height, canopy cover), cane yield and evapotranspiration for these treatments were compared to that of a bare soil treatment. **Initial stalk population in the plant crop and radiation capture in the plant and ratoon crop were affected negatively by crop residue layers, but without significantly reducing final stalk population and cane yield**. Peak stalk population occurred later in crops grown in residue layers, but peak and final stalk populations were unaffected. **2.3. IRRIGATION MANAGEMENT CONSIDERATIONS** Increased drainage has been observed under residue layers. This emphasises the importance of accurate irrigation scheduling to avoid water logging and deep drainage losses (Olivier and Singels, 2012). Burnt cane tends to have a greater response to irrigation than mulched fields. Mulched fields conserve water better and provide the higher water use efficiency. This is particularly important during drier periods, where irrigation is not available or where variable moisture cycles persist. Generally, yields under mulched conditions are more sustainable, less variable and on the longer term higher than under burnt conditions. • **Gosnell JM (1970):** Trials conducted in Zimbabwe (1966-1969) showed that by increasing irrigation levels from 37% to 84% of Class "A" Pan evaporation produced a linear increase in cane yield from 65 to 146 tons/ha. The response with burnt cane was greater due to more severe moisture stress, and there was also an increase in cane yield between 84% and 100% Pan which was absent in trashed cane. Different levels of' irrigation were best for different criteria: 100 % Pan gave highest yields of sucrose/ha with burnt cane. 84% Pan gave highest yields of sucrose/ha with trashed cane. 68 % Pan gave highest yields of sucrose per unit of water applied and also highest cane quality. 84/60 % Pan (AB treatment in 2nd ratoon), with burning was

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		probably the optimum treatment, as it achieved the highest yield of sugar/ha together with one of the highest efficiencies of water use. In conclusion it must be reiterated that the above levels of irrigation were taken on a net basis, and for practical purposes should be multiplied by the following approximate factors: Sprinkler irrigation 1.2, Efficient furrow systems 1.2-1.4, Less efficient furrow systems 1.4-1 .6. • **Olivier and Singels (2012):** The objective of this study was to quantify the effect of 2 different types of residue layers on crop growth, cane yield and evapotranspiration of fully irrigated sugarcane. **Evapotranspiration was reduced by both residue layers, mainly due to a slower developing canopy** (reduced transpiration) and reduced evaporation from the soil, during the pre-canopy phases. **Increased drainage was observed under residue layers**, emphasising the importance of accurate irrigation scheduling to avoid water logging. It is important that irrigation scheduling practices be adjusted to realise the potential water savings of sugarcane production systems that make use of residue layers. **2.4. TRASH WORM MANAGEMENT** Carnegie and Dick (1972) describe the range of caterpillars that inhabit cane residues following harvesting. Larvae numbers appear more pronounced where trashing rather than burning has been practised i.e. after cutting, the trash is removed unburnt from the crop and spread as a blanket or placed along the inter rows as a surface mulch. The caterpillars, which are nocturnal in habit, use the residue to shelter by day and emerge at night to feed. The species, *Mythimna phaea* Hamps was found to feed on young cane for the first few weeks of cane regrowth, while other species were found to feed on the trash residue itself (Carnegie, 1977). The trash blanket shelters the caterpillars and pupae from many natural enemies, adverse climatic conditions, and from insecticides. Fields of high trash levels including fields with incompletely burnt trash and cane tops are more susceptible as they afford sufficient shelter for the caterpillars. Trash caterpillars are indigenous, are grass inhabiting insects, and attack sugarcane only between May and late November, during which period cutting is in progress and young ratooning cane is available. Ratoons are attacked only during the first few months of growth. With the advent of early summer rains and warm weather there is an increase in natural control and outbreaks cease. Carnegie and Dick (1972) also describe the **control of trash caterpillars through natural enemies** (especially Tachinid flies); Hymenoptera; Fungus; Virus and insecticides. Infestations were generally noted as being “sporadic and patchy” and once detected, the worst of the infestation was generally over. **Insecticides were not found to be effective** and it was thought that the trash protects the caterpillars and that insecticides were adversely affecting the numbers of natural predators in conjunction with the caterpillars. Little research data are available on the population dynamics relating to different residue layer depths.

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		SASRI Entomologists conducted a project investigating trash moth control in Swaziland (Project 10CP05) (*see SASRI POW 2013 / 2014. Page 27. 10CP05 Technology development*). However, the results of that study were inconclusive due to the erratic appearance of trash moths. SASRI information sheet 8.4 contains further information on trash caterpillars and leaf eaters. **2.5. WEED MANAGEMENT** Campbell (2015) reports **"***In general, a full trash cover is required to be effective for weed control. Once it breaks down, there should be canopy to shade weeds. Any gaps in the trash cover will stimulate weed seed germination. Moisture in soil under trash benefits weeds but also helps cane growth to develop canopy to shade out weeds.* • ***Creeping grasses:*** *it is not so effective or allows them to spread further in the field* • ***Tufted grasses like barbi:*** *Seeds are small and shallow germinators. Seed will germinate readily in light gaps, trash will have some – good effect under thicker cover.* • ***Deep germinators like morning glory:*** *can emerge through a trash blanket* • ***Broadleaf:*** *eg blackjacks and khakibos – trash cover is generally effective because they germinate in response to light – trash can reduce a full cover spray requirement to spotsprays for about 6% weed cover ie 94% effective.* *Best treatments are those soluble in water that can permeate down through trash eg Velpar®. Certain herbicides have use restrictions in trash eg Merlin*" Further studies report: • **Lorenzi et al. (1989):** In Brazil, following the harvesting of green cane (variety SP 71-1406), **the trash blanket suppressed 83-92% of the weed** infestation when compared to conventional burnt cane. Weed suppression by trash was found to be due to allelochemical substances being continually leached from the trash. Ratoon growth was initially suppressed by the trash blanket but later recovered completely. Where the trash was raked, cane rows contiguous to the trashed inter rows were found to have significant cane yield reduction. • **Van Antwerpen (2015):** Locally N27 shows signs of allelochemical effects- References: Detrashing project, BT1 records. • **Murombo (1997):** "*Substantial savings are possible through reduced weed emergence through the trash blanket and the associated weed control costs*." **3. CANESIM TRASH MODELLING FOR NORTHERN IRRIGATED REGIONS** The SASRI Agronomy modelling section can conduct Canesim model simulations to investigate:

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		a) Typical ratoon emergence delays for high residue layer load and whether this translates into an actual yield impact by the end of the season and if so, by how much, b) What are the optimal range of residues (min vs max) to be left in the field to not cause yield losses for a typical cold period in the Northern Irrigated area. This information may be sourced from SASRI through the submission of an Extension Request for Advice (ERA) through the office of Dr Pieter Cronjé. **4. EQUIPMENT: CHOPPER HARVESTER BMPs** **Minimising yield loss through infield traffic compaction and stool damage** The yield impact of the chopper harvesting systems are expected to be high relative to other systems due to the high amounts, repeated passes, and high impact of associated infield traffic. The ability to practice controlled traffic would mean that the infield traffic, preferably fitted with GNSS or alternative effective guidance system, would constrain the high levels of infield traffic to the inter-rows and may possibly be less damaging than systems with high impact equipment used infield that cannot practice controlled traffic principles. These hypotheses still need to be tested and is the subject of research currently being conducted at SASRI. SDO project 14SD03. **Minimising stool damage** Poor ratoonability can be aggravated through poor chopper harvester settings and operations. The following are items affecting base cutting operations: • Field profile; • Base cutter setup (height, profile and speed of cutter); • Blade parameters such as hardness, inclination, wear/sharpness etc.; and • Cane presentation.. The Harvester BMP manual from Sugar Research Australia (SRA) (www.sugarresearch.com.au) describes a number of guidelines to produce quality cane economically. Listed are a summary of considerations: • Cane harvested green produces higher quality raw sugar (ash content and dextran levels) than burnt cane; • Clean cane, lower losses, less soil and less stool damage improves at lower harvester pour rates which are achieved by slowing down the harvester – all at the expense of higher harvesting costs; • Optimum topping height should be set; • Gathering spirals are optimised for speeds of 6-8 km/h; • The type (profile) and setup of floating shoes can be adjusted in order to best gather stalks; • Height control settings of the gathering fronts is essential to pick-up all the crop; • Forward feed controllers regulate the supply of cane evenly and consistently into the base cutters and can cause stool damage if not setup correctly; • Knockdown roller assists primarily in non-erect cane to position the cane away from the harvester for butt first feeding. Setup is

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		important to minimise stool damage, soil in cane, extractor losses etc. • Finned rollers help moderate the cane supply across the basecutters. Their speed of rotation is important; • Basecutters cut the cane at ground level and feed the cane into the feed train and are also the source for stool damage and soil ingress; Setup considerations includes: number of blades, sharpness, angle of leading edge, blade length, blade speed (rpm), surface profile, blade thickness, blade design, hardness, soil surface characteristics encountered, • The butt lifter roller is used to guide cane into the feed-train butt-first. Roller tip speed of the butt roller needs to be considered; • The roller train accepts and conveys cane to the chopper box evenly. Speed adjustment will affect the feed roller speeds and harvester feed through the machine. Critical ratios of relative speeds of the sets of rollers is essential to ensure good billet quality and minimum deterioration; • Rubber coated rollers are required for quality seedcane billets with minimum damage. Ratios of roller to chopper speeds are essential; • Rotary chopper systems- factors affecting losses include: roller speed ratios; pour rate; blade sharpness & variety and crop condition; • Primary extraction chamber is where the cane is cleaned via extractor fan. Correct setup is essential; • The deflector plate controls the trajectory of the cane from the chopper; • Elevator conveyor is the next phase of getting the cane to the haul out equipment; • The secondary extractor is located on top of the elevator for final clean-up of extraneous matter from the cane. Balancing of the primary and secondary extractor workload is required by the operator; • Cane losses are an inevitable part of the process of separating trash from cane on the harvester. Cane losses through the extractor are essentially invisible with typically less than 20% cane loss as visible cane stalks. For each ton of trash not extracted an additional 2 to 5 tons of cane is recovered compared to normal harvesting operations. The full manual on harvester best practices is available on the Sugar Research Australia website: http://www.sugarresearch.com.au/page/Growing_cane/Harvesting/Publications/ Weblink address: http://www.sugarresearch.com.au/content/FlippingBooks/Harvesting%20Best%20Practice%20Manual/ Accessed 24/06/2015. Vaux *et al.* (2004): Green cane chopper harvesting was used successfully at Ramu Sugar in Papua New Guinea during the 1980s and early 1990s to assist in the control of vigorous weeds. A substantial benefit was also seen in the control of damage caused by cicada nymphs. The continuing evolution of farming systems, agronomy and harvester capacity instigated gradual changes in strategy. This resulted in the greater use of pre- and post-harvest burning to facilitate **cultural operations such as centre-busting (compaction relief) and re-hilling, to enhance yields and re-form**

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		the row profile to minimize harvesting losses. Burning was also used to facilitate the tillage operations associated with the planting of fallow legume crops and re-establishment of the new cane crop. The recent move to a dual row cropping system, incorporating controlled traffic, has allowed a re-focusing of efforts to maintain high levels of green cane trash blanketing. In parallel, there has been a concerted effort to move into minimum tillage and integrated pest management programmes, all strategies for a lower cost sustainable cropping system. Central to this strategy has been the need to **adopt harvest best practice (HBP) strategies to minimize direct and indirect, invisible and visible losses, and to reduce the need for row profile maintenance during the crop cycle. HBP has involved major changes to both harvester set-up and operating strategies**. Similarly, the move to minimum tillage has involved the **rapid evolution of tillage and planting machinery**. The rationale behind, and the benefits accruing from, the changes to the farming system are described. Núñez *et al.* (2008): To evaluate the feasibility of green cane harvesting at San Carlos Sugar Mill in Ecuador, agronomic parameters that may be affected when changing from burned cane harvesting to green cane harvesting were evaluated. Two sites subjected to manual green cane harvesting were compared with two adjacent sites subjected to manual burned harvesting. Measurements were made from 2004 to 2006 in fields with cane varying from the first to the fourth ratoon of cultivars Ragnar, CC8592 and CR74250. Manual green cane harvesting was not feasible for San Carlos Mill due to the prohibitive increase in harvesting cost caused by the reduction in productivity of 68% of the field labourers. Subsequently, an experiment undertaken with mechanical harvesters comparing six sites that had been cut green and another six adjacent sites that had been burned before harvesting. Under mechanical green cane harvesting, **machine productivity was reduced by 43% and the trash content in the delivered cane was increased by 38%**. Crop residues that remained in the field after mechanical harvesting were significantly greater under green harvesting (17.31 t/ha) than under burned harvesting (3.7 t/ha). P and K concentrations in residues were the same, but N content in green harvesting residues (0.85%) was significantly higher than that in burned residues (0.55%). **After green cane harvesting, the costs of weed control and irrigation were reduced by 35 and 10%**, respectively. Sucrose recovery was not affected, and sufficient data were not available to draw valid conclusions on cane yield. **Economic analysis favoured burned cane harvesting**. Chopper harvesters can be set to switch off fans in order to recover the bulk of the residues during harvesting. These residues will thus be harvested with the crop for recovery at the mill. Harvester speed will typically be reduced to cope with the extra material being conveyed through the harvester. Densities of the cane with residue will be less than the stalks and impact on payloads and reduce transport efficiencies to the mill. Normal chopper harvesting and subsequent gathering of full residues from the field is not ideal as: • cane losses are high;

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		• the green tops and dry leaves are all mixed during gathering; and • additional field traffic is required to further gather the residues. **5. EQUIPMENT: RESIDUE MANAGEMENT BMPs** Field based operations to deal with residue layers may include any of the following: • leaving the high residue levels untouched - this may be problematic in certain times of the year where either a) cold temperatures are frequently encountered hampering cane regrowth or b) wet periods are encountered where the soil may become waterlogged and difficult to dry out due to the presence of the trash layer. Such waterlogged conditions are likely to affect cane regrowth and will hamper field access by mechanical means; • raking of the entire field into windrows for subsequent processing such as a) bailing, flail mowing or similar; • bailing: the pickups should ideally be elevated to leave a small proportion for the benefits of a partial cover; • Teddar: to spread the leftover windrow material across the field; • Mulcher: to further process the leaf materials infield into smaller pieces; and / or • partial raking of the leaf material: To move the residues covering the crop row to the adjacent inter-row areas. This is more practical in a raised bed tramline type planting configuration where the wider inter-rows (hollows) can contain the higher trash levels. Raking of field with full residues is not ideal as the tops and dry leaves are then mixed. Unless the tops are pre-processed ie: Flail mowing and scattering of tops is a possible option so that these remain on the field during raking of dry leaves (Figure 1). However, te costs associated would need to be determined to see if this operation is economically viable.  **Figure 1: Use of forage harvesters to pick up leaf/residue materials**

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Figure 2: Partial and full trash rakes

Figure 3: Field layout showing partial raking of the crop residue off the crop rows and onto the wider inter rows

- **Cock *et al.* (1997):** In Colombia, sugarcane yields average >130 t/ha, with individual fields often yielding up to 200 t/ha; there is no specific season for maturing cane, and **the quantity of tops and dry leaves produced is high, 50-100 t/ha**. Left in the field after green cane harvesting, **these quantities of cane trash lead to poor germination in wet periods**, and create problems for traditional agricultural practices. At present, problems associated with harvesting cane and managing crop residues are overcome by pre- and post-harvest burning, but with increasing environmental constraints, all cane will have to be harvested green by the year 2005. In conjunction with the sugar industry, Cenicaña (the Colombian Sugarcane Research Centre) is developing an integrated production package for green cane harvesting. This includes evaluation of **erect self-trashing varieties with less top and high sugar content**, to improve cane harvestability. To overcome the problem of poor germination under wet conditions, the **cane will be grown on ridges**. Machinery for use immediately after harvesting is being developed which will **finely chop the residues** and allow them to fall into the interrows where they will decay rapidly.
- **Rees *et al*. (2014):** This work investigates various residue recovery modes and a range of processing techniques and plants. These options were also modelled economically to determine the most feasible processes. The models developed require validation for local conditions and scale of operations (pending work).
- **Viator *et al.* (2009):** Louisiana sugarcane (*Saccharum officinarum* L.) growers are increasingly harvesting fields 'green', without pre-harvest burning to eliminate leafy material. The post-

