SHORT COMMUNICATION

THE IMPACT OF TRASHING ON YIELD RESPONSE IN THE SOUTH AFRICAN SUGAR INDUSTRY: A SUMMARY OF RESULTS FROM SEVERAL BT TRIALS

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Abstract

During the 1960s and 1970s, Dr Gerald Thompson initiated several burning and trashing (BT) trials to complement the BT1 trial, which is well known to sugarcane scientists around the world. BT1, which is located at the South African Sugar Research Institute (SASRI) at Mount Edgecombe, was established in 1939 and is still maintained today by SASRI staff. The duration of other BT trials, which were all conducted near the coast, north and south of Durban, was only two to three years, but, unlike BT1, the results have not been widely published. Measurements in these trials were mainly of cane yield, and all crops were harvested between 1978 and 1981. Two more trashing trials were established in 2000 in the midlands, the first on a heavy soil and the second on a light red soil. The first of the two BT trials reported here is being maintained, but the latter was terminated after the first crop. The average trashed over burnt yield response for the BT1 trial is 9 tons/ha/an, and this figure is commonly used in the sugar industry to represent the response that can be expected from a trashing system. However, past internal reports at SASRI have quoted responses ranging from 25 to –23 tc/ha/an. In certain years, small responses to trashing were recorded for BT1 and in other years much higher responses. This paper summarises the results from eight BT trials, with the added objective of quantifying yield response to trashing based on rainfall and the season in which the crops were harvested.

Keywords: trashing, burning, rainfall, soil type, cane yield, altitude, region

Introduction

The decision to continue burning before harvest or change to trashing is far more pressing now than ever before. A recent industry survey (Anon, 2005a) found that 90% of all cane fields are burnt at harvest. Regionally, industry extremes are the irrigated areas, which are almost 100% burnt, and the northern areas of KwaZulu-Natal near Empangeni, where burning before harvest is estimated to be less than 30% of the area (personal communication[1]).

Most of the of the sugarcane in South Africa (70%, Anon, 2005b) is produced under rainfed conditions, with rainfall varying from 800 to 1200 mm per annum. From this, it may be inferred that the South African industry is by far the driest sugarcane industry world-wide. Thompson (1965, 1966) found that the potential conservation of rainfall from trashing was equivalent to 90 mm/an, which would have a significant impact on crop yield, especially in

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dry years (van Antwerpen *et al*, 2001, 2002). The value of this additional water in terms of yield was established by Thompson (1976) to average 9 tons cane per 100 mm water lost through transpiration. Responses obtained from other trashing trials conducted by the South African Sugarcane Research Institute (SASRI), have ranged from 25 to –23 tc/ha. van Antwerpen *et al.* (2001) reported small yield responses to trashing from the long term BT1 trial, which were invariably associated with above average wet years (more rain than the long term mean of 968 mm per annum). Likewise, the best yield responses to trashing were associated with dry years (less than the long term mean).

The objective of this paper is to quantify cane yield responses due to trashing from available burning and trashing trials in terms of season and rainfall.

Materials and Methods

Data from eight dryland trashing versus burning trials conducted in the South African sugar industry are summarised in Table 1. All trials compared burning at harvest with green cane harvesting (trashing) as the major treatments.

The most basic measurement for all sites was cane yield. More treatments than those reported in this paper were available, but only those practised by sugarcane farmers in the South African sugar industry were selected. These included green cane harvesting (trashing, T), cane burnt and the tops spread after harvest (Bt) and cane burnt with all residues removed after harvest (Bto). All yields were expressed relative to the trashed treatment (Equation 1).

$$\text{Yield response (\%)} = 100 - \left[\frac{\text{Burnt yield data per crop}}{\text{Trashed yield data per crop}} \times 100 \right] \qquad (1)$$

Although many parameters were measured in the various trials, only rainfall will be considered here. Total rainfall was calculated per crop and expressed relative to the total mean rainfall per crop calculated from the long-term mean (LTM) data.

Results

Thompson (1990) reported a mean yield response of 9 tc/ha/an in favour of trashing (T) when compared with the practice of burning at harvest and removal of all residual material (Bto). This represents an average benefit of 11%, which was confirmed by the BT1 data used to compile Table 2. When trashing is compared with burnt cane at harvest with all residues (tops) retained (Bt) and spread over the soil surface (the last two cropping cycles – 1977 to 2001), the benefit to trashing diminished to 2 tc/ha/an or 2.4%. This suggested that the partial surface covering of 70-80% by burnt tops was effective in contributing to the production capacity of the crop. A number of reasons may be suggested, but once again reduced soil water loss (evaporation) is probably the most likely reason. Thompson (1965) reported reduced evaporation of 90 mm/an on average by a full trash blanket.

However, a yield benefit from trashing was not obtained in all years, as shown in Table 2. Analysing the data from Table 2 for the impact of season in which the crop was harvested and rainfall relative to the long-term mean (RRLTM), revealed interesting trends. For all crops harvested in spring and summer (starting in September), T relative to Bto showed a yield response of 13% in dry seasons (RRLTM = <90%), 10% in average years and 1% in wet years. T relative to Bt showed a yield response of 6% in dry years, 5% in average rainfall years and –1% in wet years. For all crops harvested in winter, none fell into the `dry season' category. Yield responses for T relative to Bto showed a yield response of only 4% in average rainfall years and –15% in wet years. Yield responses for T relative to Bt showed a yield response of –1% in average rainfall years and –13% in wet years.

