THE IMPACT OF TRASHING ON SOIL CARBON AND NITROGEN: II: IMPLICATIONS FOR SUGARCANE PRODUCTION IN SOUTH AFRICA

R VAN ANTWERPEN[1], P J THORBURN[2], H HORAN[2], J H MEYER[1]
and C N BEZUIDENHOUT[1]

*[1]South African Sugar Association Experiment Station, P/Bag X02, Mount Edgecombe,
4300, South Africa*
[2]CSIRO Sustainable Ecosystems, 120 Meiers Rd, Indooroopilly, Qld 4068, Australia
E-mail: antwerpen@sugar.org.za

Abstract

Trashing has the potential to improve yield by conserving water, soil C and soil N in sugarcane production. However, the benefits of trashing are complex to determine because of variability in rainfall (between regions and seasons) and the long-term effect of cropping soil systems on N dynamics. In a companion paper a cropping systems model, which accounts for the impacts of water and N stress on sugarcane growth, was shown to predict the long-term response of cane yield and soil organic matter changes under a range of trashing treatments. This paper expands the modelling analysis by examining the benefits of trashing over a wider range of soils and climatic conditions. Possible changes to cane production management practices in the South African sugar industry following the adoption of trashing are discussed.

Keywords: APSIM, cane trash, cane yield, soil biomass carbon, soil biomass nitrogen, sugarcane

Introduction

The practice of burning cane before harvest under the monocultural system of sugarcane production in South Africa is the major reason for the loss in organic matter from soils (van Antwerpen and Meyer, 1996), which causes soil degradation. The supply of large quantities of organic matter within the South African sugar industry is limited and growers have to make use of what is available. The only consistent and widespread sources of organic matter are filtercake (milo, filtermud) and trash (dead leaves and green tops from cane fields that are harvested without burning). Until recently filtercake was available from all sugar mills and generally when used, nearly always resulted in measurable yield responses (Meyer *et al.*, 1992; Roth, 1971). The availability of trash is determined by on farm management, and under a non-burn policy will assure a permanent source of organic matter. Examples of areas where the value of trash has contributed towards sustaining soil productivity include conservation of moisture (Thompson, 1966), increased soil microbial activity (Graham *et al.*, 1999), availability of N from trash (Ng Kee Kwong *et al.*, 1987), management of N fertilisation following trashing (Robertson and Thorburn, 2000; Thorburn *et al.*, 2000), the effect of long-term trash blanketing on cane yield and N cycling (Thorburn *et al.*, 2001a), the effect of trash on soil chemical and physical properties (van Antwerpen and Meyer, 1998), the effect of trashing on the abundance of leaf nutrients (van Antwerpen *et al.*, 2001), the effect of properties such as soil pH, texture and fertility on the N immobilization-mineralisation relationship in soil organic matter (Wood, 1966), and general agronomic advantages such as improved soil water and nutrient retention, weed control, improved soil structure and reduced erosion (Wood, 1991).

The long term burning and trashing trial known as BT1 was established on a vertisol in 1939 at the South African Sugar Association Experiment Station (SASEX). It is widely acknowledged to be the oldest cane burning trial in the world and since its inception has provided a wealth of information regarding the extent of cane response to trashing compared with burning with and without fertiliser, as well as changes in soil fertility over 60 years of continuous cropping. Despite the valuable information that has been generated from this trial it has limited application as the soil on which the trial is situated accounts for only 5% of the sugar industry. In addition the seasonal rainfall conditions experienced over the 60 years are not fully representative of the rest of the industry. This makes it difficult to extrapolate outcomes from the trial to other parts of the industry.

Manpower and financial constraints limit the establishment of further trials on a range of soils in other climatic regions. It is for this reason that the computer simulation option was taken to estimate crop response to a trash blanket on various soils under a wide range of simulated climatic conditions. The APSIM cropping systems model (McCown *et al*., 1996) was selected because of its ability to simulate cane yield (Keating *et al*., 1999), the rate of trash decomposition (Thorburn *et al*., 2001a) and soil N cycling (Probert *et al*., 1998), and its demonstrated accuracy in simulating trashing effects from trials conducted under Australian and South African conditions (Thorburn *et al*., 1999, 2001b, 2002a). The aim of this paper is to report on cane yield responses obtained, as well as water use and N balances following trashing from simulations conducted on five soil types using eight weather stations that represent the five main climatic regions in the South African sugar industry. The paper forms part two of an investigation on the impact of trash management on soil carbon and nitrogen of which part one was reported by Thorburn *et al.* (2002b).

Methods and Materials

APSFront, which is a user friendly windows interface for the APSIM sugarcane crop model (Keating *et al*., 1999), was used to simulate the effect that trash management would have on water use, soil biomass N and cane yield in various climatic regions of the South African sugar industry. The climatic regions included in this study were the South Coast, North Coast, Hinterland, Midlands and various irrigated areas. Further information on the weather stations used from the SASEX records to represent each climatic region is summarised in Table 1. Because it was expected that rainfall and the accompanying weather data would affect the response of crops to trashing the data were subdivided into low, normal and high rainfall categories (see Tables 3 to 5).

Table 1. The weather stations used in simulations.