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		harvest residue, however, is generally burned on the ground to avoid the debilitating effects of the residue on the subsequent ratoon crop in the production cycle. A best management practice (BMP) that allows for the retention of the residue to minimize surface runoff and increase the soil fertility status would be viewed as both environmentally sound and producer friendly. The objectives of this study were to evaluate the effects of four post-harvest residue management treatments on surface water quality and sugarcane development and yield at two locations in the Vermilion-Teche watershed. **Treatments included two approaches designed to mitigate the adverse effects of retained residue on sugarcane, the application of stabilized urea plus composted tea (generated from sugarcane bagasse, poultry litter and corn gluten) and the shredding of the residue for accelerated decomposition; and two treatments currently employed by the industry, ground burning of the residue and full post-harvest retention of the residue.** "Edge-of-field" runoff collections were made using automated samplers. Rainfall collection-event load averages for all of the principal water quality parameters (total suspended and total dissolved solids, biological oxygen demand, nitrate and total phosphorus) for the four residue management treatments were not significantly different. Seasonal differences in soil erosion rates among the residue management treatments, however, indicated that exposed soil in the burned areas would be subject to higher sediment removal with high rainfall during the period from post-harvest burning to full-crop canopy. **Neither of the residue management treatments designed to hasten residue decomposition was effective, with the urea-compost tea treatment producing elevated N levels in runoff and the shredded-residue treatment generating the greatest volume of surface runoff. The urea/compost tea and shredded-residue treatments were also ineffectual in either enhancing cane and sugar yield or promoting residue decomposition. Burning of the residue did not result in higher yields than retaining the residue.** **6. ECONOMICS OF TRASHING** • **Lecler *et al.* (2009):** The costs and benefits of having a green cane trash blanket (GCTB) under irrigated conditions are investigated in this paper. For the case studies reported, the direct **cost savings in water, energy, herbicides and fertiliser, were offset by an average increase in harvesting and haulage costs of 22% under a GCTB system**. Although per hectare partial margins for both systems were similar, a GCTB farming system could allow a relatively larger area of cane to be irrigated for a given amount of irrigation water and this should result in increased overall returns. For example, in Pongola it was shown that the same amount of water used to irrigate an area of burnt N14 could be used to irrigate a 33% larger area where a GCTB system was used. The opportunity cost of water in the above example was R3544/ha converted to a GCTB system. For sectors of the industry which may face significant reductions in irrigation water allocations, the option to try and maintain production and supply of cane to

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		Sugar Mills through conversion to a GCTB farming system should be considered. If a GCTB system is considered unfeasible due to harvesting constraints, early morning or 'cold' burns should be adopted. The larger amount of trash and tops which remain relative to a 'hot' burn should then be scattered to cover the soil surface and the fields watered as if they were fully trashed. • **Wynne and van Antwerpen (2004):** This paper steers away from the environmental debate and focuses on the economics of trashing versus burning. A reasonable trash blanket left in the field after trashing inhibits weeds, thereby reducing herbicide costs. The additional organic matter above and below the soil surface improves moisture retention and soil health, which can significantly improve cane yields and profits. Trashing, however, is not appropriate in wet, low lying and cooler areas because the trash blanket increases the risk of stools rotting and inhibits ratooning respectively. The volume of trashed cane is also higher than burnt cane, which increases transport costs. • **Van Antwerpen *et al.* (2008):** A decision support program (DSP) was developed at the South African Sugarcane Research Institute (Wynne and van Antwerpen, 2004) but needed verification before it could be released to the industry. This poster summary reports on the verification process and the performance of the DSP when estimating real economics on farms, comparing burn with no-burn at harvest. The trash recovery methods as described by Rees (2014) were added to the DSP. This information may be sourced from SASRI through the submission of an Extension Request for Advice (ERA) through the office of Dr Pieter Cronjé. **References** • Campbell, P (2015). *Personal communication*. SASRI. 22 June 2015. • Carnegie AJM (1977). Activity patterns of *Mythimna phaea* Hamps., *Athetis Ignava* Gn. and *Simplicia extinctalis* Zell. (Lepidoptera: Noctuidae), which infest trashed sugarcane fields. *Proceedings of the International Society of Sugar Cane Technologists* 16: 711-718. • Carnegie AJM and Dick J (1972). Notes on sugarcane trash caterpillars (Noctuidae) and effects of defoliation on the crop. *Proceedings of the South African Sugar Technologists' Association* 46: 160-167. • Chapman LS, Larsen PL, Jackson J, Hogarth DM (2001). Trash conservation increases cane yield in the Mackay district. *Proceedings of the Australian Society of Sugar Cane Technologists* 176-184. • Cock JH, Torres JS and Villegas F (1997). Management of green cane harvesting with high yield of crop residues. *International Sugar Journal* 1181: 257-259. • Donaldson RA, Redshaw KA, Rhodes R and Van Antwerpen R (2008). Season effects on productivity of some commercial South African sugarcane cultivars, II: Trash production. *Proceedings of the South African Sugar Technologists' Association*, 81: 528-538. • Donaldson RA, Redshaw KA, Rhodes R and van Antwerpen R (2008). Season effects on productivity of some commercial South African sugarcane cultivars, II: Trash production. *Proceedings of the South African Sugar Technologists' Association* 81: 528-538. • Donaldson RA, Redshaw KA, Rhodes, R and Van Antwerpen R (2008). Season effects on productivity of some commercial South African sugarcane cultivars, II: Trash production. *Proceedings of the South African Sugar Technologists' Association* 81: 528-538. • Gosnell JM (1970). Optimum irrigation levels for cane under burnt and trashed conditions. *Proceedings of the South African Sugar Technologists' Association* 44: 121-130.

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4	**Remote Sensing- the use of drones and satellites to monitor the crop growth, irrigation efficiencies and early detection of pests, diseases and weeds.** Tsb is currently in a position to develop remote sensing technology. One of the main points of interest is the early detection of pathogen infections by using various lens filters. This process and guidelines to image interpretation needs to be developed. This should be a collaborative process between Tsb and the local P&D with assistance from SASRI. **Description:** * Use of modern technology e.g. remote sensing and precision agriculture increasing worldwide, starting in lane production. **Background:** * Happening in individual areas (informal). * Need combined effort / share knowledge * Precision farming underway in some areas --> maps for yield, fertilization. **Desired Outcome:** * Formulating extension strategies (BMPs) taking these new techniques into account. * Workshop to explore required actions.	Remote sensing is a tool that provides a synoptic view of the area in a non-destructive, non-invasive and objective manner. The advantages of using remote sensing is that it affords timely information over a larger area whilst proving a spatial dimension to the information. Remote sensing (RS) of biotic stress is based on the assumption that plant stress chemically interferes with photosynthesis and physical structures such as plant tissue and the canopy. The results of this interference thus affect the absorption of light and alters the reflectance in the different and respective regions of the electromagnetic spectrum. Research into the vegetative spectral reflectance can assist in understanding the resulting physiological and biochemical processes from pests and disease attack. There are numerous sources of remotely sensed data that can be evaluated. The cost and benefit analysis will have to be conducted for each source; i.e. there are sensors with narrow bands that are most suitable for detecting plant biochemistry, although at a premium cost. With the fast-growing trend of using mobile devices to access and share data, a review will be conducted to assess a workflow that can be used to integrate both GIS and remote sensing data for operational use in the sugar industry; focusing on pest and disease management. This review will also include scientific evidence of where this technology has been used to detect pest and disease presence and damage. Due to anticipated resources constraints in 2016 / 2017, the planned review will commence in 2017 / 2018. As there is also considerable interest in the application of state-of-the-art technologies in smut monitoring, the review will focus the following topics: 1. A review on smut infestation 2. Cost benefit analysis of the available remote sensing platforms 3. Remote sensing of smut 4. Data management at SASRI – capacity and infrastructure 5. Review of current data sharing mechanisms

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5	**Developing BMP's for our "future farming" system- GIS, Satellite guidance, best rig configuration, cane husbandry, precision fertilisation, precision variable irrigation, mechanical planting and harvesting protocols etc.-** A new set of BMP's to guide the new entrant into next generation technology through the process. This would entail recording practises and some experimentation to develop BMP's. This process needs to be done "on site with insight" and would require local recording of practises and options. **Description:** * Use of modern technology e.g. remote sensing and precision agriculture increasing worldwide, starting in lane production. **Background:** * Happening in individual areas (informal). * Need combined effort / share knowledge * Precision farming underway in some areas --> maps for yield, fertilization. **Desired Outcome:** * Formulating extension strategies (BMPs) taking these new techniques into account. * Workshop to explore required actions.	**Considerations prior to adopting precision agriculture (After: Alabama Cooperative Extension System, Ronin, JD and NH webpages relating to precision agriculture)** There are a myriad of options, suppliers and products that are on the market and one has to wade through acronyms, product names and marketing jargon. In the USA, many agricultural research and extension efforts are linked, providing useful and impartial information on precision agriculture (PA) technology adoption (eg. Alabama Cooperative Extension http://www.aces.edu/anr/precisionag/). It is considered useful information as about 60% of the farmers in their region (by way of example) have adopted some form of precision agriculture and related adoption issues are well documented. As a quick overview, the adoption of such equipment requires the integration of a number of components including: • Variable rate technology (VRT) enabled equipment; • GPS positioning (various signal corrections and suppliers available to deliver signals of varying accuracy as required) - information and offsets sent to the equipment controller to adjust rates or switch off units accordingly; • On board computer hardware (console) and software that needs to integrate with the equipment VRT controllers based on some type of prescription map; Apparently there are downloadable apps that can be also integrated with the GIS/prescription maps aspects too and for uses such as field scouting etc; • Office based GIS software and record keeping databases are required to be compatible and to define and generate VRT prescription maps that need to be in a suitable format for the on-board console; various software formats include .shp files; .tgt files. Data transfer options include flashdrives, PCMCIA and other data transfer cards, wireless, etc. • Sensors on equipment such as metering devices, flow controllers, speed sensors etc. and diagnostics; • Wiring harnesses/cables/signals from control unit to equipment control valves, ISOBUS communications etc. PA research work is advancing towards wireless interfaces, cloud based processing and real time PA data storage. A number of calibrations are typically required to validate that the system is fully functional: • test the accuracy of controllers and switches and flow meters; • check that the correct GPS offsets are programmed; and • validate that all systems are synchronised and fully functional; In looking at some PA websites a few general considerations were also noted: • ensure compatibility of systems and data formats- these can vary between different equipment and systems; • ease of recording and transferring data between computer and console and control units and is it available and accessible in a

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		useful format for management (eg. printouts of data treatments/maps; pdf exports etc.); • there will be a steep learning curve with any system; • consider your future plans to expand PA further: One would need to check the compatibility of existing and future equipment, data formats, systems and upgrades and the ease at which to integrate new systems and equipment; and • product backup, support and technical advice would need to be considered. There seems to be a lot of data communications that need to be integrated and this needs careful consideration when considering PA suppliers and services and backup support to ensure that your expectations (and benefits) are fully met. **Benefits driving adoption of PA:** • savings in inputs through Automatic Section Control (ASC) through reduced overlaps and section shut offs; and • savings in inputs through Guidance systems through accurate swath widths resulting in reduced infield travel and improved productivity. **Getting started:** • Objectives: eg. variable rates based on grid sampling surveys or area based maps. • Current equipment versus new requirements, implementation of new technologies. • Training, support and service tools available for the PA equipment and products is most importantimportant. • Is there compatibility of systems with multiple operations/equipment? • GNSS accuracy and repeatability required; • Proprietary linked versus independent systems. • Ease of recording and transferring data. • The format in which your data are recorded and exported also varies by PA equipment so it is also important to ensure that the data can be downloaded in a format that you will be able to access. For example, if you do not have an Agricultural Geographic Information System (AgGIS) program, then a PA system which can export data as a Portable Document Format (.pdf) or Rich Text Format (.rtf) file would be important to allow you the option of viewing your data. • Learning phase associated with new equipment and systems adoption • Future plans to expand/integrate PA. **Minimum components:** • VRT equipment with integrated controller, GPS receiver and a linked or reference decision support system. **Typical components:**

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		• GPS receiver (accuracy required? – various GPS signals and corrections available eg. Omnistar HP, XP etc.; John Deere SF2, SF1; WAAS; VBS), 3D corrections for vehicle pitch or yaw on sloped areas; • Display and console: Controller with software capable of ASC, mapping/recording, ; • Control valves for applicable medium/Electronic control unit/, • Sensors (speed, flowrate, real time diagnostics), flow meters to validate/maintain desired outputs • Wiring harnesses, cables from ECU to control valves **Prescription maps** (Agribusiness / 3rd party consultants offer such services): • Based on soil test recommendations from soil samples taken on a grid or area delineated basis. • Allows for variable rates based on prescribed rates of product or on a manual basis by the operator (in cab) • What equipment setups are required? - GPS (preferably differentially corrected GNSS signal for high accuracy) o John Deere Starfire o Trimble - Computer/controller/console typically all integrated o AgGPS® FmX™ integrated display o EZ-Guide® 500 system - Metering device o Field-IQ™ crop input control system for swath/section/VRA controls - Control valves on the equipment to alter application rates or to switch off the application o Various channel controllers for multiple products simultaneously - NB: the appropriate devices and integration will prescribe the data formats that the prescription map is written in, the data cards (eg. SD) or communication modes required. - Software: o Prescription maps: Usually this is provided as an integrated software supported by the company offering the PA products. This could either be from the tractor manufacturing brand or from a third party company dealing with PA systems and integration. In addition, agricultural GIS packages need to be checked for software format compatibility between the GIS and in cab computer controllers. Transferring of the information may be through wireless communications, compact flash drives, PCMCIA cards or other data storage cards. Some controllers apparently require separate field boundary files and prescription maps to be uploaded into the in cab control system. o Farm GIS system showing treatment boundaries o Database for record keeping, field costing information, planned and actual operations and application rates, multiple years of data to be stored, yield databases, soil analysis databases etc.

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		• The prescription maps inform the controller on the amount of product to apply based on the position of the equipment in the field. The delineation of various zones can be obtained from various information sources such as boundary and field maps, maps generated from soil sample maps, yield variability maps, aerial imagery, field scouting and other management factors ideally integrated to create various management zones of similar field conditions and treatment regimes. A database linking these management zones to the various treatment application rates and management operations would need to be kept. The final prescription maps needs to be in the appropriate format that the controller can read. o 'Ag Leader' products require a ***.tgt*** format; o Raven products require ***.shp*** files. o Ronin products using Trimble GPS require farm prescription maps compatible with OFDM applications (Farm Works version 12, SGIS software, GTA Software Suite, Map Shots, Ag Leader SMS) • Controllers: o Dickey-John IntelliAg - ISO 11783 standard for compatibility with various manufacturers equipment **Examples of Equipment Suppliers** (list not exhaustive but provides some examples): • John Deere Ag Management Soultions (AMS) with Starfire™ GNSS receivers, Greenstar display consoles, GS™ Rate Controller helps you accomplish rate control and map-based prescription. • New Holland Precision Land Management (PLM™) with various levels of GNSS accuracy (WAAS, OmniSTAR, centrepoint™ RTK), guidance and steer assistance options, controls key equipment functions, but also precision applications such as auto guidance, IntelliView™ or FM display consoles providing as-applied mapping and implement control, software. • Raven PA systems with Phoenix™ GNSS receivers, Cruizer™ guidance system, Raven control consoles, ISOBUS communications. • Ronin PA systems with Trimble GNSS, AgGPS® FmX™, EZ-Guide® 500 system, Dickey-John IntelliAg controller, Field-IQ™ crop input control system. **Examples of Precision Agriculture (PA) adoption within the Brazilian sugarcane industry:** Precision agriculture (PA) techniques have been adopted in various aspects within the Brazilian sugar industry as follows: 1. Geo-referenced soil sampling with site specific management: a. Grid sampling at 1 sample per 2 or 4 ha (8-15 cores in a 3 to 5m radius) taken at the replanting phase, b. Data are interpolated to create application maps indicating variable lime/fertilizer distribution rates. 2. RTK GNSS Auto steer adopted on tractors and harvesters for the precise layout and planting of rows; accurate non-overlapping of

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		fertilizer distribution and crop sprayers; precise harvester tracking (particularly useful for night operations or lodged fields where the tracks ordinarily are difficult to discern); controlled traffic operations preventing row traffic and consequential stool damage. 3. GIS mapping of fields and field attributes. 4. Machinery equipped with adjustable wheel tracks to match the crop inter-rows. 5. Ground-based active optical sensors are able to measure crop reflectance and nitrogen variances in the crop. Remote imagery is also being used. 6. Yield maps are still a limitation as they are far from accurate and not yet used as a site management tool. Yield from multi-spectral imagery is also not yet sufficiently developed to be suitable for large scale adoption.
6	**Smut** Factors favouring development or hampering development of the disease (local knowledge available) - Possibility of chemical control. Time of year when spore release takes place.	**The following information is available on smut infection and dispersal:** • Smut infection is influenced by varietal susceptibility and environmental conditions with hot, dry weather favouring its development and spread (Ferreira and Comstock, 1989). • A smut-risk model was developed using data for naturally infected NCo376 on the SASRI Pongola Research Station and corresponding meteorological data from 1978-1999 (Rutherford *et al*., 2003). During this period, smut incidence ranged between 3 000 and 33 000 whips per hectare. This variation was influenced by rainfall and temperature for May through August of each year with warmer, drier winters resulting in increased smut incidence. • Cane planted in spring is more prone to smut infection than autumn-planted cane (Anon, 1991; McFarlane and McFarlane, 2002). • Smut whips are reported to produce 10^6 – 10^9 spores per day in an infectious period that can last up to three months (Waller, 1969). • Most smut spores are found on sugarcane plants around the inoculum source and on the bare ground up to 40 m outside the infected field (Hoy and Grisham, 1988; Hoy et al., 1991). Spores also ascend in convectional up currents resulting in long distance dispersal, and descend either through gravity or rainfall (Simmonds, 1994). • There is usually more than one disease cycle per season (Momol *et al*., 1990). • Spore viability decreases rapidly in wet soil with few viable spores surviving past four weeks (Anon, 1993, Hoy *et al*., 1993). A more gradual decrease in viability has been noted in dry soils with spores surviving past 12 (James, 1969; Hoy *et al*., 1993) and 31 weeks (Matherne *et al*., 1977 – cited by Hoy *et al*., 1993). • In the irrigated areas, N14, N19, N25, N32 (de-gazetted), N41 and N46 are particularly prone to smut infections. **Current project (Ref: 00CP04) – Effect of fungicides on smut development** • Two products have shown promise in reducing smut infection in the smut-susceptible variety NCo376, particularly after hot water treatment (50°C/2hours). The possibility of registering one or both of the products after additional large-scale trials is being discussed with the chemical company.

