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Economic Evaluation of Precision Controlled Traffic Farming in the Australian Sugar Industry: - A case study of an early adopter

By

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Abstract

Controlled traffic has been identified as the most practical method of reducing soil structural degradation in the Australian sugarcane industry. GPS auto-steer systems are required to maximize this potential. Unfortunately, there is a perception that little economic gain will result from investing in this technology. Regardless, a number of growers have made the investment and are reaping substantial economic and lifestyle rewards. In this paper we assess the cost effectiveness of installing GPS guidance and using it to implement a Precision Controlled Traffic Farming (PCTF) based on the experience of an early adopter. The Farm Economic Analysis Tool (FEAT) model was used with data provided by the grower to demonstrate the benefits of implementing PCTF. The results clearly show that a farming system based on PCTF and minimum tillage is more profitable than the producers' traditional practice. PCTF and minimum tillage provides sugar producers with a tool to manage the price cost squeeze at a time of low sugar prices. These data provide producers with the evidence that investment in PCTF is economically prudent.

Introduction

The Australian sugarcane crop is harvested mechanically by a chopper harvester (weighing approx. 18T) that processes the standing cane into billets (18-20 cm lengths of cane). The billets are cleaned and conveyed into a haulout (weighing approx 20T) that travels beside the harvester. The harvest operation results in each inter-space being trafficked four times by heavy machinery (Braunack 1997). It is virtually impossible to avoid compaction with four passes and weights of this magnitude. Further, current sugarcane culture is based on rows 1.5m apart, while cane harvesting and haul-out equipment typically has 1.83m wheel centres. This mis-alignment increases the percentage of the paddock trafficked during harvest (Bell *et al*. 2003; Norris *et al*. 2000; Braunack *et al.* 2003). Norris *et al*. (2000) estimate the trafficked area during a harvest operation is 65 – 90% of the paddock. In addition to the compactive forces during a normal harvesting operation it is often necessary to harvest in wet conditions to maintain mill throughput. This further increases the severity of compaction (Braunack 1997). Norris *et al.* (2000) and Bell *et al.* (2001) identify the mis-match between cane harvest equipment width, cane row spacing and harvesting in wet soil conditions as the causes of compaction in Australian caneland soils.

Australian sugarcane soils have experienced a reduction in productive capacity since the 1970's. This phenomenon has been termed Yield Decline (YD), which Garside *et al.* (1997) describe as the loss in the productive capacity of soils under long-term sugarcane production and mention that sugarcane soils have become structurally degraded. Although not necessarily causative, the emergence of the yield decline phenomenon co-incided chronologically with the introduction of heavy chopper harvesters.

Controlled traffic is the separation of crop growth zones (beds) from vehicular traffic zones. Controlled traffic doesn't eliminate soil structural degradation (SSD) but rather contains SSD to the traffic zones, leaving the beds in an un-compacted state (Tullberg 2005). Further, Braunack *et al* (1999) demonstrated that zonal tillage (where only the planting zone is tilled) based on controlled traffic offered the opportunity to reduce input costs without affecting productivity in the sugarcane farming system.

The Sugar Yield Decline Joint Venture (SYDJV) was established in an attempt to develop an understanding of the causal agents of the YD phenomena. The SYDJV program has developed a new sugarcane farming system based on legume rotations, reduced tillage and controlled traffic (SRDC 2004/5), to improve the productivity and sustainability of the Australian sugar industry. However, the practical implementation of controlled traffic without guidance has proved difficult even with matched wheel and row spacings machinery "wandering" has been sufficient to still compact substantial areas of the paddock. GPS – Autosteer technology offers a practical solution to prevent "wandering" however this technology costs a substantial amount of money. Thus the adoption of controlled traffic has proceeded more slowly than is desirable due to the cost of installing GPS guidance systems.

This paper evaluates the farm data the Russo Brothers, early adopters of Precision Controlled Traffic Farming (PCTF) in the Isis mill area of Southern Queensland, to determine its impact on total farm gross margin.

Materials and Methods

To assess the impact of PCTF the Farm Economic Analysis Tool (FEAT) model (Cameron 2005) has been used to analyse three scenarios; the Russo Brothers historic, current and potential production systems. These production systems are outlined in Table 1. The Russo brothers produce sugarcane, peanuts and soybeans.