However, exceptions to the above findings were noticed. An example is the 25th crop from the BT1 trial, where a good response of 13% (12 tc/ha/an) was recorded despite having received above normal rainfall. A closer look at the rainfall pattern showed that the rainfall received up to the age of 12 months was 262 mm below the long-term mean (LTM), whereafter it was above the LTM for the remainder of the crop cycle. A similar trend was noticed in the 28th crop, which received above normal rainfall only after the age of eight months.

Results from the midlands trials (BT101/2000 and BT102/2000) were excluded from the above discussion because no rainfall data were available. Nevertheless, the mean yield responses of T relative to Bto and T relative to Bt was 5% and 3% respectively.

Length of the cropping cycle ranged from 8 to 24 months and covered virtually all ages in between. Analysis of the data in Table 2 showed there is no relationship between crop age and yield response (Bto relative to T and Bt relative to T).

Conclusions

Rainfall and the season in which the crop is harvested are two factors in a potentially long list that determines the response of sugarcane to trashing. Crops harvested in winter and followed by an above normal rainfall are likely to produce less cane than cane burnt at harvest and all residues removed. On the other hand, cane harvested in summer followed by below normal rainfall is likely to show the highest yield response where trashing is practised.

From the limited data used in this paper, it is probable that the quantity of rainfall during the first six months after harvest has an important impact on the yield response of sugarcane where trashing is practised. This coincides with the period before canopy closure where the difference (in terms of soil water content and temperature) between uncovered and covered (trashed) soil surfaces are likely to be the largest.

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Table 1: Site information of eight dryland burning versus trashing trials.

Trial name	Area	Site	Altitude (m)	Soil form	Clay (%)	pH (water)	Variety	Number of crops	Data collection period	LTM rainfall (mm/an)
BT1	Mount Edgecombe	SASRI	95	Arcadia	44	5.5	Co281, Co301, NCo376, N16	40	Oct 1939 to Sep'2001	968
BT10	Umhlanga	CFS	76	Hutton	6	8.5	N55/805	3	Nov 1978 to Nov 1982	960
BT11	Tongaat	Charters Hill	72	Hutton	52	5.8	NCo376	3	Nov 1978 to Sep 1982	1047
BT12	Umhlali	Helmsley Est, Compensation	24	Longlands	12	5.3	NCo376	2	Nov 1979 to Sep 1982	1052
BT13	Renishaw	Isonti Section	160	Glenrosa	20	5.5	NCo376	3	Nov 1979 to Sep 1982	1011
BT14	Renishaw	Isonti Section	140	Swartland	23	5.4	NCo376	2	May 1980 to Nov 1982	999
BT101/2000	New Hanover	Fairview	750	Hutton	55	4.6	N12	2	Jun 2000 to Jun 2004	978
BT102/2000	Seven Oaks	West Cliff	1067	Hutton	15	5.5	N12	1	Jun 2000 to Jun 2002	904

BT = Burning versus Trashing   LTM = Long term mean   Soil form = Soil Classification Working Group (1991)

Table 2. Summary of relative yield response to trashing in relation to rainfall as a percentage of long term mean (LTM).

Trial name	Starting crop	Crop number	Start date	Harvest date	Age (mths)	Bt/T (%)	Bto/T (%)	Rain/ LTM rain (%)
BT1	1st R	22	10Nov78	25Jun80	19.8	12	23	67
	2nd R	23	25Jun80	02Oct81	15.5	–1	7	126
	3rd R	24	02Oct81	11Nov82	13.5	1	17	87
	4th R	25	11Nov82	26Jun84	19.8	13	12	116
	5th R	26	26Jun84	22Sep85	15.1	1	9	101
	6th R	27	22Sep85	11Nov86	13.8	–4	1	96
	7th R	28	11Nov86	10Dec87	13.1	3	5	151
	8th R	29	10Dec87	04Nov88	11.0	0	–3	166
	9th R	30	04Nov88	21Nov89	12.7	–8	2	137
	10th R	31	21Nov89	13Nov90	11.9	–1	4	100
	Plant	32	26Nov91	30Jun93	19.4	5	12	56
	1st R	33	30Jun93	29Sep94	15.2	0	3	91
	2nd R	34	29Sep94	12Sep95	11.6	18	26	96
	3rd R	35	12Sep95	10Sep96	12.1	–15	–11	133
	4th R	36	10Sep96	11Sep97	12.2	1	12	96
	5th R	37	11Sep97	28Sep98	12.7	12	16	100
	6th R	38	28Sep98	28Sep99	12.2	15	25	82
	7th R	39	28Sep99	13Sep00	11.7	–1	1	156
BT10	3rd R	1	2Nov78	19May80	18.6	4	7	71
	4th R	2	19May80	1Sep81	15.4	–24	–37	108
	5th R	3	1Sep81	9Nov82	14.3	5	4	90
BT11	2nd R	1	6Nov78	16Dec79	13.3	0	5	85
	3rd R	2	16Dec79	8Jun81	17.8	10	14	84
	4th R	3	8Jun81	24Sep82	15.2	13	16	90
BT12	1st R	1	5Nov79	1Jul81	19.9	3	9	81
	2nd R	2	1Jul81	3Sep82	14.1	–10	–7	102
BT13	1st R	1	1Nov79	3Jul80	8.1	9	20	54
	2nd R	2	3Jul80	19Oct81	15.5	–7	8	96
	3rd R	3	19Oct81	30Sep82	11.4	–2	9	55
BT14	2nd R	1	21May80	8Sep81	15.6	–4	–7	97
	3rd R	2	8Sep81	16Nov82	14.3		–3	78
BT101/2000	3rd R	1	1Jun00	28Jun02	24.9	2	–4	101
	4th R	2	28Jun02	3Jun04	23.2	5	2	97
BT102/2000	1st R	1	27Sep00	19Sep02	23.8	8	8	97