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		• In two separate trials, foliar application of different products, reported to be relatively systemic, did not reduce smut incidence. The fungicides were applied three and four months after planting. **Proposed project for 2016-17 (Ref: 15TD02) - Application of qPCR in smut epidemiology research** A project has been devised to develop a method to monitor the weekly smut spore load using the washings from the spore trap located at the Komati Research Station. The objective is to provide information on smut epidemiology in the region. However, due to current capacity constraints, implementation of the project has been deferred to 2017 / 2018. **References** • Anon (1992). Smut in spring and autumn planted crops. S Afr Sug Ass Expt Stn Annual *Report*. 1991/92: 22. • Anon (1993). Viability of smut spores in soil. S Afr Sug Ass Expt Stn Annual Report. 1992/93: 23. • Ferriera SA and Comstock JC (1989). Smut. In: *Diseases of Sugarcane: Major Diseases*. C Ricaud, BT Egan, AG Gillaspie Jr and CG Hughes (eds). pg 211-229. Amsterdam, The Netherlands, Eslevier Science Publishers BV. • Hoy JW and Grisham MP (1988). Spread and increase of sugarcane smut in Louisiana. *Phytopathology* 78: 1371-1376. • Hoy JW, Grisham MP and Chao CP (1991). Production of sori and dispersal teliospores of *Ustilago scitaminea* in Louisiana. *Phytopathology* 81: 574-579. • Hoy JW, Zheng J, Grelen LB and Geaghan JP (1993). Longevity of teliospores of *Ustilago scitaminea* in soil. *Plant Disease* 77: 393-397. • James GL (1969). Viability of sugarcane smut spores in the soil. *Sugarcane Pathologists Newsletter* 3:10-12. • McFarlane K and McFarlane SA (2002). Improvements in the smut screening programme at the Pongola Research Station. *Proceedings of the South African Sugar Technologist' Association* 76: 285-288. • Momol MT, Purdy LH and Schmidt RA (1990). Analysis of disease progress curves of sugar cane smut in Florida. *Sugar Cane* 1: 8-10. • Rutherford RS, McFarlane SA, van Antwerpen T and McFarlane K (2003). Use of varieties to minimise losses from sugarcane diseases in South Africa. *Proceedings of the South African Sugar Technologist' Association* 77: 180-188. • Simmonds NW (1994). Some speculative calculations on the dispersal of sugarcane smut disease. *Sugar Cane* 1: 2-5. • Waller JM (1969). Sugarcane smut (*Ustilago scitaminea*) in Kenya. I Epidemiology. *Transactions of the British Mycological Society* 52: 139-151.
7	**Renewable Energy** Options to generate energy from the various cane by-products- self-sufficiency in energy- explore the various options and report- desktop study- also ways to save energy in the irrigated cane environment Peter Tweddle to clarify exactly what is required of SASRI by the Lowveld and provide feedback on what is available from SASRI e,g.	**Introduction** Trash residues contains up to 40% of total biomass (typically about 15 to 20 tons per hectare) and about 28% of the total energy content of the sugarcane crop (Donaldson *et al*., 2008; Prabhakar *et al.*, 2010). The potential yield of trash material is roughly 10% of the cane stalk yield. This trash residue consists of dry dead leaves and green foliage components proportioning about 50% each. For more detailed specifications regarding seasonal and varietal fluctuations in these general values, please consult the paper by Donaldson *et al*. (2008). • The energy in cane leaves is 16.7GJ per ton or 108 GJ per hectare (assuming a 6.5t/ha yield of dry leaves) (Rees *et al.* 2014). • The energy in diesel fuel is about 37.27GJ/1000L.

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	On-farm Energy Calculator, EconoCane. **Lowveld clarification:** Electricity costs are escalating rapidly and threatening cane production systems through increasing production costs in the order of R1300 per hectare and approximately R65 M for the NI areas. Ways to generate electricity (mill scale) and ways to reduce energy (on farm) are required. Progress on industry strategic negotiations as power producers needs regular communication feedback to the industry and especially NI areas in the light of high electricity use.	• That equates to approximately 2900 litres of diesel per hectare, equivalent for a typical cane yield of 65 tons per hectare. From an alternative viewpoint, the energy contained in dry cane leaves ranges from 3.5kWh per kg to 4.6kWh per kg. Assuming a value of 4kWh per kg, this equates to 26000 kWh per hectare, assuming a 6.5 t/ha yield of dry leaves. Fifteen million (15M) tons of cane, at an average of 65t/ha, equates to 230,000 ha of area under cane (AUC). If 100,000 ha are available for trash recovery, with approximately 5t/ha dry leaf recovery, this equates to 500,000 tons of dry leaf material = 4,000 kWh per ton x 500,000 tons per season = 2M MWh per season available (excluding bagasse). Bagasse: contains 4.9 kWh per kg. Approximately 30% of annual tonnage is bagasse = 15M tons x 30% = 4.5M tons bagasse = 22M MWh per season. Eskom: generation capacity is 42000 MW or 370M MWh per year. The sugar industry can provide about 22M out of 370M MWh required by Eskom (±6.5%). **References** • Donaldson RA, Redshaw KA, Rhodes R and Van Antwerpen R (2008). Season effects on productivity of some commercial South African sugarcane cultivars, II: Trash production. *Proceedings of the South African Sugar Technologists' Association* 81: 528-538. • Prabhakar N, Raju DVLN and Vidya Sagar R (2010). Cane trash as fuel. *Proceedings of the International Society of Sugar Cane Technologists* 27: 1-11. • Rees B *et al.* (2014). Sugarcane trash recovery systems for cogeneration. *Proceedings of the South African Sugar Technologists' Association* 87: 478-481. Various additional local and international sources of information are available that pertain to energy related costs and savings. **Local Information** • **Energy calculator: operational savings in on-farm energy** Techniques for measurement and estimation of energy used in production operations as well as the potential to reduce energy use are identified. Studies in sugarcane production in Australia have shown that energy savings of 10-30 % for tractor powered operations, 10 % for harvesting, 36 % by improved farming practices and 50 % in irrigation operations are possible. Energy audit tools and protocols for on-farm assessments for sugarcane production in South Africa were established. Boote DN, Smithers JC and Lyne PWL (2014). The development and application of an energy calculator for sugarcane production in South Africa. *Proceedings of the South African Sugar Technologists' Association* 87: 459-463. • **Electricity use in irrigation (SASRI Information Sheet [In press])**

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		Deficit irrigation is a strategy aimed at maximising profitability as opposed to yields, and results in improvements in water use efficiency. The design and management strategies affecting the performance of conventional irrigation systems, in terms of uniformity and application efficiency are highlighted, as are irrigation scheduling methods and potential deficit irrigation planning tools. Jumman A and Lecler NL (2010). Deficit irrigation: a strategy to counteract escalating electricity tariffs and water shortages. *Proceedings of the South African Sugar Technologists' Association* 83: 160-173. • **Integration of biorefinery processes** Four major pre-treatment processes are discussed including uncatalysed steam explosion, hot liquid pre-treatment and acid and alkaline pre-treatments. Gasification, pyrolysis, cogeneration, biomass digestion and hydrolysis are discussed as major well-developed biorefinery processes, including major process characteristics and process parameters. Existing synergies between some of the biorefinery processes are discussed, including Simultaneous Saccharification and Fermentation (SSF), which is a popular method of producing ethanol. Dlamini SC (2012). Integration of biorefinery processes into the kwaZulu-Natal sugarcane and forestry industries. MSc Proposal. University of KwaZulu-Natal. Available at: http://efwe.ukzn.ac.za/Library.aspx • **SASRI DSP: *EconoCane*** Various modes of sugarcane trash recovery from the field, and its transport to the mill are investigated including residue separation infield or separation at the mill. Residue densification processes are investigated including torrefaction, pelletising and pyrolysis. These modes of trash recovery were integrated into the SASRI *EconoCane* DSP. Rees B *et al.* (2014). Sugarcane trash recovery systems for cogeneration. *Proceedings of the South African Sugar Technologists' Association* 87: 478-481. • **Variable Speed Drives and their potential for reducing electricity costs** - Boote D and Jumman, A (2013). Variable Speed Drives: The answer to high electricity bills? *The Link* 22 (2): May 2013. - Boote D and Jumman A (2014). The unusual setting of an irrigated research farm: reduced energy consumption with variable speed drives (VSDs). *South African Institute of Agricultural Engineers (SAIAE) symposium and biennial CPD event*: *50 years of Agricultural Engineering Excellence in South Africa*. 3 – 7 November 2014. • **Local projects** - CANEGROWERS innovation group – biodigesters for fertilizer and cogeneration. - CANEGROWERS - briquette manufacturing from cane residues

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		- INDEPENDENT POWER PRODUCERS - Charl Senekal's planned co-generation plant in Mkuze. **International Information** • The slow pyrolysis process of cane residues such as green harvest trash and bagasse can produce thermal or electrical energy as well as biochar. A commercial slow pyrolysis unit could generate over 1 MWhr of electricity from every two tonnes of trash (dry basis), with a biochar recovery of between 31.3-33.6%. Our work has demonstrated that implementing slow pyrolysis and biochar utilisation in the sugarcane industry has potential to provide (1) renewable energy (2) income from waste (3) climate mitigation through stabilisation of carbon and (4) climate mitigation through reduced emission of N_2O from soil. Quirk RG, Zwieten L, van Kimber S, Downie A, Morris S and Rust J (2012). Utilization of biochar in sugarcane and sugar-industry management. *Sugar Tech* 14(4): 321-326. • Brazilian mill installation improvements over time, trends and possible mill designs into the future. From sugar, ethanol and bioelectricity to: Biosugar, bioethanol, bioelectricity, biodiesel, biofertiliser and biowater. Increases in milling capacity and productivity – increases in diffusers, milling unit capacities, boilers, fermentation vessels. Increases in efficiencies (Ethanol fermentation processes and bio electricity generation) - Fibre processes, fluidised bed boilers, fermentation improvements, low steam energy consumptions and sugar losses, stillage concentration improvements. Sustainability improvements – certification, recycling, reuse, reduced water use, reduced emissions etc. Synergy – Intercropping/conjunction: Sweet sorghum integration with sugar milling processes (for energy production) being investigated in Brazil, other facilities integrated (eg. Biodiesel plant, bio-polyethelene), Value adding – yeasts, fuels, solvents, bio plastics etc. Olivério JL and Boscariol FC (2013). Expansion of the sucro-energy industry and the new greenfield projects in Brazil from the view of the equipment industry. *Proceedings of the International Society of Sugar Cane Technologists* 28: 1-20. • Biodiesel second-generation (2G) feedstock production (tricyl glycerides) through fermentation of oleaginous yeast with C source (sugar molasses) is investigated. Modelling and feasibilities using a bench bioreactor were conducted indicating a capacity of 17000 t/y (microbial lipids) and 11700 t/y (cellular debris) may offer revenues of $27 M per year. Vieira JPF *et al.* (2013). Industrial optional route for sugar molasses conversion in sugarcane biorefinery: kinetics analysis and pre-economic viability. *Proceedings of the International Society of Sugar Cane Technologists* 28: 1-10. • Ethanol from bagasse yields lignin fragments and cellobiose. Various treatment to increase sugar availability for fermentation and cellobiose conversions were investigated.

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		Day DF *et al.* (2007). By-products from bagasse. *Proceedings of the International Society of Sugar Cane Technologists* 26: 1162-1168. • Sugar mill conversion to multi-product processing plant investigated. Products include: Ethanol, chemical intermediaries and feedstocks. Obstacles include: Fractionation and hydrolysis of lignocellulosics as well as thermochemical treatments listed. Stepwise conversions and add-ons provide economic pathway for certain processes. Louisiana case study. Rein PW (2007). Prospects for the conversion of a sugar mill into a biorefinery. *Proceedings of the International Society of Sugar Cane Technologists* 26: 44-60. • A pilot research plant to process sugarcane fibre lignocellulose via various pretreatment technologies to produce bioethanol and lignin and fermentation co-products. O'Hara IM *et al.* (2010). Demonstration of cellulosic ethanol production from sugarcane bagasse in Australia: the Mackay renewable biocommodities pilot plant. • Biomass Integrated Gasification / Combined Cycle (BIG/CC) conversion of biomass into electricity and synthesis of biofuels for systems with high pressure cogeneration capabilities fuelled with bagasse and cane straw. Electricity output of 186 kWh/t of cane processed in biorefinery; 32 kWh/t cane for fuel synthesis system with ethanol production of 116 L/t cane and 4 L/t of higher alcohols. BIG/CC requires higher economic investment compared to synthesis plant. Seabra JEA *et al.* (2013). Sugarcane biorefineries based on gasification technologies. *Proceedings of the International Society of Sugar Cane Technologists* 28: 1-11. • Sugarcane value chain simulation platform to evaluate different bio-refinery technologies and products comparing economic, social and environmental aspects including life cycle assessments and sensitivity analyses of calculated impacts. Junqueira TL *et al.* (2013). Virtual sugarcane biorefinery: computational tool to assess different technologies/routes in sugarcane production and processing. *Proceedings of the International Society of Sugar Cane Technologists* 28: 1-10. • Opportunities available for sugarcane biorefineries. Mackay Renewable Biocommodities Pilot Plant. Biorefinery products include: fermentable sugars from bagasse for- fuels and oils through chemical synthesis; organic acids; feeds; plastics; fibre products; resins. O'Hara IM *et al.* (2013). Prospects for the development of sugarcane biorefineries. *Proceedings of the International Society of Sugar Cane Technologists* 28: 1-14. • Cogeneration and biofuel production systems implementation and major technological changes associated. Steam process advancements. Hydrolysis and gasification biofuel technologies. Biorefinery processes integration and implementation. LCA sustainability analyses and drivers. Production scenarios for ethanol, sugar and energy (fuel and electricity). New varieties and agro techniques leading to higher sugar recovery in the mills.

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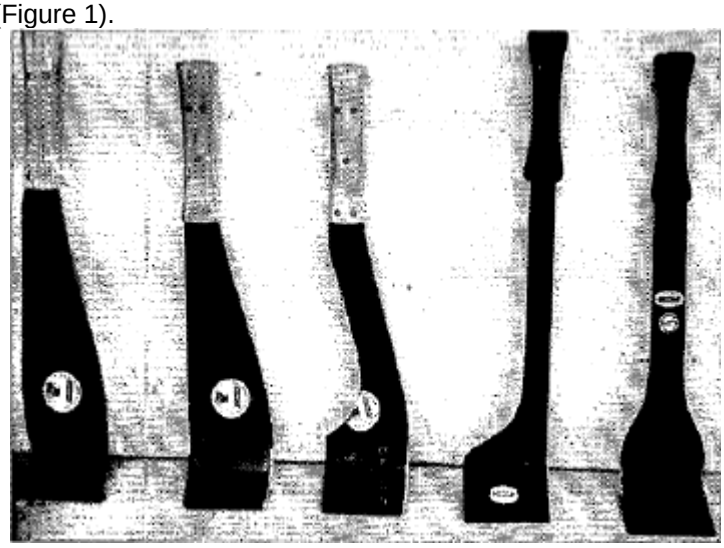
		Reduced energy consumption in milling processes. Wastes and use of these (vinasse, trash). Alternative products. Lora EES *et al.* (2013). The sugar and alcohol industry in the biofuels and cogeneration era: a paradigm change. *Proceedings of the International Society of Sugar Cane Technologists* 28: 1-26.
8	**Better manual harvesting practices** Methods to improve productivity with manual harvesting, re-assessment of tools and methods- air-pressure cutters etc.	**1. Manual harvesting efficiency aids** • *Benchmarking and Improving manual cutter performance:* Factors affecting cutter productivity have been investigated. These include cane factors, knife design, work techniques, cutter wellbeing and motivation (Brooks, 1983). Various work techniques, knife designs and practices were compared against cutter performance (Figure 1).  **Figure 1:** Various knife designs (After Brooks, 1983) In the early 2000's work was done on benchmarking cutter performance. "The Link" article (February 2003) titled "Cane Cutter Productivity" details cutter performance standards for different harvesting systems and cane knife preferences (Tables 2 and 3).