	Historic	Current	Potential
Row spacing (m)	1.6	1.8	1.8
Tillage practice post cane – pre legume	Offset Disc * 2 Square plough Rip and cross rip Rotary hoe Bed form	Offset Disc * 3 Rotary hoe Bed form	Stool rake Bed Conditioner
Tillage practice post legume - pre cane	Offset disc * 2 Rip and cross rip Rotary hoe Mark-out	Zonal tiller	Zonal tiller
Guidance	N/A	GPS - Autosteer	GPS - Autosteer
Harvester Guidance	N/A	GPS - Autosteer	GPS - Autosteer

Table 1: Scenario summary of Historic, Current and Potential production systems used in the FEAT analysis.

The assumptions used in the analysis are:
- Same mix of crops, yields and input costs (other than tillage).
- The same product price (sugar, peanuts and soybean) for all scenarios.
- Sugar production consists of a plant and four ratoons
- The fallow land is used for the production of peanuts and soybeans with the land being split 60% and 40% respectively.
- Sugar price $260/tonne
- Peanut price $850/tonne
- Soybean price $575/tonne
- Input costs are current values exclusive of GST.
- Fuel price 100c/L

Using the same input costs, productivity and commodity prices enables the isolation of the effects of changing to PCTF and reduced tillage on total farm gross margin across all scenarios. Only cost savings have been accounted for. Whilst Russo Bros. believe that there has been a yield improvement it is difficult to validate due to a range of factors and as such has not been included in these scenarios.

The historic and current scenario data are the real values supplied by the Russo Brothers farming enterprise. The potential scenario is what the farming entity believes is achievable once the entire farm has been converted to controlled traffic, thereby further reducing tillage inputs.

The sugarcane productivity data was attained from the Isis Central Sugar Mill, whereas all the other input data (tractor, tillage equipment, crop inputs fertilizer, chemicals etc) were supplied by the Russo Bros.

These scenarios are expressed as “steady state” meaning that the transition phase has already taken place.

In the face of increasing fuel prices we also used the FEAT model to assess the impact on gross margin between the historic and current production systems using a range of fuel prices. The model also makes it possible to account for changes in fuel consumption between the different scenarios.

It was also possible with the FEAT analysis to identify the main driver of the increased gross margin as reduced tractor hours and labour input associated with reduced tillage that was facilitated by the PCTF.

Implementation of PCTF and reduced tillage requires the purchase of additional equipment and provides the opportunity to make redundant conventional tillage equipment. To account for this a list of new and redundant machinery was made and an annual replacement allowance was calculated

Results

Crop Gross Margin

Investment in GPS-autosteer technology was pivotal in implementing reduced tillage practices. The combination of PCTF and reduced tillage has seen the Russo Bros. farm gross margin increase by 11.8% with $1234/ha and $1380/ha for historic and current scenarios respectively. A further 6.8% is achievable bringing the potential scenario’s gross margin to $1474/ha (Figure 1).

This increase is due to the reduction in tillage and associated costs and through the greater efficiency of converting to the wider row spacing. There are 6 250m and 5 555m of row per hectare for the 1.6m and 1.8m row widths respectively, which improves field efficiency.

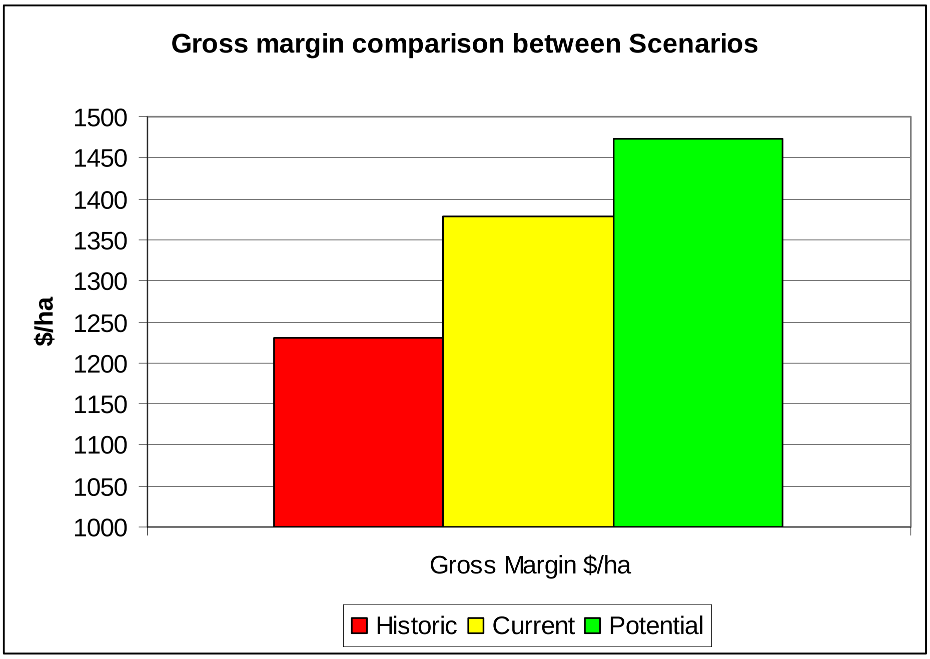

Figure 1: Comparison of farm gross margin, expressed on a per hectare basis, for historic, current and potential scenarios.

Gross Margin with increasing fuel prices

Whilst the gross margin of both systems decrease with increasing fuel cost, the adoption of PCTF and reduced tillage in the current system reduces the impact on gross margin thereby increasing percentage difference; with a 11.9%, 12.9% and 14% improvement for 100, 125 and 150c/L respectively (Figure 2).

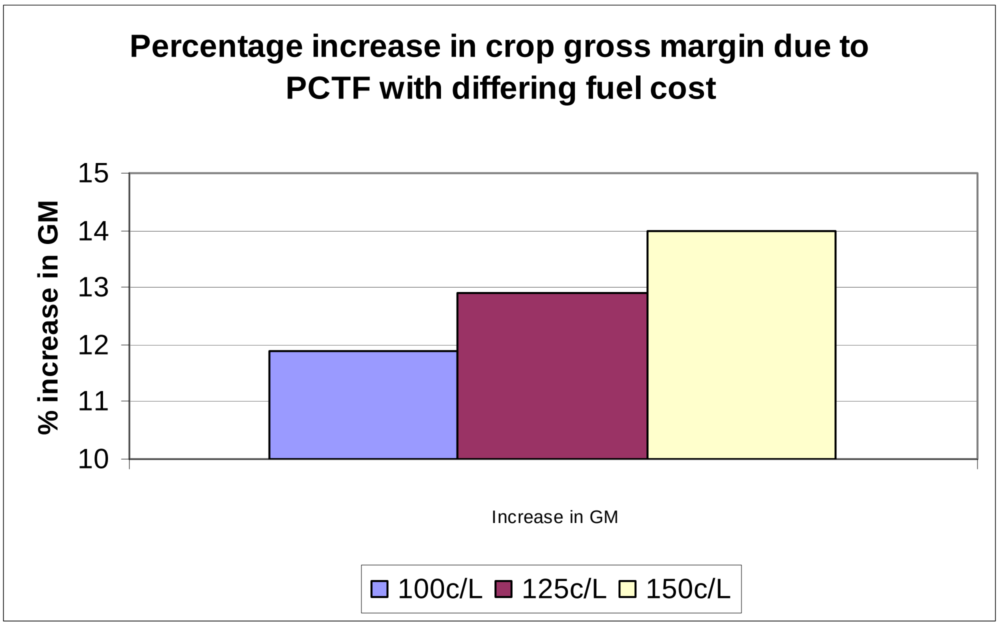

Figure 2: The impact of fuel price on the improvement in gross margin between the historic and current scenarios.

Tractor/labour Hours

The reduction in tractor hours is the driver of the cost reductions that is reflected in improved farm gross margin. The change over from historic 1.6m rows and full cultivation to current 1.8m rows, PCTF and implementing reduced tillage has resulted in a 39% reduction in tractor hours Figure 3. The Russo Bros. have the potential to save another 16% through the adoption of zonal tillage post-cane and pre-legumes as modeled with the potential scenario.