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Table 2. Average cane cutter performance for various harvesting systems

Harvesting system		Average cane yield (t/ha)	Cutter output (tons/day)
Cut and stack	green	73	3.5
	burnt	70	4.2
Cut and bundle	green	74	5.6
	burnt	70	6.6
Cut and windrow	burnt	93	8.0

Table 3. Cane knife preferences

Cane knife type	Cut & Stack		Cut & Bundle		Cut & Windrow
	Burnt (%)	Green (%)	Burnt (%)	Green (%)	Burnt (%)
Long handled curved	64	22	84	67	89
Short handled curved	18	33	13	33	11
Mixed	18	45	3	0	0

The details pertaining to the study were presented in the following paper:

- Meyer and Fenwick (2003). Manual cutter performances in SA. *Proc S Afr Sug Technol Ass*

The SASA Shukela Training Centre has the latest techniques and best practices available to train cutters to maximise cutter performance.

- A trash working group article compared changes in cutter productivity over time (Recommended Reading: 2002 labour productivity survey and a 1994 article in the SASTA Proceedings).

Various mechanical aids have also been investigated in the past. These range from the design of cutters knives to fully mechanised systems that require minimal labour.

Various knife blade and handle designs have been developed and evaluated:

- The South African Sugar Journal of March 1985 has an article of an improved knife design. It consisted of a moulded polyethylene handle, longer length and thicker blade yet was of the same weight as the traditional riveted wooden handle blades.
- In 1991, alternative designs of the standard cane knife were presented in the May edition of the South African Sugar Journal. This knife had a longer handle and bent blade of tempered steel. Another design was developed for green cane trashing, cutting and topping.

2. **Semi-Mechanical harvesting aids**

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		There are a number of publications that highlight the history and development of mechanical harvesting both in South Africa and internationally. These are listed as follows: • Agronomy Association Review paper No. 11: Development of cane harvesting machinery and systems in SA (Booklet) • Review of systems in South Africa (Meyer, 2005) • "The Link" article (May 2004) titled "*What's new on the harvesting front*" details a number of mechanical harvesting options available. • Review of international cane harvesting machinery and systems (Booklet) • SASRI info sheet 6.6: Mechanical cane harvesting systems (1998) • SASRI info sheet 6.7: Factors to consider when implementing a mechanised cane harvesting system • ISSCT paper on Mechanical green cane harvesting by de Beer et al (1983). Harvesting aids that have been investigated in the past include: • Mechanical windrow toppers (SASTA paper) • Detrashing equipment (internal SASRI report) • Hodge topper/detrasher (Australia) (Figure 2).  **Figure 2**: *Hodge topper/detrasher* **I**n India, a mechanical loader has been developed to assist with manual loading of vehicles. The loader consists of a vertical conveyor that is mounted onto the side of the vehicle load bin. As a bundle of cane is placed on the conveyor the bundle is lifted and dropped into the loading bin (Figure 3).

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		 **Figure 3**: *Mechanical loader to assist in manual vehicle loading*. Various types of small-scale equipment are available to top and remove trash from green cane in field (Figure 4).   **Figure 4**: *Examples of small items of equipment available for trash removal during green-cane harvesting*. Late in the 1970's in South Africa, work on modifying a Jonsered brush cutter was conducted to develop what was called the "Mini-Mech". As more work was conducted the brush cutter which had gone through a number of alterations became unwieldy and eventually the work was terminated in 1980. More recently, work has been done in developing a brush cutter for cane cutting. • Illovo cane cutter: Details of this can be found in SASTA papers (Langton *et al.*, 2006) and (Lyne *et al.*, 2007) (Figure 5).

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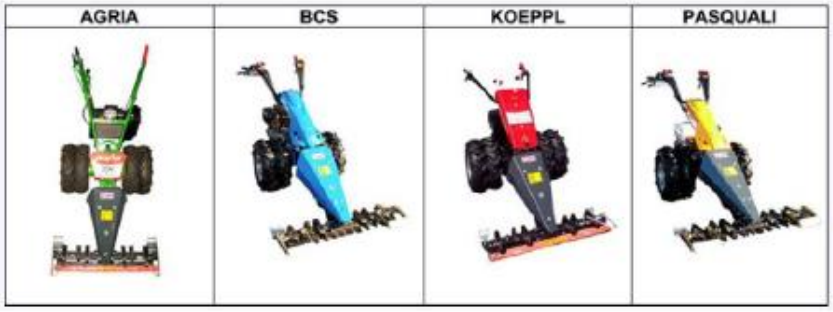
		 **Figure 5**: *Illovo cane cutter* Further work on mechanical cutters led to the development of the walk behind, self-propelled Cane Thumper (Langton *et al.*, 2008). This has a sickle bar principle oscillating blade and has been developed for use in sugarcane plantations (Figure 6).  **Figure 6**: *Cane Thumper* Internationally, there are also a number of walk behind harvesters. The Bunmei is such an example (Figure 6).  **Figure 6:** *The Bunmei* Others include harvesters based on the walk behind tractor (Figure 7).

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		 **Figure 7:** *Harvester based on the walk-behind tractor* 3. **Cane Harvesting- Mechanical equipment** When investigating larger equipment, there are a number of factors to consider regarding the overall mechanised harvesting system. SASRI Information sheet 6.7 provides details on these factors which include: • Mechanisation issues: Field layouts, row spacing and profile, soil compaction (weight of machinery and wheel spacings), stool damage and base cut quality, quality (soil, losses, deterioration), size and type of machine • Agronomic issues: Row spacing, varieties, field lengths, • Handling of lodged cane – varietal traits? • Cost versus shortcomings in machine design (what degree of mechanisation will be achieved typically and what are the limitations of the machines). From the mid 1970's to the mid 1980's the South African sugar industry developed a number of semi-mechanized, low cost harvesting systems. The focus at the time was to develop whole stalk cutters that could be compatible with existing harvesting and handling systems. The possible future lack of labour willing to cut cane was the motivation for the work. The purpose was to develop machines that were to be operated on slopes of up to 30% and within fields not carefully prepared for mechanised operations. The machinery also had to be simple in design, operation and maintenance. A SASTA paper by de Beer (1980) titled, "*Semi-mechanised sugar harvesting systems for a developing country*" describes a number of these machines that were developed. Here is a list of machinery developed and their main characteristics: • *Gobbler cane harvester (South Africa)* Mounted to the side of a tractor, this machine was designed to top and base cut cane, convey the cane stalks into a bin for accumulation to approximately 200kg capacity whereafter the cane was dropped into a loose bundle for mechanical loading (Figure 8).

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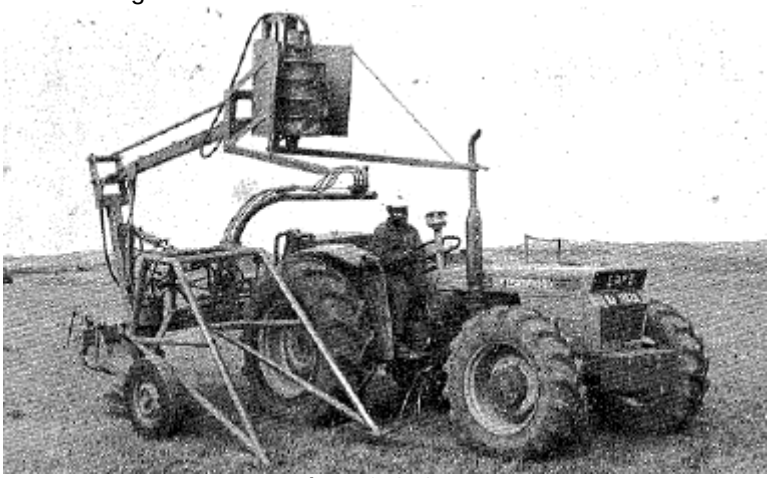
		 **Figure 8**: *Gobbler cane harvester* • *SASEX cane cutter (100t/day) (South Africa)* This cutter was also mounted to the side of a 50kW or greater tractor and carried on the 3-point hitch for easy hitching or detaching (Figure 9). Various models were developed that could top and base cut and laid in a sausage windrow for manual stacking, bundling or windrowing.  **Figure 9**: *SASEX cane cutter* • *Edgecombe cutter (200t/day) (South Africa)* Initially this design was a front mounted cutter, but variations included a rear mount with reversed controls (Figure 10). Two rows of cane (of 1 to 1.5m row spacing) were topped and base cut into a sausage windrow. The cutter was able to straddle the rows being cut and could thus cut in any direction, open up a field or create fire breaks as required and could operate in burnt or green cane.

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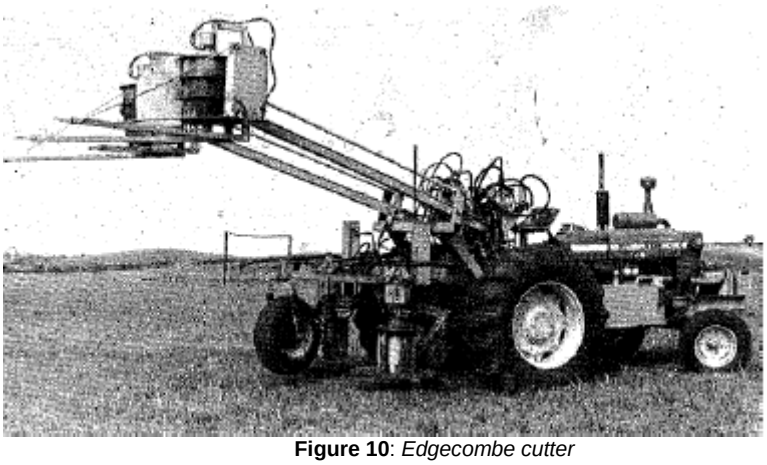
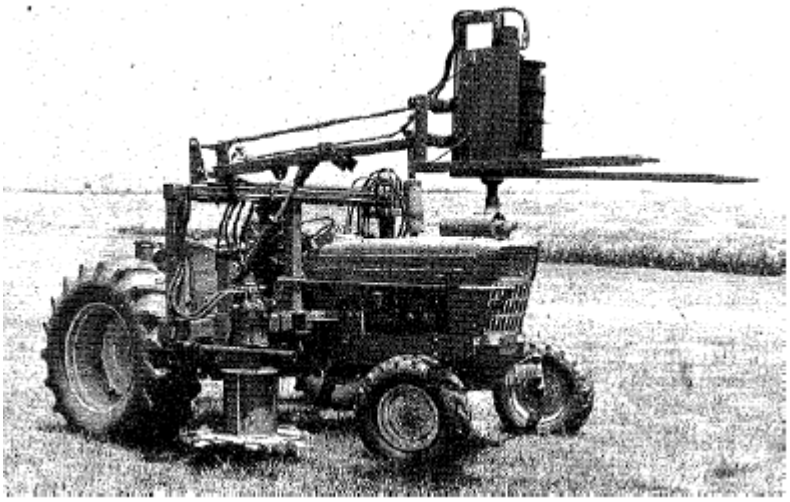
		 **Figure 10**: *Edgecombe cutter* • *Midway cutter: (100t/day) (South Africa)* As the name suggests, the cutting mechanism was located mid-way between the front and rear tractor tyres (Figure 11). A sausage was cut and placed underneath the tractor. A topper was mounted in front of the tractor.  **Figure 11**: *Midway cutter* • *Bell cutter: (13t/hr to cut, top and load) (South Africa)* A Bell loader was fitted with two base-cutting components from the Edgecombe cutter (Figure 12). This resulted in 2 rows being cut per pass (The Bell loader operating in the reverse direction). Various topping mechanisms were tested, the final version being a compact side mounted sickle bar operated during loading operations. The sausage windrow formed required labour to manually assemble the cut sausage into neat bundles (200kg) prior to the loading/topping operations.

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		 **Figure 12**: *Bell cutter* • *Ngwenya cutter (South Africa)* This machine was developed as a green cane soldier type harvester which would cut, top, detrash and bundle between 200-300kg of green cane (Figure 13).  **Figure 13:** *Ngwenya cutter* "The Link" article (May 1996) titled "Mechanical Cane Harvesting Equipment-What choices are there?" details the range of mechanisation options that were commercially available in the industry at that time. These included the following equipment. • *Marsabit harvester (South Africa)* The Marsabit harvester is depicted in Figure 14.

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		 **Figure 14**: *Marsabit harvester* • *Orbach harvester (South Africa)* The Orbach cane harvester is designed to base cut, top and bundle cane in the field (Figure 15)**.**  **Figure 15**: *Orbach harvester* • *Front mounted cutters (Various designs): (±30t/hr to base cut and top) (South Africa)* A SASTA paper by Boast (1989) describes the development of an economical mechanical front mounted cane cutter. The paper gives details on labour requirements for the harvesting and loading systems associated with the system.

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		 **Figure 16**: *A front-mounted harvester* • *Vicro harvester (±25t/h) (South Africa)* The Vicro harvester is mounted on the 3-point tractor linkage and cuts cane rows adjacent to the tractor (Figure 17).  **Figure 17**: *Vicro harvester* • *Hodge cane cutter (Australia)* The Hodge cane cutter is a tractor mounted whole stick harvester (Figure 18).  **Figure 18**: *Hodge cane cutter*

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		• *Simon cane cutter (France)* The Simon cane cutter is a tractor 3-point mounted cutter (Figure 19).  **Figure 19**: *Simon cane cutter* 4. **Chopper Harvesters** Various options are available from manufacturers in China (Figures 20 and 21) and India (Figure 22), as well as the more well-known manufacturers (Figure 23).  **Figure 20**: *Whole stalk harvester (China)*

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		 **Figure 21**: *Chopper harvester (China)*  **Figure 22**: *Whole stalk harvester (India)*  **Figure 23**: *Case A4000/Austoft AHX1800* In addition to the harvesters depicted in Figures 20 to 23, various other options exists including the John Deere 3520W Harvester, the Claas cc3000 and the Santal harvester from Brazil.