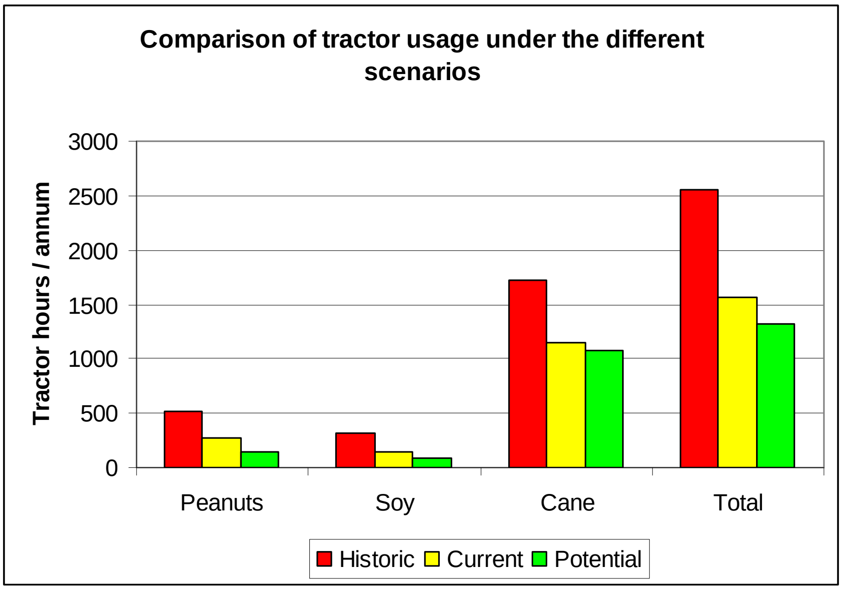

Figure 3: Tractor/labour hours associated with the different crops under the different scenarios.

Machinery additions/redundancies

The change to PCTF and reduced tillage has necessitated machinery modification/purchase. Similarly, system change has highlighted equipment that is no longer of use; these are highlighted in Table 2. These data demonstrate that the changed farming system is cost neutral. Further in the Russo case one of their tractors is now redundant representing $9 000/annum replacement allowance saving. The replacement allowance provides for the money that needs to be set aside on an annual basis to keep the farming fleet up-to-date.

New Equipment				Redundant			
Machine	New Price	Life (Yrs)	Replacement Allowance ($/an)	Machine	New Price	Life (Yrs)	Replacement Allowance ($/an)
Zonal Tiller	20 000	30	667	Ripper	11 500	30	383
GPS	40 000	10	4 000	Rotary	35 000	15	2 333
				Square Plough	15 000	30	500
				Offset Discs	35 000	20	1 750
Total			**4 667**	**Total**			**4 967**

Table 2: Replacement allowance for new and redundant machinery.

Fuel usage

The adoption of reduced tillage that has been able to take place through the implementation of PCTF has significant incurred reductions in fuel use. Fuel usage in the historic, current and potential scenarios are 82, 35 and 24L/ha respectively, Figure 4. The shift from conventional farming practices to the current PCTF and reduced tillage system is saving the Russo Bros. 47L/ha representing a 58% reduction.