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		5. **Equipment plans** Plans for constructing the following items of harvesting equipment are available from SASRI through Peter Tweddle (peter.tweddle@sugar.org.za). • Cutters (various): – Base cutter (shafts and assembly) – Edgecombe – SASEX – Midway • Bell cane loader cutting attachments 6. **SASRI videos** Videos (.wmf format) on the following items of equipment are available from SASRI through Peter Tweddle (peter.tweddle@sugar.org.za). • Brush-cutter • Cane Thumper • Tractor Front Mounted Cutter (FMC) • Vicro Harvester • Bell loader with cutting attachments • Small chopper harvesters • Case IH Austoft 4000 / AHX1800 • SH7500 Harvester (China) • SH30 Harvester (China) Growers may request an advisory economic analysis tailored to their farming operational needs to ascertain whether a mechanical aid is comparable or more cost effective than manual labour costs. Peter Tweddle will be able to assist growers in this regard (Peter.Tweddle@sugar.org.za) or, alternatively, growers are encouraged to consult with their local extension specialist. **7. Additional sources of information** Tweddle, P (2013). Mechanisation Past and Present. SA Sugar Journal 97 (4). June 2013, pp 98-100. Tweddle, P (2014). Mechanisation Systems. SA Sugar Journal 98 (3). June 2014, pp 40-41 Tweddle, P (2015). Mechanical sugarcane harvesting. *The Link* 24 (1): January 2015, pp18-19. Mechanisation Page on SASRI website: Go to **www.sasa.org.za**; choose SASRI and then “Mechanisation” or follow link below: www.sasa.org.za/divisions/SASugarCaneResearchInstitute/Mechanisation.aspx **SASRI Information Sheets:** 6.6 Mechanical sugarcane harvesting systems 6.7 Factors to consider when implementing mechanised cane harvesting **References**

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		• Brooks R (1983). Improving cane cutters' productivity. *Proceedings of the South African Sugar Technologists' Association* 165-166. • Langton M, Harding T and Lyne P (2008). Preliminary results of the Canethumper® operating on the lower south coast of South Africa. . *Proceedings of the South African Sugar Technologists' Association* 402-407. • Langton M, Smithers J, Bezuidenhout C and Lyne P (2006). Evaluation of the Illovo mechanical cane cutter. . *Proceedings of the South African Sugar Technologists' Association* 100. • Lyne P, Langton M, Bezuidenhout C and Smithers J (2007). Performance and economics of the Illovo mechanical cane cutter. *Proceedings of the International Society of Sugar Cane Technologists* 168-172. • Meyer E (2005). Machinery systems for sugarcane production in South Africa. *MSc Eng Seminar, South African Sugarcane Research Institute*. • Meyer E and Fenwick L (2003). Manual sugarcane cutter performances in the southern African region. . *Proceedings of the South African Sugar Technologists' Association* 150-157.
9	**Ripening trials** Please test our current varieties response with Modus as replacement ripener for Ethephon and also determine the BMP protocols for it's use.	This research will commence during 2016 using the current ripener trial at the Komatipoort Research Farm. In consultation with Dr Pieter Cronjé and Jacques Schoeman it was agreed that the Fusilade® Forte treatment in this trial will be replaced with Moddus®. Another novel concept that will be tested in this trial is a combination treatment involving Ethephon™ and Moddus®, which are both hormonal mode-of-action ripeners. This trial will evaluate the response of varieties N23, N25, N36, N43, N49 and N53 to Ethephon™, Moddus® and Ethephon™ + Moddus®. Another trial will be planted on the Pongola Research Farm during 2015 where the response to Ethephon™ and Moddus® will be compared in varieties N36, N41, N49, N53 and N57.
10	**Weed control issues – Combination of Pendamethaline and chloromuron combination (Parabat en Extreme Plus) Poor control of weeds especially in standard spacing tram line dripper fields when there are canopying delays. Also the control of Cynodon infield and verges. Glyphosate control with 2% mixture not working well- this is at higher rates than the recommend 3kg per /ha with a 1% follow-up for regrowth.** Current recommendations need to be re-assessed. Especially the Cynodon problem seems to be worsening. Places where Arsenal Gen 2 was used, the effect was good, but the economics of long crop	1. **Pendimethalin and chlorimuron-ethyl (Parabat en Extreme Plus)** These products are extremely water dependent, requiring application to moist soil, and with irrigation for incorporation. Thus, this treatment will be adversely affected if: (a) applied to dry soil (should irrigation be delayed); and (b) during ripping operations (to alleviate compaction), there are clods present in the ripped inter-rows. Any soil clods present after ripping will prevent an even application to soil for pre-emergence treatments such as pendimethalin + chlorimuron-ethyl. Clods should be broken down with sufficient irrigation before applying herbicide. In addition, these treatments should be applied within two days of irrigation, or weeds such as rottboellia (tarentaal gras) will escape and not be controlled. Remember to follow up with a spot-spray application e.g. of MSMA + ametryn, and inspect field regularly to hand-weed escaped grasses. Contact your supplier for more information regarding use of this treatment. 2. **Dripper line irrigation in standard spacing tram line fields** A summary recommendations table is presented in the SASRI publication entitled "*Calibration & Herbicide Selection. Weed Control Module for Emerging Farmers in the Irrigated North*". Recommendations by a local consultant are given below: Where there is drip line with sprinklers, use sprinkler irrigation to moisten soil for effective chemical control across the whole swath/

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	breaks needs to be investigated	row width. When planting cane: apply pre-emergence herbicide at early spiking of cane. When cutting ratoon cane: apply herbicide within two days after irrigation. Use sprinkler irrigation again to incorporate pre-emergence herbicides/ move herbicide to weed roots Beware of emerged grasses: select a treatment for grasses containing Gramoxone or ametryn, or containing MSMA for post-emergence control. Select a treatment containing diuron or MCPA for broadleaf weeds. Where there is drip line, with no sprinklers, if there is rain after planting or cutting, apply herbicide just after rain and hoeing. If there is no rain after planting or cutting, you need a two spray operation: • Spray 1 – spray a band where the soil is moist from dripper lines • Spray 2 – apply herbicide in the inter rows just after rain and hoeing. There are nozzle position recommendations for tramlines, illustrated in the "*Calibration & Herbicide Selection. Weed Control Module for Emerging Farmers in the Irrigated North*". These diagrams have been shared with RCL contractors, at their request. 3. **Cynodon control recommendations** For cynodon control, the basics need to be followed – these are available in the SASRI Herbicide Guide and in several Link articles. Currently, new products are being tested. Economics of a long fallow as an option is currently under investigation. An Integrated Control Booklet and decision tree is currently under development. This knowledge will be shared in the Weed Management Working Group, and also disseminated from there via a) Extension Newsletters, b) through Karlien Trumpelmann (SASRI biosecurity) and c) Hestia Saaiman (RCL Agronomist).
11	**Round-up ready cane** Information required regarding the process and progress to get to GM cane.	A GM Workshop with the SASRI Committee and other Industry Principals was held in October 2013 and there was strong support for GM commercialisation. In particular Bt cane was identified as a priority, based on the current losses due to early cutting cycles to manage infestations, direct economic loss due to eldana damage and the cost of insecticide application. Subsequently in October 2014, a business case for Bt cane was developed by an external consultant with input from SASRI specialists. This was presented to the SASRI Committee in February 2015 and was discussed again at the May 2015 meeting, where further interrogation of the return on investment was made. The business case presented various scenarios for engagement with external parties for licencing the Bt gene(s) from international companies. The use of two different insect resistance genes is required to minimise any potential build-up of resistance in eldana populations. The details of how SASRI should go about accessing the insect resistance genes are being discussed by the industry decision-makers. It is important to note that it is likely to take more that twelve years to develop and test the transgenic cane, assess it for food and feed safety and for it to be passed through the regulatory framework. Unfortunately,

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		a shorter route is not possible as there is a strong requirement by government for testing GM crops under different conditions and for rigorous safety and risk testing. Although Bt is the primary gene of interest, herbicide tolerance is also likely to be considered as part of the GM package.
12	**Impact of Climate Change on Sugarcane water Requirements** A study is required to determine the impact of climate change on crop water demand/use, the current irrigation scheduling systems and water allocation model, and to recommend alternatives or changes in the systems and/or model by; Reviewing the amount of irrigation water required by the crop in each of the Swaziland sugar industry regions (North, Central and South) under the prevailing climatic conditions. Reviewing the water duties of the different regions used in the current model and taking into account the output from the objective above. Determining the impact of high intensity storms on available soil moisture balance. Determining the impact of high intensity storms on parameters in the current water allocation model.	A meeting was held with SSAES to further clarify details of a proposed project. It was agreed that this was an important project that is likely to deliver important information regarding crop water and irrigation requirements for the present and immediate future. Evapotranspiration models have been calibrated on data from the 70s and 80s and conditions may have changed significantly since then. It was agreed in principle that SASRI will manage this as Specialist Advisory Request, and that that most of the work will be contracted out an external consultant. A quote will be compiled in due course.
13	**Application of Ethephon via drip irrigation** Ethephon (2-chloroethylphosphonic acid), a chemical from the ethylene forming group, is a plant growth regulator with systemic properties. At present, ethephon is applied on the leaves and shoots of the sugarcane plant where it penetrates plant tissues and is progressively translocated, and it then decomposes into ethylene	This research is in progress as an SAR funded by Netafim. Severe lodging in the commercial field on the UVS Estate in Komatipoort prevented trial work during 2015. This research will continue during 2016. SSA can enquire about the results/progress from Netafim.

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	to give economic benefit to the grower. Of late, there is a 'talk' that ethephon being systemic in nature can be applied with drip irrigation and consequently taken up by the plant roots giving similar results as when applied above ground. However, there is no scientific evidence or literature supporting this claim. With drip irrigation expanding in the irrigated areas of the sugar industry, and fertilizer being extensively applied through this system, there is therefore a need to investigate if there is any economic benefit of applying ethephon via drip irrigation.	
14	**Nutrition requirements of fields planted with tramline rows** Do fields with tramline row spacing require the same volume of nutrients per hectare as single line spacing? This especially applicable to the first 3 years of a crop when the lines are still separate.	Since yields with tramlines are similar or greater than with conventional spacing, nutrient requirements should be higher or remain unchanged. Two important factors to take into account to determine the amount of fertilizer to be applied is the total row length per hectare and the yield aimed for. If the average row spacing of the traffic control layout is more than your current system then more fertilizer will be required to sustain the expected higher yield. There is, however, a likelihood that in the long-term the efficiency of nutrient acquisition by the crop may be improved by the more favourable soil conditions resulting from controlled traffic (if this is implemented) resulting in an expected yield increase which will require more fertilizer. This aspect would require long-term research to verify. Calculation of the amount of fertilizer to be applied in a controlled traffic system with dual rows is explained in the control traffic manual.
15	**The advantages or disadvantages of incorporating fertilisers into the soil in the inter-rows** How big are the advantages or disadvantages in terms of growth response of band applying fertiliser under the soil at 20cm depth in the inter-row?	• With conventional row spacing, placing the fertilizer at depth in the middle of the inter-row may be a disadvantage since the efficiency of the root system is not likely to be optimal in that area. Burying should ideally be in closer proximity to the row. • Burying should be to 10 cm to optimize uptake. 20 cm may be too deep, and a waste of fuel. • Burying N (as urea) has the advantage of essentially eliminating volatilization losses. • Buried P, K and Zn will be more effectively used by the crop than when surface applied. It is not possible to quantify the benefits of burying, since numerous factors are involved, including soil type, residue management and irrigation management.
16	**Eldana population dynamics in short cycle cane under irrigation**	Key issue is eldana infestations occurring with greater frequency in "young" (short cycle) cane in the northern irrigated areas. What follows is based on the assumption that in this instance, the term "young" cane refers only to annual irrigated crops.

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	There are signs that eldana population dynamics do not always follow the same pattern as with long cycle non-irrigated cane. We need to verify if there is a change in the dynamics and how best to control these **Description**: Change in eldana population dynamics - present in young cane. **Background**: • Increase in eldana in young cane throughout industry. • Increase carryover over? Variety, etc. • Need to monitor, develop control measures. • Noted in Irrigated North and other areas. **Desired Outcome**: • Verify population dynamics (shift?) • IPM • Risk moving forward	As mentioned in comments for ISSUE 2 above, there are a number of factors that govern the development of eldana in sugarcane. It is possible that some of these factors, such as heat units may favour a more rapid generation time, so encouraging greater population growth and consequent damage in a "shorter" time frame. Mention was made in ISSUE2 of a "young crop" (in the region) being "*normally rich in nitrogen fertiliser and growing luxuriously*". Such a crop could indeed encourage eldana development. However it would be useful to initially interrogate just what levels of damage are being experienced and how (if) these levels can be related to practices known to encourage eldana (high levels of N, crop stress, poor field hygiene etc). A suggested important first step would be that P&D in the region conduct such an analysis, which may indicate those practices or circumstances that are encouraging eldana development in short cycle crops.
17	**The effect of increasing use of insecticides and fungicides on beneficial insects and other organisms** Agrochemical reps are increasingly promoting the use of insecticides to control thrips, aphids, eldana, rust and other sporadic pests such as army worm. Although it may be required the use of agro chemicals should be limited to a minimum. The results from the thrips and rust yield loss trials under irrigation which is being conducted at	Synthetic agrochemicals are not necessarily detrimental to the environment, particularly when used responsibly and if they allow a farmer to maintain his income on a lesser proportion of the total area of land available to him than would otherwise be necessary. Indeed, new generation pesticides are becoming increasingly target specific, having minimal or no effect on beneficial species, whilst providing superior pest control. A benchmark of less than 5kg total active ingredients per hectare per year has been suggested (herbicides, nematicides, fungicides, insecticides and ripeners). This is calculated over the total farm area (inclusive of 'natural' areas etc). In sugarcane agriculture this is readily attainable particularly if IPM principles such as varietal diversity, smarter soil management, habitat management (increased natural habitat areas) and green manuring are employed. Far from rejecting the use of agrochemicals, growers are encouraged to adopt a full IPM approach in which, on the advice of Extension

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	Pongola combined with first-hand information on the detrimental effect of agrochemicals will be useful to limit the use of agrochemicals to where and when it is really required. Let us timeously learn the lessons that other agricultural industries such as citrus had to learn the hard way.	Specialists, agrochemicals remain beneficial both financially and environmentally when used responsibly.
18	**Yield effect of hail damage** After hail damage growers need to adjust their yield estimate for both MGB and budget purposes. We need to be able to say what the % impact on yield would be for both leaf damage and growth point damage due to hail.	Hail damage needs to be assessed approximately five days after the hail event has occurred. The yield potential is determined by the amount of leaf area present to produce dry matter and leaf damage after a hail event. As such, a hail event is likely to cause a reduced growth rate and lower recoverable value (RV %). The extent to which hail damage affects final cane yields depends on the growth stage at which the hail event occurs. Three month old cane has been shown to be the most negatively affected by hail damage e.g. where hail damage caused a reduction in leaf area of approximately 75%, the final yield attained by the damaged crop was 30% lower than an undamaged crop. Hail damage can also be estimated by the percentage Stalk Length Red (SLR %). Any percentage of stalk length red is likely to cause a reduction in recoverable value (RV %) because they have been shown to be directly correlated. An example would be if there was 1% SLR observed in surveyed stalks after a hail event occurred, the yield loss would be approximately 1% RV yield less than an undamaged crop. Further to this information, the SASRI Information sheet on hail damaged sugarcane (4.11) has been updated and now includes a decision tree to help with the management of hail damaged cane. An article published in the September 2015 edition of *The Link* detailed the yield effect on hail damaged cane and the management decision tree to inform husbandry practices following a hail event. See: Eksteen, A (2015). How to manage hail damaged cane/ Hoe om haelbeskadigde suikerriet te bestuur. *The Link* 24 (3). September 2015, pp 14 -16.
19	**The use of modern technology such as satellite imagery, remote sensing and drones for crop monitoring in growth, pests & diseases and irrigation efficiency and general management** Develop methods of interpreting images as tool in P&D management, irrigation management, crop nutrition and general farm management.	**Remote sensing of sugarcane** Remote sensing (RS) is a tool that provides a synoptic view of the area in a non-destructive, non-invasive and objective manner. The advantages of using RS is that it affords timely information over a larger area whilst proving a spatial dimension to the information. Remote sensing of biotic stress is based on the assumption that plant stress chemically interferes with photosynthesis and physical structures such as plant tissue and the canopy. The results of this interference thus affect the absorption of light and alters the reflectance in the different and respective regions of the electromagnetic spectrum. Research into the vegetative spectral reflectance can assist in understanding the resulting physiological and biochemical processes from pests and disease attack.

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	Description: Use of modern technology e.g. remote sensing and precision agriculture increasing worldwide. **Background:** • Happening in individual areas (informal). • Need combined effort / share knowledge • Precision farming underway in some areas --> maps for yield, fertilization. **Desired Outcome:** • Formulating extension strategies (BMPs) taking these new techniques into account. • Workshop to explore required actions.	There are numerous sources of remotely sensed data that can be evaluated. The cost and benefit analysis will have to be conducted for each source; i.e. there are sensors with narrow bands that are most suitable for detecting plant biochemistry, however at a cost. With the fast-growing trend of using mobile devices to access and share data, a review will be conducted to assess a workflow that can be used to integrate both GIS and remote sensing data for operational use in the sugar industry; focusing on pest and disease management. This review will also include scientific evidence of where this technology has been used to detect pest and disease presence and damage. Due to anticipated resources constraints in 2016 / 2017, the planned review will commence in 2017 / 2018. As there is also considerable interest in the application of state-of-the-art technologies in smut monitoring, the review will focus the following topics: 1. A review on smut infestation 2. Cost benefit analysis of the available remote sensing platforms 3. Remote sensing of smut 4. Data management at SASRI – capacity and infrastructure 5. Review of current data sharing mechanisms Alex Searle (SASRI Extension Specialist) has been working on the development of a project in Umfolozi related to this issue and has a fair understanding of the requirements. This issue is a local area issue and the progression of the development of the tool will be dependent on the local role players becoming involved. An investigation is required into the total costs and material requirements for the development of such a tool. It is suggested that Alex Searle and Marius Adendorff develop workshops in the region to determine the interest and willingness of growers to develop such a tool.
20	**In-field RSD testing**	The project 11TD08 *'An alternative method for diagnosing ratoon stunting disease (RSD)'* has recently closed. This project aimed at developing a new molecular technique, known as Loop-mediated isothermal amplification (LAMP) for diagnosing RSD. The first objective of the project was to develop the LAMP method, which involved the design of specific primers, optimisation of the protocol, and specificity and sensitivity studies to ensure this assay is reliable, rapid and robust. The assay was developed successfully and allows detection of *Leifsonia xyli* subsp. *xyli* (Lxx) in 30 min at 65°C, using xylem sap as the template. This is then followed by visualization of the amplified DNA product using a disposable lateral flow device (LFD) which gives a negative or positive RSD result. The second objective of the project was to investigate the feasibility of using this test in a near-to-field situation. Due to the highly sensitive nature of the LAMP assay, it is prone to contamination which increases the risk of false positives. For this reason the LAMP-LFD method needs to be refined further, prior to testing this new method in outlying areas. Briefly, the optimization plan incorporates the use of an enzyme known as uracil-DNA-glycosylase (UDG), which has been shown to alleviate the

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		problems associated with contamination in LAMP. This work will be continued in 2015 by Dr Meenu Ghai (at the University of KwaZulu-Natal [UKZN]). A new sampling method will also be tested in this phase. Once the contamination issue has been resolved in the laboratory at UKZN, a Knowledge Exchange project will be developed to investigate the feasibility of using the LAMP-LFD method routinely in the RSD diagnostic laboratory and, if successful, the subsequent use of this method in a near-to-field situation will be thoroughly tested. That project would investigate the use of the refined LAMP-LFD method in terms of practicality and overall economics (i.e. costs of chemicals and consumables, the expertise required and the associated costs of changing systems in the RSD laboratory and near-to-field requirements). These costs will be compared to the current methods of RSD detection. Although molecular methods for disease detection in general have the distinct advantage of being rapid, reliable and highly sensitive to low pathogen titres, the cost of these methods can be high, with a number of the LAMP-LFD components being imported from various countries adding to the overall cost. However, the increased sensitivity of this new method would allow for the pooling of stalk samples, resulting in a reduction in sample numbers and make a new, non-destructive sampling method feasible. All these aspects would need to be considered before the implementation of the new LAMP-LFD method at SASRI and in outlying areas. In conclusion, although a scientifically sound, sensitive, reliable and robust molecular assay was developed to detect RSD in a laboratory environment with staff who have expertise in molecular methodology, the practicality, reliability and cost of this method in a near-field situation performed by less skilled personnel remains under investigation.

COASTAL TUGELA NORTH (Amatikulu, Felixton)

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21	**High Non-Sucrose Problem** High non-sucrose has always been an issue, and appears to be more prevalent in rapid growing climatic conditions such as we have. While factors influencing high non-sucrose are well-known from the growers' side, the miller somehow has an influence on high non-sucrose build-up during the crushing operations. There could be an adjustment made by both parties to reduce this high non-sucrose problem. Therefore, growers are requesting a study to be done to determine the areas that the millers could possibly be causing an increase in high non-sucrose levels during crushing operations. **Description:** High % of non-sucrose than other milling area. **Background:** • High non-sucrose has been a problem in the Felixton area. • The issue has been revised - it is more an extension issue than a miller issue. • Desire Outcome: • To reduce non-sucrose levels to be achieved through the extension program. • To address all issues contributing to non-sucrose level.	SASRI's mandate from the Industry Principals: (a) does not encompass the discussion or resolution of issues at the grower-miller interface; and (b) is to focus on agro-technical matters pertaining to sugarcane agriculture and production sustainability. Therefore, SASRI will actively support growers in the Felixton area to implement management practices that will lead to a reduction in the non-sucrose component of their crops. Such support would include: (a) practises that enable cane ageing on a longer cutting cycle; and (b) when and where feasible, the use of chemical ripeners.
22	**Stunted Roots/Yield Decline**	A SASRI project (Project Ref: 12CM01) commenced in April 2013 to investigate possible factors responsible for poor root development in the sugarcane industry.

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	Despite on-going requests there have been no real developments to address the issue of poor root development and consequent yield decline, particularly in the hinterland areas .It is understood that this could be a multi-faceted problem, but recommendations to date, such as combating sub-soil acidity have not remedied the overall problem. **Description:** Poor root development and consequent yield decline. **Background:** Registered project 12CM01 **Desired Outcome:** Feedback on progress.	The project involves a multi-disciplinary team (i.e. soil chemistry, soil physics, plant pathology, nematology, agronomy and entomology). With poor rooting already noted in many fields in the Midlands, Zululand, North and South Coast, the approach was to identify the management and soil factors most often associated with good and poor rooting. **Field surveys:** Good and poor rooting systems were sampled in most extension areas with black root problems. Soil pits were opened and four FAS samples were taken at 20 cm intervals. Nematode samples as well as soil microbiological samples were taken from each pit. Detailed field and laboratory measurements were conducted in both "good" and poor root systems. Information on a range of soil types, varieties and histories of herbicides used were collected and this data is currently being analysed. **Pot trial:** A pot trial was conducted using humic soil and sandy soils with 12 chemical ameliorants as treatments. At harvesting of the trials, high volumes of roots with very few or no black roots were obtained, suggesting that the amelioration did not have an effect on the root systems. Data from this pot trial is also currently being analysed. **Pathological tests on root and soil samples:** Pathology tests are conducted in association with Dr Sandra Lamprecht from the ARC-PPRI Vredenburg research Centre in Stellenbosch. No known diseases such as *Pythium* or *Phytophtera* could be isolated, but investigations are still in progress. **Herbicide trial**: Two replicated herbicide trials were established on small areas (0.4 ha each) with differing soil clay contents to examine the effect of herbicide residues on sugarcane roots. One site is at SASRI Gingingdlovu Research Station (15-20% clay) and the other at the SASRI Mount Edgecombe site (approx. 50% clay). Velpar DF 750 or Diuron 800 were sprayed at single and double dosages, with appropriate controls. There will be one or two applications per year. Soil and root samples will be collected just prior to each spray. Sugarcane bioassays will test the presence or absence of herbicide in the soil samples. Root samples will be visually assessed for damage symptoms (e.g. black, short roots) and their volume measured. The SABS have been contacted and quotations obtained for analysing for herbicide residues. Once the entire root, chemical, physical and biological data from the pits, soil amelioration pot trial and herbicide residue trials have been analysed, common factors that are associated with healthy and poor root systems will hopefully be identified.
23	**Eldana Control** There is a belief that controlling early eldana infestation via chemical	The strategy of treating young crops prior to the April/May moth peak has merit. SASRI conducted a trial following this approach, but it failed to show any treatment effects. In the past this approach was not considered to be as important as developing a summer treatment to control eldana in carry-over cane. This was partly because it was

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	means will have a positive effect on overall eldana damage. To date chemical control is registered for carry-over cane only. We require research on chemical control of eldana at an early stage of ratoon development and consequent recommendations to counter early eldana infestation. **Description:** • Early eldana infestation in young ratoon requires control. • Chemical control is only registered for use on carryover cane. **Background:** Eldana infestation at an early stage has resulted in significant damage prior to harvest. **Desired Outcome:** Registration of chemical control for eldana reduction at an early growth stage.	assumed that if high eldana levels were detected in crops during the March - August period, they could be milled, so eliminating the problem. However where growers identify carry-over fields early on in the crop cycle, and eldana is considered an issue, early treatment can make sense in the light of the view that the eldana population that develops in a field remains in that field, increasing over time. Thus, should one be able to suppress the initial population, this may have a significant effect on subsequent population growth even in the carry-over period. This approach will be re-examined with revised treatments in trial conducted in the SASRI Principle Agrochemical project (Ref: 00CP04).
24	**Nutrition** Boron deficiency is common amongst other crops such as avocado's. Is this micro-nutrient in sufficient supply for sugarcane? We require research on the yield impact of Boron deficiency and other micro-nutrients in sugarcane and recommendations to counter possible deficiencies. **Description:** Boron is known to be an essential micro-nutrient in many other crops but its	• Sugarcane has a low requirement for B, and certainly considerably lower than crops such as avocado. • SASRI has included B in a number of field trials. It is anticipated that useful results will become available within the next 12 months. • B sufficiency can be assessed using FAS's leaf analyses (supplementary analysis).

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	role in sugarcane is unknown. **Background:** Boron nutrition has been linked to pest resistance in other crops and there is a need to determine the role in sugarcane. • Are there deficiencies? • How significant is this element in controlling eldana? **Desired Outcome:** Clear understanding of the role that boron has to play in sugarcane agriculture.	

COASTAL TUGELA SOUTH (Darnall, Gledhow, Maidstone, Sezela, Umzimkulu)

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45	**Liquid Fertilizer vs Granular** **Description:** There is an increasing use of liquid fertilizer and there is a need to understand if there is any added benefit to use this form of fertilizer. **Background:** The supplier has claimed that the use of this fertilizer is beneficial and we need to quantify this benefit. **Desired Outcome:** To determine relative efficiency of liquid fertilizer versus granular.	The efficiency of liquids and solids is expected to be largely similar. Benefits of liquids relate largely to practical issues. There are numerous liquid products and formulations, so it would be very difficult to conduct research to address this issue.
25	**Eldana** Although a lot of knowledge exists on Eldana, growers feel not enough is done to fight this pest and the financial impact on the industry. Growers on the NC practice practices out of SASRI recommendation in an effort to minimise the impact. **Description:** Need serious and urgent Eldana Control. **Background:** Growers are moving off label in attempts to control. **Desired Outcome:** • Label extension of insecticide for spraying on younger cane. • Pro-active recommendations to	Where heavy infestations are clearly present in young cane, this probably indicates inadequate eldana IPM practices (such as lack of green manuring, infested seedcane and inadequate control in the previous ratoon). A full IPM approach needs to be implemented along established guidelines. While insecticide use could be considered in such situations, it should be unusual emergency use and should be coupled with strategies aimed at addressing any management short comings that may have encouraged the initial eldana problem. The strategy of treating young crops prior to the Autumn (April/May) moth peak has merit (albeit currently off label). SASRI conducted a trial following this approach, but it failed to show any significant treatment effects. In the past, this approach was not considered to be as important as developing a summer treatment to control eldana in carry-over cane. This was partly because it was assumed that if high eldana levels were detected in crops during the March - August period, they could be milled, so eliminating the problem. However where growers identify carry-over fields early on in the crop cycle, and eldana is considered an issue, early treatment can make sense in the light of the view that the eldana population that develops in a field remains in that field, increasing over time. Thus, should one be able to suppress the initial population, this may have a significant effect on subsequent population growth even in the carry-over period. This approach will be re-examined with revised treatments in trial conducted in the SASRI Agrochemical Principal Project (Ref: 00CP04). Treating the Autumn moth peak in older cane could also be beneficial. It may help limit re-infestation of young cane at this time. The efficacy of treating the Autumn moth peak will be investigated in a trial conducted

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	deal with emergency situations.	in the SASRI Agrochemical project (00CP04). At present, treating the autumn moth peak is not legal with Fastac®. The Fastac® label states: *'Follow a preventive spray programme, by applying the first application, starting in August. Follow up at two week intervals up to a maximum of eight applications*' i.e. control is August through November. Thus, treating the March, April, May moth peak in older cane can be considered to be currently 'off label'. Likewise, the Steward® label states: *'Start applications in August. Four applications to be made at a monthly interval period*' i.e. control is August through November. On the other hand, the Coragen® label states: *'Start applications in August. Four applications can be made at a 2 monthly interval period. Longer residual effect of treatments will thus be possible into the February/March period*' i.e. control can begin in August and continue through to the autumn moth peak. The spraying strategies outlined in the product labels are currently legal. However, it has become apparent that all of the pesticide labels for eldana control chemicals are not compliant with the Insecticide Resistance Action Committee (IRAC) guidelines. In the near future, product labels should to be re-written to include IRAC compliance, and also with an emphasis on levels of damage and infestation (rather than time of year – August) as a trigger for the commencement of a spray programme. Additionally the labels should also support compliance with LPD&VCC rules which now include insecticidal control as a gazetted enforceable remedial measure.
26	**Yellow aphid** Not enough is known about this pest as there are no indications of what, how and when to start a successful spray programme and what is the yield impact of this pest? **Description:** Yellow aphids - not enough known about yield loss and control of the pest. **Background:** No guideline for growers on assessing and treatment. (Note: work in progress). **Desired Outcome:** • Connect with chemical companies and their progression.	A new project to investigate yield loss due to yellow sugarcane aphid (YSA) (Ref: 14CP02) commenced in November 2014, which will provide preliminary information on the effectiveness of pymetrozine as an insecticide for use against YSA. However, success in estimating yield loss due to YSA is dependent on the occurrence of pronounced YSA infestations in the project field trials. In terms of chemical control, application has been made for the registration of Allice™ (a.i acetamiprid) as an insecticide for use against YSA. However, it should be noted that it is not legal to use Allice™ against YSA until it has been registered and SASRI cannot yet recommend its use against this particular pest. No economic threshold has yet been developed for insecticide application against YSA. New chemistries for use against aphids will be tested as they become available. Many of these new agrochemicals are now 'Blue Label' products, with substantially reduced environmental concerns. A second project also started in November 2014 to determine varietal differences in leaf damage due to YSA (and sugarcane thrips) (Ref: 14CP03). Clear differences in leaf damage produced by aphid feeding have been recorded in an aphid-infested released variety trial containing 20 varieties. The differences in YSA damage between commercial varieties will be confirmed over the course of the next season (2015/16) in further field trials, as well as by SASRI Extension, Pest and Disease specialists in grower fields. Once confirmed, this information will be used to advise growers on preferential variety choice in situations where aphids are of major concern.

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	• Need recommendations (what, when, how?) on management.	
27	**Eldana Management (Push pull) Alternative to BT maize** Bt maize as a pull plant does not grow well on the Coast i.e. get destroyed by bush pigs/ Is there other pull plant with BT gene that can be looked at other than maize. **Description:** Need alternative pull plant for Eldana (other than Bt maize) **Background:** Push / Pull in coastal areas may need to be re-looked at. **Desired Outcome:** Alternative methodology / plants.	There are no viable pull plants for replacing Bt maize. However, Push-Pull is still a system that should be considered where there is opportunity to establish spaced clumps of natural wetland sedge host plants as pull plants, in combination with melinis grass as the push component.
28	**Trace Elements. Quarry dust as an alternative source of trace elements** Can quarry be use as an alternative source of trace elements/If it can be used how much should be applied and will the trace elements be released to be available for crop use? **Description:** Using Quarry dust for trace elements. **Background:** • Efficiency of release of nutrients unknown. • Needs to be tested. **Desired Outcome:**	This depends very much on rock type, fineness of milling, rate of application, soil type and soil acidity levels. Where these are not optimal, the product will be of little or no use.

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	Communication with a specialist.	
29	**Vertical mulching to mitigate frequent drought** Drought is becoming more and more frequent/ Can vertical mulching be utilised to mitigate drought and if can be utilized how much should be applied and how frequent. **Description:** Vertical Mulching **Background:** Can it be used to mitigate drought? **Desired Outcome:** Set of recommendations on methodology.	Vertical mulching (VM) is only effective to mitigate the effects of drought if the ERD (20cm or less - but not due to rocks) is much shallower than the working depth which is limited by the length of the ripper tine. It is important to consider the purpose of the ameliorant to be used with VM. In most soils, filtercake will be the most suitable as it will: (a) keep the surface from crusting and thereby lead to a multi fold increase of water infiltration rates; (b) act as building material for a structured soil; (c) improve nutrient and water holding capacity; (d) have a favourable effect on soil micro-organism numbers; and (e) protect plant roots against nematode infestation. Improvement in these soil properties are especially noticeable in sandy soils. The best ameliorant in clayey soils is sand, as it will not decompose and its effect is therefore of a permanent nature. It will also lead to improved water infiltration rates, will keep the vertical slots from closing up and could therefore facilitate with drainage of excess water if the slope of VM slots where planed with drainage in mind. See also SASRI Information sheet 4.9.
30	**Ripening (Brix/Pol reading) to test juice purities** The aim of ripening is to influence the top end of the cane stalk and to estimate juice purity Brix/Pol are taken from bottom, middle and top end. Should the top end be targeted be the only target this purpose? **Description:** Ripening **Background:** * Clarity on what is needed for strategy. * Would like quicker testing (top only?). **Desired Outcome:** Knowledge transfer of known information.	No, the physiological responsiveness of the sugarcane plant to ripeners is determined by whole-stalk juice purity. For ripeners to be effective whole-stalk juice purity needs to be below 75% for Ethephon™ and below 85% for Fusilade® Forte (and generics) at the time of ripener application. To estimate whole-stalk juice purity from refractometer readings the Brix% gradient along the length of the stalk needs to be measured. During 2015 an Excel-based juice purity calculator (*PurEst*) will be released in conjunction with a SASRI Information Sheet detailing the exact measuring procedures to follow.
31	**GM Cane**	