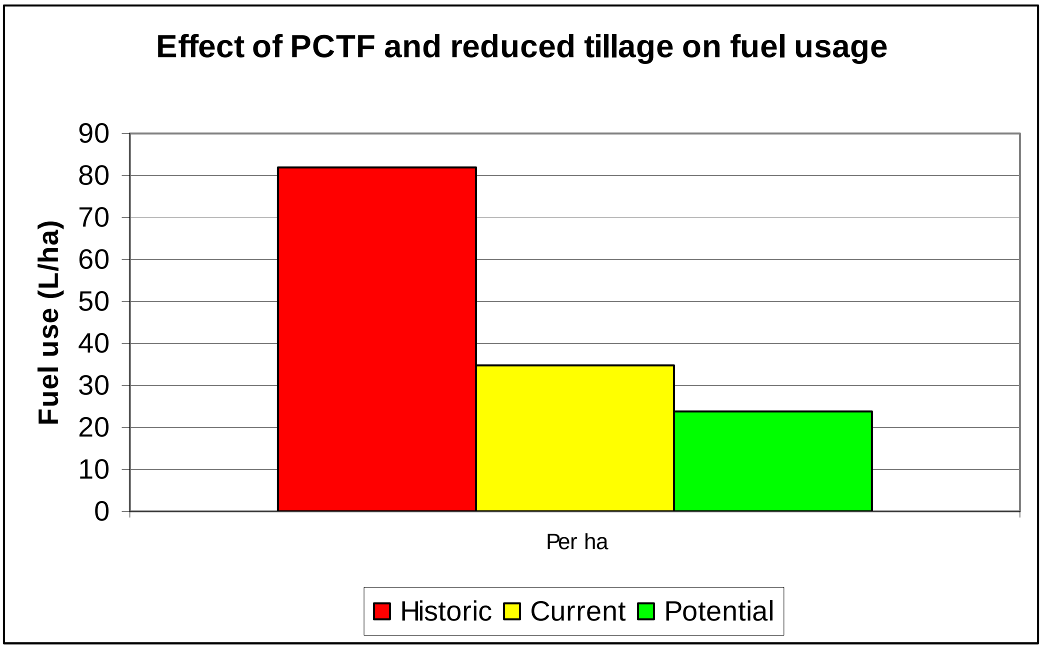

Figure 4: Comparison of tractor fuel usage expressed on a per hectare basis, for historic, current and potential scenarios.

Discussion and Practical Implications

In addition to the improvements in gross margins demonstrated above there are other practical and social advantages of adopting a PCTF system. These are discussed below.

Zonal Tiller

To effectively adopt zonal tillage it is necessary to have a zonal tillage implement. One of the tools that the Russo Bros. have designed and manufactured that is essential in reduced tillage has been the "Zonal Tiller" Figure 5. The zonal tiller prepares the seed bed for cane establishment post legumes in a one pass operation replacing the five operations that occurred prior to the implementation of controlled traffic (Table 1). Under the historic system legume residue had to be incorporated to allow the ripping operation to occur. The ripping operation was necessary to remove compaction caused by random traffic. The isolation of traffic has removed the need for four tillage operations. Further without the traffic zone being tilled cane planting is more efficient due to reductions in rolling resistance (the energy required to move a vehicle in the field).

Figure 5: Russo Bros. Zonal Tiller; folded for road transport

Cost of GPS-Auto steer

Cost of GPS-Auto steer is a fixed cost of $4000/yr based on $40 000 depreciated over 10yrs (B Robotham GPS-ag® pers comm..) Given that it is a fixed cost it is not accounted for in farm gross margin analysis. The difference in gross margin between the current and historic scenarios is $147/ha, therefore that fixed cost is recouped on an entity of 27.2ha. However smaller entities have greater cultivation costs so the real "break even" figure is likely to be lower than 27.2ha.

Further, there are a number of projects that enable producers to share the "cabin mounted rover unit" which means that producers only require $12 000 for the "steer kit". This would lower the fixed cost of this technology to $1 200/yr. The break even figure for this fit out would be 8.1ha.

Timeliness of operations

The time saved through the implementation of PCTF and reduced tillage has facilitated the implementation of growing legume crops Peanuts and Soybean. Effectively these techniques have “freed up” time that would have been invested into tillage, which now can be invested in growing a range of break crops. Loeskow *et al.* (2006) demonstrated how vital rotation cropping was to the economic viability of sugar based farming systems.

Further, the lower tillage input facilitates crop rotation. In the Russo Bros. case the zonal tillage option allows late autumn plant of cane post peanuts, thus a paddock that would have being laid fallow until spring will be growing sugarcane, further improving total farm productivity.

The model did not have the capacity to evaluate the improvement to productivity due to cultural operations (fertilizer, herbicide applications etc) being done on time.

Impact of farm entity size

The fact that the Russo Bros. farming entity is larger than industry average does not mean that these results are not indicative of what average farming entities are capable of achieving. The size of the Russo Bros. operation makes their tillage operations cheaper on a per hectare basis, therefore smaller entities have more to gain due to the proportionally higher cost of their tillage operations. For example the Russo Bros. cost per hectare is $45, whereas for smaller growers this figure can be as high as $100.

Reduced tractor fleet

These data clearly demonstrate that with vast reductions in cultivation there is the opportunity to reduce the tractor fleet requirement of an individual farming entity. The high capitalization in the Australian sugar industry comes with a high fixed cost that severely erodes profitability. PCTF and reduced tillage techniques provide producers with the tools to improve viability in the face of low world sugar prices.

Social

GPS-Auto steer technology allows the operator to concentrate more fully on the task. Time that would normally be spent keeping the tractor “straight” is now spent ensuring the task is being performed well and the operator is also less fatigued. This particularly true during cane harvest and planting operations.