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	In an effort to reduce the amount of chemicals being sprayed into the environment, as well as to get a more effective and specific solution to eldana and thrips problems, the genetic modification of varieties of cane needs to be accelerated. A promise of GM for nutrient uptake or similar such advantages in the next ten years or so is not adequate. Eldana is costing far more than nutrient uptake and to solve this problem would justify any cost in accelerating the research to this end. If Bt is not the answer, then we need to work to finding another such gene. **Description:** GM cane - investigate using for Eldana rather than NUE, etc. **Background:** Prioritising cost to industry. **Desired Outcome:** • If Bt is not available, find alternative gene to target Eldana. • Fast-tracking of GM (more resources).	Several issues are listed: 1. GM cane (see response #11) 2. Note that thrips control is not possible using the Bt GM cane. The Bt gene is specific for Lepidopteran (moths) insect control e.g. eldana and chilo. 3. Nutrient uptake (N) is a GM project that has been in the Programme of Work since 2010. Research in this area is well underway under a commercialisation agreement with Arcadia Biosciences (USA) for N use efficiency. Continuation of the project is reliant on meeting specific research project milestones and regular evaluation of the value of the N uptake GM research by industry decision-makers (elected members of the miller and grower leadership). • A Link article on GM cane was published in 2011. See Watt and Snyman (2011). Sugarcane biotechnology: Where are we? *The Link* 20 (2): May 2011, pp 1-2. • RD&E feedback on the topic was given in 2012, 2013 and 2014 • SASTA presentations were given in 2012 and 2014. • An Agronomists' Association presentation was given in October 2015 by Sandy Snyman. Go to http://www.sasa.org.za/sasiaa It likely that another *The Link* article to update growers on progress with planning for insect resistant GM cane will be published during the course of 2015.
32	**Varieties – disease in new varieties** There are concerns about the susceptibility of new varieties to diseases. Older varieties such as NCo376 and N12 are still very commonly used due to their perceived hardiness and ability to deal with disease. **Description:**	All varieties released by SASRI are rigorously tested for their reactions to major pest and disease threats in the industry. While routine pest and disease screening was not in place when NCo376 was released in 1955, similar testing procedures that are employed currently for newer varieties were in place before N12's release in 1979. In general, there is a curious perception in the industry that all older varieties are hardier than newer varieties. The reality is that many older varieties have actually failed after succumbing to major pest and disease outbreaks or due to poor performance. The popular variety NCo310 was degazetted due to its susceptibility to smut but was also susceptible to mosaic and gumming. Other older varieties that were degazetted due to disease susceptibility include: NCo339 (mosaic); N7, N8 and N13 (smut); N15 (leaf scald, pokkah boeng); N34 (pokkah boeng). Variety N55/805, although susceptible to smut, mosaic and gumming, was not degazetted but lost favour after developing severe brown rust during a resurgence of the disease in the mid-1970s. Other examples of older varieties that lost

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	Varieties - perceived susceptibility to disease and poor recovery from stress. **Background:** Older varieties seem to be better. **Desired Outcome:** Variety testing in region - in pipeline. Knowledge exchange.	favour include N52/219 and N6 (poor performance), N11 (poor performance, eldana), N18 (poor ratooning, eldana) and N20 which was released for its eldana resistance but was never adopted by growers. Even variety NCo376 is susceptible to smut, mosaic and eldana, and is therefore not as hardy as some of the more recently released varieties. Variety N12 is actually an exceptional variety that has proven itself to be more tolerant to pests and pathogens than most, and this is one of the reasons for its longevity in the industry. One of its major advantages in the midlands from a disease point of view, is its resistance to brown rust when many other varieties have become infected. However N12 has an intermediate rating for mosaic and, with it being grown in a mosaic-prone area for so many years, the disease has become prevalent in this variety in the midlands over time, largely through the planting of infected seedcane. Mosaic-free seed sources of N12 are scarce, particularly in the midlands, which could ultimately cause the demise of this variety in the region. SASRI's breeding program prioritises pest and disease resistance in new releases, which are all measured relative to standards like N12 and NCo376. Varieties will only be released if they demonstrate improved yields under the prevailing conditions, with superior pest and disease resistance profiles relative to the most important risks in the different regions. To demonstrate the agronomic and pest and disease resistance characteristics of new varieties compared with N12, two new variety trials will be established on the lower south coast in 2015. These trials will help guide growers in the region on variety choice issues and hopefully alleviate some of the concerns about newer variety performance under their local conditions.
33	**Varieties – agroclimatic suitability** With Plant breeding trials all being conducted in other regions, the suitability of the varieties to the conditions on the Lower South Coast needs to be assessed more thoroughly. There is a perception that new varieties appear to "bruise easily" and not recover well from stress conditions. **Description:** Varieties - perceived susceptibility to disease and poor recovery from stress. **Background:** Older varieties seem to be better. **Desired Outcome:**	There is currently one released variety trial running in the lower south coast at Paddock (long cutting cycle). The other trial in the region under coastal conditions is at Sezela (short cutting cycle). These two trials were established to provide overall recommendations for the south coast. With the recent release of a range of newer coastal varieties, it is acknowledged that more trial sites are required to provide up to date recommendations. To this end, SASRI has already identified two growers in the lower south coast to collaborate with. One trial will be established at Harding (long cutting cycle), while another trial will be established at Umzumbe (short cutting cycle). Both trials will be established in October 2015, and consist of approximately 18 released varieties. The trials will demonstrate the agronomic and yield characteristics of all available varieties for the area and help guide grower decision making.

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	Variety testing in region - in pipeline. Knowledge exchange.	
34	**Remote Sensing** With the varying challenges in the region that affect cane health, even with the new P&D structure (with an extra team), getting an overview of the state of the cane and finding areas to prioritise for ground level assessment is difficult. By using remote sensing (satellite, drone, or other suitable method) and using NIR spectra, P&D teams could be used more efficiently and effectively in finding and dealing with problems across the region. **Description:** Remote sensing. **Background:** Adding a tool to help P&D work better. **Desired Outcome:** Industry wide tool for Biosecurity strategy.	**OVERVIEW** This issue appears to have two parts: (1) the application of remote-sensing technology for identifying areas where crops appear to be unhealthy; and (2) the application of remote-sensing technology to identify pest and disease incursions. The desired outcome is a Biosecurity Risk Management decision support program of some kind. **GENERAL CONSIDERATIONS** **Spatial scale and resolution** Drones / UAVs typically provide high-resolution imagery for a small area. This would effectively limit application to the scale of prioritizing fields/panels within a farm. Satellites provide relatively low resolution, but cover a much greater area. The difficulty here is that the features of interest to the Industry (e.g. disease infections, pes infestations) are smaller than the quite large (~30x30 m) pixels available in cost-effective satellite imagery; higher resolution imagery is exorbitantly expensive and, hence, not affordable for these highly desirable Industry applications. **Temporal resolution** UAVs can fly in most weather conditions, but varying light conditions (i.e. cloud shadows) in partly-cloudy weather make quantitative image analysis difficult. UAVs can acquire imagery satisfactorily under overcast conditions, however, unlike satellites. UAV imagery can usually be acquired at short notice. Collection of UAV imagery does require more logistical work: the 'stitching' (merging together) of large numbers of digital images taken by a UAV, to produce a single large, geographically-correct image, is generally based on feature (shape) identification in overlapping images. This is necessary because UAVs are inherently unstable, have high spatial resolution (sub-cm) cameras, and use GPSs with accuracy limited to a few m (so position errors are more than 100x the resolution of the imager). As sugarcane can appear rather featureless, accurate image post-processing requires the strategic placement beforehand of uniquely-shaped, highly visible markers that can be used for automated image stitching after the flight. Satellites have limited orbits and so overpass at a particular frequency. In the case of LandSat, this is every 15 days. Operational dependence on satellite imagery can be risky, because there is a very high probability that fields will be obscured by cloud cover, especially in rainfed areas in spring and summer. **Quantitative vs qualitative analysis** Standard colour (RGB) imagery can be analysed qualitatively - a patch of field that is brown, or has visibly lower leaf area, can be detected by a person interpreting images. Quantitative analysis is the process of

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		training a computer to detect phenomena based on computer-based analysis of multi-spectral imagery. **Quality of data and post-processing** Quantitative data analysis requires a much higher standard of post-processing to ensure that images can be analysed and that the analysis is meaningful (and comparable between images, over time, etc). This usually means that at a minimum, data are georeferenced and radiometrically-corrected. UAV imagery and satellite imagery have different types of considerations and needs for post-processing corrections, but both are complex, time-consuming specialist operations, making use of expensive software. **Hyperspectral analysis** The automatic identification of species (i.e. differentiating sugarcane from other vegetation), varieties, and pest and disease damage via image analysis of remotely-sensed imagery may be possible. It is understood that features that may appear similar in the RGB spectrum might appear very different in other spectral ranges. By analysing additional wavelength bands, it might be possible to conduct some of these types of analyses. It is imperative to note the following, however: • the identification of a single pest or disease from remotely-sensed imagery is likely to constitute an major research project in itself; • affordable satellite imagery (i.e. LandSat) has a limited number of 'bands' (wavelength ranges), and limited spatial and temporal resolution; • hyperspectral cameras on UAVs are (other than cameras that offer a near-infrared band) relatively uncommon, very expensive, and heavy, and have limited spatial and spectral resolution; and • other associated information might be required to assist interpretation - information such as crop age, soil moisture status, whether or not chemical ripeners have been applied, etc. (these additional data are not necessarily available, particularly at spatial scales larger than a farm). **Legal implications** UAV use is currently unregulated (so is neither legal nor illegal). The current consensus appears to be that it is legal to operate a UAV recreationally, but not legal to sell imagery or services supplied by a UAV. Clear regulations are due to be released within a month or two of the date of writing this document. Based on information currently available regarding these regulations, it is likely that the regulations will be reasonably sensible and enabling, rather than very limiting. **DISCUSSION** **Qualitative analyses** Growers and extension specialists have for centuries relied on the visual appearance of crops for assessing their health. Many pests and disease have visual ‘signatures’ that specialists are able to identify. There is

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		every chance that 'pro-sumer'-type drones – intended for high-end recreational use – may provide a valuable tool for extensionists, pest and disease officers and growers. These products typically feature a forward-looking camera with the video feed displayed directly on the operator's screen. They require little training and far less preparation (and little to no post-processing) in order to be useful tools. The main advantage that these offer is the ability rapidly to get an aerial view of a field that might otherwise be hidden from view, and to provide coverage of a whole farm fairly quickly. A research project is not required for this (a Parrot or Phantom product, for example, costs in the region of R8000-R15000). If the operational use of a drone can be demonstrated to result in a measurable saving in time, fuel, or some other resource that can be translated into a monetary value, or results in a clear increase in productivity, a financial case could be put forward for the Industry to purchase drones for use by extensionists and P & D teams. Operators of these tools would might acquire sufficient experience with them to be able to advise growers as to the value of these types of drones for operational on-farm use. Drone-based qualitative analyses could assist in 'getting an overview of the state of the cane', and probably would aid the P & D teams in prioritising fields on a farm for inspection. They would probably not be useful for prioritising farms in a region, however, due to the short-range nature of these drones and likely legal restrictions on use transcending property boundaries. **Quantitative analyses** For quantitative analysis of remotely-sensed imagery to become part of SASRI's operations, several large system components need to be put into place: 1. Appointment / training of personnel and acquisition of software for post-processing imagery to prepare it for analysis 2. Development of hyperspectral analysis algorithms for identifying sugarcane, varieties, pests / diseases, etc. Each analysis target would likely constitute a separate multi-year project. 3. Development, active maintenance and ongoing population of some kind of field records database that would allow access to attribute information (age, variety, ratoon number, field identifiers, etc). 4. Development of operational software systems ('DSPs') that link together these imagery sources, databases and algorithms into information products that assist with specific operations. In the case of UAV/drone-acquired imagery, the actual airframes, cameras, batteries, mission planning software, and training would also have to be acquired/undertaken. It is clear that to introduce information derived from quantitative data sourced from remotely-sensed imagery into operational functions would be a large undertaking for SASRI. Two strategies are possible: (a) to develop a large, ambitious remote sensing strategy at SASRI and assign resources to this over several years; and (b) to develop remote-sensing workflows and analyses to address very specific research questions as

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		individual SASRI projects. Over time, this will likely develop into the kind of capacity required for wider-scale operational implementation of remote-sensing based services. The implementation of remote sensing-based image analysis is likely to require some degree of outsourcing to / collaboration with external specialists (consultants and universities). SASRI is in the process of developing expertise with remote sensing: • A recently closed-out project found that irrigation scheduling and per-field yield estimation in Mpumalanga could be improved by correcting simulated canopy cover with values derived from the commercial 'SugarcaneLook' remote sensing product. • A current project at SASRI seeks to improve the crop/yield forecasting system by correcting estimations of canopy cover for rainfed sugarcane using satellite-derived information. This will apply to two mill-supply areas. In this project, the acquisition and geo-processing of the LandSat imagery has been contracted-out to the University of Stellenbosch. Two milling companies will provide attribute field data. Remote sensing-based quantitative analyses have great potential for a range of applications, including identification of pests and diseases. With dedicated long-term effort, it is likely that operational implementation of a biosecurity tool as described in the issue would be possible and effective. It would, however, be premature to submit this as a new project proposal at this stage. **Other aspects of a Biorisk Management Decision Support Tool** Although there is no doubt that remote sensing-based imagery analysis has the potential to be of great value for Biorisk management and P&D operations, generally, there is also probably wide scope for developing a GIS-based Biorisk Management software tool without necessarily requiring remotely-sensed data. Such an information system would probably be a prerequisite for the development of remotely-sensed applications anyway, a kind of software platform or framework. This software could provide the necessary associated attribute data. As the software would reflect the current operational practices of P&D and biosecurity operations, it would probably be easier to build this into day-to-day operations than a completely new remote sensing-based system. P&D / Biorisk management and Extension are currently in a state of transition, so developing such a system now would be premature: further discussion and workshopping amongst SASRI, Extension and other stakeholders are required before a project concept is submitted. **CONCLUSION** It is likely that application of 'pro-sumer' drones for conducting rapid aerial visual (qualitative) surveys of cane fields on a farm could assist in identifying pest and disease problems and could be used to prioritise fields for inspection and further treatment. This would be based on a 'look-see' approach, that is neither research-based nor requires a specific technology development projects. A recommendation in this regard would be for the P&D Inspectorate or Extension service to purchase a drone for trialling.

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		The development of an operational Biorisk/Bio-Security Management Information System, based on analysis of remotely-sensed imagery, is a very much larger task. SASRI is in the process of building experience and capacity with remote sensing imagery analysis, which will help to build the foundations for developing biorisk management analyses and information systems in future. Further discussion and workshopping to define the requirements and specifications for a Biorisk Management Information System, which should include considerations of remote sensing-based data products and analyses, should be conducted before a specific project concept is submitted.
35	**Alternative Cane uses at the mill** To try and make the crop more profitable and thus financial sustainable, additional uses of the cane (co-gen, bioethanol, etc.) need to be investigated. With this sort of technology available at the mill, cane could still be profitable in a dry season like this and would also assist in preventing mill closures. Are we positioning ourselves for this in the new future? **Description:** Alternative uses for cane to increase value. **Background**: Readiness to make use of efficient systems. **Desired Outcome:** Pressure on the industry.	This is a broad industry-level issue beyond SASRI's mandate from the Industry to resolve/address. SASRI will submit to CANEGROWERS on behalf of Umzimkulu for consideration.

MIDLANDS (Eston, Noodsberg, UCL)

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42	**Fertilizer** Correct/best placement of fertilizer – banded, spread, buried. **Description:** Correct / best placement of fertilizer - banded / spread / buried. **Background:** Various methods of application are now available. **Desired Outcome:** • Currently an existing trial - therefore progress thereof. • Know the economics thereof.	A trial is in progress, which was harvested in August 2015 and data are currently being analysed. A further trial will be established on the same farm (Torquay, Eston).
43	**Fertilizer** Does the continuous use of CMS have an acidifying effect on the soil? **Description:** Does the continuous use of CMS have an acidifying effect on the soil? **Background:** Many growers have been using CMS for a number of years. **Desired Outcome:** What is the long-term effect of continual use of CMS?	The net effect following the use of unfortified CMS is not to acidify the soil. The pH of CMS is in the order of 4.5 to 5.5. Within days following the application of CMS, soil pH drops markedly but quickly increases to a level substantially higher than that of the original soil pH. Over the next few months the pH will slowly decrease to reach an equilibrium pH just above that of the original soil pH. With continuous use over a long period at recommended rates, CMS will result in a net increase in soil pH. However, this is also subject to the management of fields. Often CMS fortified with N is applied and the N has an acidifying effect on the soil (the use of unfortified CMS with N from another source will have the same effect). Thus, CMS and N are 'working against each other' in determining the pH of soils. Unfortunately, the quantities of N required from fortified CMS to sustain cane growth have an acidifying effect that is stronger than the alkaline effect of the CMS. Applications higher than the recommended rates in dryland areas could be considered, but are not recommended because they will lead to luxury uptake of K at a cost. The over-application of CMS in irrigated regions is strongly discouraged because the development of saline conditions is a general problem in those areas. A new Information Sheet, 7.18 Condensed Molasses Solids (CMS) as a fertiliser, was published in August 2015.
44	**Frosted Cane** BMP for frosted cane. **Background:**	**Best Management Practices for frosted sugarcane:** Two types of frost exist - frost that is white due to moisture being present in the air during cold night-time temperatures, and black frost that occurs when little or no moisture is present in the air. Black frost will cause greater damage than white frost because it causes plant sap in the cane

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	2014 Abnormal frost year, certain growers "woke up" too late and realized parts of their farm were frosted in areas where they don't normally get frosted and put the mill under pressure to crush the extra cane at a reduced quality. **Desired Outcome:** Updated recommendations.	stalks to dry up. Shorter cane with an open canopy is more susceptible to frost damage and successive frost events during one winter season will increase the damage to the cane canopy. Frost can cause varying degrees of cane damage from light damage that will cause a minor delay in growth to severe damage where the cane needs to be harvested immediately and sent to the mill. It is important to assess the age and maturity of the cane that has been exposed to a frost event, as well as the amount of damage that the frost has caused to the growing point. A decision tree for choosing the best option is available, along with other information on the management of frosted cane, in the SASRI Information Sheet on Management of Frosted Cane (4.6). Another important note on management of frosted cane: If a grower has experienced frost in a particular field before, it is very important to demarcate the "frost lines" of fields because the management of that field/area will need to be different from that point onwards. Demarcating frost zones or lines will allow quicker and easier assessment of areas prone to frost so that management decisions related to harvesting can be performed more timeously.
39	**Sour Rot** In the past season many varieties showed their weaknesses regarding sour rot. Looking at the climate over the past seasons there seems to be an increase in the number and severity of droughts. Growers need to know how susceptible varieties are to be able to assess if they would want to take the risk in planting such varieties. Is there an age correlation? **Description:** Are some varieties more susceptible to sour rot? Is there an age correlation to sour rot incidence? **Background:** The dry conditions experienced last year lead to an increase of sour rot. Climate change appears to be leading to the increase in the number of severe dry spells / drought. **Desired Outcome:**	**Reaction of varieties to sour rot** *Phaeocytostroma sacchari* causes rind disease which is a common, usually minor condition affecting weakened cane stalks. During periods of severe drought, particularly when cane is mature (usually more than 15 months), rind disease may develop into sour rot, which can cause substantial losses in sucrose. Sour rot was first reported in the South African sugar industry in 1998. The disease affected mature cane in the Midlands South area after a prolonged dry winter and spring and caused a reduction in purity which resulted in cane consignments being rejected by the mill. Since then sporadic outbreaks have occurred. The disease was common and severe in the Midlands in 2014 following severe frosts and a dry spring / early summer. N50 was particularly badly affected. A method to screen varieties for resistance to sour rot has been developed (Ref: 09CP03) and will be introduced as a routine procedure in the ongoing Variety Evaluation project in 2015. The method uses marcotted stalks that are inoculated with the sour rot fungus. Internal damage is assessed after eight weeks. At this stage sour rot ratings cannot be assigned to the varieties that have been tested because the pot trial was experimental and there were no varieties with known ratings that could be included as standards. However, all five varieties included in the trial showed some susceptibility to sour rot. Symptoms included black hardened pustules on the rind, orange to red discolouration of the internal tissue and an associated strong sour odour typical of the disease. Stalk damage, measured as percent volume damaged, was lower in N35 than N31 and N39 (P=0.004). Based on this data, sour rot susceptibility was as follows: N39 (21.1%)> N31 (18.3%)> N12 (10.8%)> N37 (10.3%)> N35 (4.6%).

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	A rating of susceptibility towards sour rot per variety.	
40	**Nomograph** The nomograph is currently in a hard copy format. It may be more practical to create an excel calculator or an app. **Description:** The current nomograph is only available in hardcopy to determine VI for field layouts etc. **Background:** ESs doing LUPs and some growers wanting to calculate VIs / panel widths could use the nomograph. **Desired Outcome:** A nomograph using an Excel based calculator or smart phone application.	The current format of the nomograph has been simplified but not as an Excel spreadsheet. Transforming the current format of the nomograph into an Excel spreadsheet should be possible and is a work in progress. However it must be noted that the current nomograph is based on relatively old factors making up the Universal Soil Loss Equation (USLE). Research is required to update these factors and investigate whether there are more desirable tools available, which will benefit from collaboration with the School of Engineering at UKZN. SASRI is to motivate to the Industry for a research project to be out-sourced to Professor Jeff Smithers (UKZN School of Engineering) over a three-year period, commencing in 2016/2017. The proposed project is entitled '*Development of updated design norms for soil and water conservation structures in the sugar industry*'. Implementation of the project remains subject to 2016/2017 budget approval by the Industry Principals.
41	**Herbicide – Picloram** Heavy infestations of wattle seedlings and bugweed in cane fields, especially plant cane are being noted. The current herbicide cocktails are proving ineffective in controlling wattle. Picloram is effective in controlling this weed but is not registered for use on sugarcane. Is there any registration for products containing Picloram pending currently? What alternatives could be considered? **Description:** Is there any registration for products containing Picloram currently pending? What alternative active ingredients / formulations could be considered?	Biocontrol agents attacking seeds of wattle are being produced by the ARC-PPRI in Stellenbosch, and they have a few release sites of these in the KZN midlands. They will be happy to upscale production and expand releases into wattle in and around sugarcane to try and help minimise the spread of viable seeds into sugarcane fields, should they get the funding to do this. Similarly with bugweed, SASRI have mass reared a good weevil biocontrol agent attacking the flowers and thus seeds, that is well established in Southern KZN especially. These can be collected from good sites there, and translocated to selected sites where bugweed is a problem, to get them established and working where they have not done so before. The Working for Water (WfW) biocontrol officers in KZN can be asked to help with this, or the local P&D teams can be tasked to do this as part of their pest and disease work. **Picloram is not registered for use in sugarcane, and as such, is illegal for use and cannot be recommended by SASRI**. Garlon® 4 is registered in sugarcane (NB: do not add adjuvants) and is registered for control of bugweed and wattle. This is the product of choice. If picloram products do become registered, then growers must recognise that a consistently high level of management would be required for correct use, carefully following label directions. The history of each field would need to be available to (and followed by) e.g. a new manager, to prevent more than one application. Failure to do so could result in an accumulation and leaching to lower depths.

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	Background: Midland ex-wattle plantations, heavy infestations of wattle and Bugweed seedlings in cane fields, especially plant cane are being noted. Current registered herbicide cocktails are proving ineffective in controlling wattle and Bugweed. Picloram is effective but is not registered on sugarcane. It's also a threat to ground water sources as it is easily leached. **Desired Outcome:** A herbicide formulation or cocktail that: 1. Is effective in controlling wattle and Bugweed seedlings AND one that doesn't pose a threat to underground water sources? 2. Is Triclopyr (Garlon) registered on sugarcane?	On the plus side, picloram is relatively environmentally friendly (low toxicity to livestock pets and wildlife), has low acute toxicity to birds, is not highly toxic to fish, non-toxic to honey bees, has little to no effect on soil bacteria and fungi and is not considered an endocrine disruptor. In addition, it only affects broadleaf plants, not grasses, so is relatively safe on a sugarcane crop when applied according to label directions. One problem is when there is entry into water, and every precaution must be taken to ensure this does not happen. The risk is higher in loamy sands and sands, soils with rapid permeability throughout the soil profile, and use near a high water table. This includes improper spray equipment washing near dams, rivers, etc. Although picloram is not that soluble in water, it does not bind tightly to soil particles, and is very persistent/residual, with a long half-life of up to 12 months in cold dry conditions. There is no room for mistakes from misapplying the product and deviating from the label. Another problem is high risk of injury to non-target plants. This is found in the section "Use restrictions" for picloram from labels: "*Precautions for avoiding injury to non-target plants are:-* • *Do not permit spraymist to drift or come into contact with sensitive broadleaf crops, including but not limited to lucerne, beans, melons, potatoes, soyabeans, sunflower, tobacco, tomatoes, cotton, fruit trees, grape vines, ornamentals, soil containing roots of these plants, soil in which such plants are to be grown, grain varieties in a susceptible stage of growth or grazing or any other area not under treatment.* • *Do not contaminate water intended for irrigation or domestic purposes. To avoid injury to crops or other desirable plants, do not treat or allow spray or spray drift or spray run-off to fall onto banks or bottoms of irrigation ditches, canals, streams, dams, rivers, either dry or containing water that may be used for irrigation or domestic purposes or may carry water to an irrigation facility.* • *Do not make application when circumstances favour movement from treated site.* • *Do not apply to areas that may be rotated to any broadleaf crop.* • *Do not use manure from animals grazing treated areas on land used for growing already established or yet to be established broadleaf crops, ornamentals, orchards or other susceptible crops. Manure may contain enough picloram to cause injury to susceptible plants.* • *Do not use grass or sprayed plants from treated areas for composting or mulching of susceptible broadleaf plants or crops.* • *Do not transfer livestock from treated grazing areas (or feeding of treated grass) onto sensitive broadleaf crop areas without first allowing 7 days of grazing on an untreated grass pasture. Otherwise, urine and manure may contain enough picloram to cause injury to sensitive broadleaf plants.* • *Do not use on flood irrigated land or fields.* • *Do not spray if the loss of forage legumes, including clover, cannot be tolerated. New legume seedlings may take years to re-establish.* • *Do not move treated soil to areas other than sites for which the picloram product is registered for use.* • *Do not apply through a mist blower.*

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		• *Do not apply to land NEAR to desirable broadleaved plants or land onto which such plants are to be grown or grain varieties in a susceptible stage of growth. May, however, be applied in the VICINITY of desirable broadleaved plants, or soil or land onto which such plants are to be grown, or grain varieties in a susceptible stage of growth, PROVIDED THAT ADEQUATE PRECAUTIONARY MEASURES ARE TAKEN TO AVOID SPRAYDRIFT.(See Wind Speed Table below) OR CONTAMINATION OF RUN-OFF AREAS.* • *Apply the product strictly in accordance with the application directions*." In summary, the SASRI response is: • **<u>It is illegal to use unregistered herbicides in sugarcane. It is illegal to use picloram products in cane fields</u>**. • Garlon® 4 with NO ADJUVANTS OR SURFACTANTS is registered and recommended for control of wattle and bugweed, as foliar application. SASRI is to publish articles on this topic in the local Extension Newsletter and *The Link*. In addition, a Grower Day or Study Group with UCL growers can be organised to which an invitation to participate could be extended to an Ecoguard consultant (who recommends use of Garlon® [although supplying both picloram and Garlon products]).

SMALL-SCALE GROWER COMMUNITY

Issue No.	Issue	Communiqué
36	***Parthenium hysterophogus*** Research is required on the use of chemicals that can assist Farmers to deal with this weed problem. **Description:** • Ongoing problem for the SSGs in the greater Makhathini area. • Research is required on the use of chemicals that can assist growers to deal with it. **Desired Outcome:** • SASRI to make recommendation of registered chemicals to control Parthenium. • Demonstration trial on SSG site. • Geographical area being affected.	Establishing an official SASRI presence in Jozini has been initiated and will be enhanced in the new growing season to enable development of demonstration trials on SSG farms. This is currently a focus of SASRI SSG Programme of Work in the area and will form part of entire Biosecurity Programme for the area. In the interim period, a series of pot trials to screen candidate treatments for different weed growth stages of this weed. Best treatments will be applied in Jozini as larger-scale demonstration trials. Three insect and one fungal biocontrol agents are available for use against parthenium. SASRI is currently rearing one of them as part of the Working for Water (WfW) biocontrol contract, and is due to start rearing another in 2016. The ARC Plant Protection Research Institute (ARC-PPRI) are rearing the third at Cedara, and ARC-PPRI in Stellenbosch are mass producing the fungus in their laboratories. ARC-PPRI at Cedara are driving all the mass releases to be done with these biocontrol agents, and are especially on the lookout for secure sites where they can release and monitor the impact of these agents throughout the sugar industry where parthenium is a problem and so, would welcome contact to set up release sites. The SSG program in Pongola would be a good place to establish some biocontrol practices, and the Lowveld area is a must, as parthenium infestation is extensive there.
37	**Information Sheet (Varieties)** Development of techniques of transferring information to SSG (KMU). **Description:** • Development of techniques of transferring. • Information to SSG in a format and language understandable to them. **Background:** • Info Sheets are too technical and scientific. • Info Sheets are too detailed. **Desired Outcome:** • Simplified Info Sheets in Zulu.	There are a number of knowledge transfer and information resources that are readily available for small-scale growers. These include radio broadcasts, the Ingede magazine and modular training sessions. Some of the most effective are the SSG poster sets that are available in isiZulu. A new poster set on varieties is being developed by the Extension Team and will explain, in a less technical but more pragmatic way, how varieties should be selected for specific growth and soil conditions.

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	• Groups vary according to regions for SSGs. • Highlight ratoonability. • Use of visuals vs text.	
38	**Salinity / Sodicity** • Build-up of salts / sodium in the region has become an issue especially for growers that grow sugarcane on the flood plains of the Pongola River (Kwa-Shukela). • Implementation of cambered beds with Malleti Drains. **Description:** Build-up of salts / sodium in the Zululand has become an issue especially for growers that grow cane on the flood plains. **Desired Outcome:** Cost effective ways of overcoming the problem.	The first rule to farm sustainably with irrigation is to ensure that the field is well drained. If not naturally free draining, then the installation of subsurface drains is a necessity. Secondly, the quality of the irrigation water should be monitored and thirdly, the impact on soil quality assessed. These should be measured at least every second year. When the crop is starting to show signs of yield loss due to salinity or sodicity then it has to be accepted that it will be costly and time consuming to rectify the problem. It is therefore advisable to prevent the development of saline or sodic conditions rather than to embark on a costly reclaim programme. Soil salinity or sodicity is quantified by measuring pH, electrical conductivity (EC) and cation levels (Ca, Mg and Na), expressed as Sodium Absorption Ratio (SAR). The interaction between EC and SAR is complex and has been summarised in a book recently published by SASRI (*Understanding and Managing Soils in the South African Sugar Industry* [2013]). In short, if the soil EC value is greater than 200 mS/m or the SAR value greater than 6, then advice should be asked from the local SASRI extension specialist. Irrigation water with an Effective Electrical Conductivity (EEC) of more than 50 mS/m or an Adjusted Sodium Absorption Ratio (ASAR) of more than 3 should be used with caution as prolong use of this water without a sound management strategy will lead to the development of a saline soil condition. The development of soil salinity is initially gradual and loss in yield is hardly noticed as it is masked by variability in the weather. Later, the saline problem accelerates and starts to grow exponentially, resulting in stunted cane and eventual death of the plant. Important management strategies in the prevention of the development of a saline or sodic soil condition are: • ensuring the field is well drained; • using good quality irrigation water (if possible); • monitoring of soil and water frequently; • acting quickly at the earliest hint of the development of a saline or sodic condition; and • seeking advice from your SASRI extension specialist. Caution: Areas where cambered beds can be constructed to increase the distance to the soil surface from an impervious layer is usually a wetland and SASRI does not recommend the use of such land for the production of sugarcane or any other crop.
46	**SUSFARMS for SSGs** **Description:** Implementation of SUSFARMS® for SSGs is not taking place repeatedly enough.	One of the main responsibilities of SASRI's Extension Service, together with Government Extension Officers under the EVA agreement, is to promote the adoption of best management practices. This is achieved through a number of interventions such as demonstration trials, grower days, modular training sessions and radio broadcasts. SUSFARMS® is yet another intervention that can be used to encourage adoption of good practices. It should not therefore be seen as the only

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	Background: • There is a project in place but due to poor crop conditions and farm conditions e.g. LUP. • There is a need in fast tracking the project. **Desired Outcome:** • Current project to start in 2015 need to be fast tracked. • Improved crop condition and grower awareness (increased yields).	answer to improve crop condition or increase yield. It is a farm management system that embodies best management practices and provides a mechanism through which a farmer may determine how effectively he has implemented these practices. A SUSFARMS® tool suited to small-scale growers is being developed through a partnership in the Midlands region. This project commenced in October 2015 and will be project managed by a civil society group called Solidaridad.
47	**SSG Needs Analysis** **Description:** Often interventions and support programmes aimed at SSG do not meet the need of the growers. Background: In the past there has been financial assistance and support programmes implemented without due consultation with growers. **Desired Outcome:** • Proper needs analysis. • SASRI to facilitate through EVA engagement with government.	A new project (Ref: 14SD02) commenced in April 2015 in order to "*Develop a Participatory RD&E process for small-scale growers in the South African sugar industry*." Through exploring participatory techniques, the project will result in a strategy and mechanism for more effective needs identification and analysis.
48	**Poor Contractor Performance** **Description:** Farming operations are not done on time and are of poor standard (contractors' efficiency). **Background:** • Selection of inexperienced contractors in sugarcane farming.	This has been a long standing issue within the SSG community. A number of workshops have been held with contractors in the past, some of which have had some success. A collaboration exists between SASRI EVA, DARD and CANEGROWERS to develop and facilitate a series of interventions throughout the industry. These interventions focus on contractor education, especially regarding business plans and operational procedures.

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	• This has been an ongoing issue. **Desired Outcome:** • Training of contractors by SASRI in collaboration with DARD and STC. • Improve quality (RV - reduction of burn to crush delay < 3 days).	