Environmental

Controlled traffic is the most practical method of reducing soil compaction. Compressed soil greatly reduces rainfall infiltration which increases the risk of runoff and erosion from storm events. This is extremely important given the proximity of sugarcane production areas to the Great Barrier Reef. Through the implementation of PCTF and reduced tillage runoff and soil erosion from rainfall events are likely to be reduced. Similarly less runoff equates to greater rainfall captures which will have implications on irrigation infrastructure requirements and potential yield improvement.

The reduction in tillage and associated reductions in fuel use will significantly reduce the environmental foot-print of sugarcane production. If the Russo Bros. current scenario data saving of 47L/ha is extrapolated across the 382 600 ha (Canegrowers 2007 annual report) of the sugar industry it represents a 17.98 ML fuel saving to the industry. At 100c/L this represents an $18 000 000 saving to the growing sector of the industry.

Conclusion

These data clearly demonstrate that adoption of PCTF and reduced tillage improves the profitability of sugarcane production in Australia. These techniques are tools to maximize economic potential of the industry and at the same time minimizing any adverse effects on the greater environment.

GPS-Auto steer technology should not be viewed as a cost to a sugarcane farming entity; rather it should be seen as an investment into equipment that not only improves profitability, but also improves the timeliness of all farm operations which will improve productivity.

These data demonstrate that all farming entities, regardless of size, have the opportunity to improve their economic status through the adoption of these farming practices.

References

ANON. 1990, Cane Mechanization, *Sugar Cane*, No. 2, pp 23-26.

Bell MJ, Halpin NV, Orange DN, & Haines M, 2001, 'Effect of compaction and trash blanketing on rainfall infiltration in sugarcane soils', *Proc. Aust. Soc. Sugar Cane Technol*, Vol 23, pp 161-167.

Bell MJ, Halpin NV, Garside AL, Moody PW, Stirling GR, & Robotham BJ, 2003, Evaluating combinations of fallow management, controlled traffic and tillage options in prototype sugarcane farming systems at Bundaberg. *Proc. Aust. Soc. Sugar Cane Technol*., Vol 25: (CD).

Braunack MV, 1997, The effect of soil physical properties on growth and yield of sugarcane, *Sugar Cane* No. 2 pp 4-12.

Braunack MV, McGarry D, Crees LR, & Halpin NV, 1999, Strategic tillage for planting sugarcane, *Proc. Aust. Soc. Sugar Cane Technol*., Vol. 21, pp 101-107.

Braunack MV, Garside AL, & Bell MJ, 2003, The effects of rotational breaks from continuous sugarcane on soil physical properties, *Proc. Aust. Soc. Sugar Cane Technol*., Vol 25: (CD).

Cameron T, 2005, *Farm Economic Analysis Tool (FEAT)*, a decision tool released by FututreCane, Department of Primary Industries & Fisheries.

Garsdie AL, Bramley RGV, Bristow KL, Holt JA, Margary RC, Nable RO, Pankhurst CE, & Skjemstad JO, 1997, Comparisons between paired old and new land sites for sugarcane growth and yield and soil chemical, physical and biological properties. *Proc. Aust. Soc. Sugar Cane Technol*., 19: 60-66.

Loeskow N, Cameron T, & Callow B, 2006, Grower case study on economics of an improved farming system, *Proc, Aust. Soc. Sugar Cane Technol*., Vol. 28, pp 96-102.

McGarry D, Braunack MV, Cunningham G, Halpin N, Sallaway M, & Walters D, 1997, Comparison of soil physical properties of row and inter-row: A basis for controlled traffic in cane. *Proc. Aust. Soc. Sugar Cane Technol*., Vol. 19, pp 263-269.

McGarry D, Sharp G, & Bray SG, (1999), *The current status of soil structural degradation in Queensland cropping soils*, Department of Natural Resources and Mines Coorparoo, Q.

Norris CP, Robotham BG, & Bull TA, 2000, High Density Planting as an economic production strategy: A farming system and equipment requirements, *Proc. Aust. Soc. Sugar Cane Technol*., Vol. 22, pp 113-118.

SRDC 2004-2005 Annual Report, 2005, Project Reports YDV002, *Sugar Research and Development Corporation*, Brisbane.

Tullberg JN, 2005, 'CTF: What's known, what's next?, *Proc. 3rd Australian Conference on Controlled Traffic*. University of Queensland Gatton. July pp 47-49.