Climatic region	Weather station	Latitude	Longitude	Altitude (m)	Starting date	Last date
Midlands North	Jaagbaan	-29 21	30 41	1018	01/07/71	31/10/96
Hinterland South	Powerscourt	-29 58	30 38	631	01/12/68	28/02/95
South Coast	Esperanza	-30 18	30 38	195	01/12/68	28/02/95
North Coast	Mount Edgecombe	-29 42	31 02	96	01/12/68	28/02/95
North Coast	Mtunzini	-28 56	31 42	36	01/12/68	28/02/95
Irrigated Central	Riverview Mtubatuba	-28 26	32 11	46	01/12/68	28/02/95
Irrigated North	Pongola	-27 24	31 35	308	01/12/68	28/02/95
Irrigated North	Tenbosch	-25 20	31 54	179	01/12/68	28/02/95

Five soils with plant available water capacities ranging from 99 to 144 mm/m were used with each climatic zone. The Lonehill soil represents the vertisol from the BT1 trial at SASEX and the remainder are from trial sites in Queensland, Australia (Table 2).

Table2. Physical properties of the soils used in simulations.

Soil	SA* soil names	Topsoil texture	No. of soil layers	Rooting depth mm	mm water/rooting depth		
					LL	DUL	PAWC
Brown clay loam$^{\#}$	Katspruit	SL	5	1050	196	300	104
Brown clay^{+}	Katspruit	Clay	5	1050	232	374	142
Hydric clay	Longlands	SL	5	900	91	221	130
Lonehill	Arcadia	Clay	5	1000	303	416	113
Red earth	Shortlands	SL	6	1500	167	312	145

PAWC = Plant available water capacity
SL = Sandy Loam
LL = Lower limit of PAWC
DUL = Drained upper limit of PAWC
* Soil classification working group (1991)
\# Holz and Shields (1985)
\+ Cannon *et al.* (1992)

The APSIM model configuration was similar to that described by Thorburn *et al*. (2001a). The following discusses the parameterisation used in simulations. Each soil was divided into six soil layers, with a total depth of 1500 mm. Roots in all soils, except that of the Red earth, were restricted to a depth of about 1000 mm because of the high clay content or luvic character at this depth. Residue left on the soil surface after green cane harvesting was assigned a C to N ratio of 100. As burning removed 70% (unpublished data from BT1) of the residue, a C to N ratio of 50 was used for tops left scattered in the field (Robertson and Thorburn, 2000). All fields were planted in April and the number of ratoons restricted to eight followed by ploughout and 10 months fallow before replanting. Annual harvesting was mid-June for all climatic regions except for Hinterland and Midlands areas, which was at the ages of 18 and 24 months respectively. Parameters for variety NCo376 (Keating *et al*., 1999) were used in all simulations. Nitrogen was applied as limestone ammonium nitrate (LAN) at rates in accordance with Fertiliser Advisory Service (FAS) recommendations for plant and ratoon cane (Meyer *et al.,* 1986). Irrigation, where applied, was only after 60% of plant available water had been depleted.

Results and discussion

Yield response relative to dry and wet periods

Yield response was analysed for three rainfall scenarios namely, dry (<900 mm/crop), normal (900 to 1500 mm/crop) and wet (>1500 mm/crop). Overall yield responses were largest for the dry periods and smallest for wet periods (Table 3). The largest mean yield responses of about 23% (or 18 tons cane/ha) in the dry periods were obtained for the Midlands (Jaagbaan) and Hinterland (Powerscourt) sites (higher altitudes) followed by 12% (or 9 tons cane/ha) for the Coastal regions (Esperanza, Mount Edgecombe and Mtunzini). The simulated response of 9.6 tons cane/ha for the Mount Edgecombe site compares favourably with the actual mean yield response of 9.3 tons cane/ha for trashing over burning (no residue retained) reported for the BT1 trial site by van Antwerpen *et al.* (2001) (data not shown).

Yield responses for the irrigated areas were lowest for all rainfall ranges probably because the simulated crops experienced no water shortages due to irrigation (Figure 1). Surprisingly no negative responses to trashing were obtained in the very wet period. A partial reason for this is probably because the APSIM crop model does not have a module to deal with waterlogged conditions. Mean yield responses for the rainfed sites in the normal period ranged from 6 to 10%. The smaller response obtained in favour of trashing in the Mtunzini area in the dry period may be due to better rainfall distribution compared with other regions.

In general the response to trashing was not greatly affected by soil type. The Red earth soil was the only soil that deviated from this trend. In the dry periods yield response to trashing was reduced markedly for the Mtunzini area compared with responses for the other soils. However, in the normal and wet rainfall periods the Red earth soil had the opposite effect producing much higher responses for the Mtunzini area. The most important difference was the greater rooting depth of 1500 mm used for the Red earth soil compared with 1000 mm for the other soils. The reason for the greater yield response in the Mtunzini area is uncertain but could be due to a combination of the soil's superior water storage capacity, drainage properties (no waterlogging), aeration and rainfall distribution for the area.

Table 3. Yield response (%) to trashing over burning for three rainfall ranges over the period 1968 to 1995.

Weather station	Soil					Mean
	Brown clay	Brown clay loam	Hydric clay	Lonehill	Red earth	
Rain less than 900 mm/crop						
Jaagbaan	22	27	23	23	21	23
Powerscourt	25	26	25	23	22	24
Esperanza	15	13	15	16	15	15
Mt Edgecombe	12	13	11	13	18	13
Mtunzini	9	8	8	9	2	7
Riverview	1	1	0	0	0	1
Pongola	0	1	0	0	0	0
Tenbosch	0	1	0	0	0	0
Rain 900 to 1500 mm/crop						
Jaagbaan	9	9	8	8	8	8
Powerscourt	6	7	5	7	6	6
Esperanza	5	4	4	6	3	4
Mt Edgecombe	4	6	4	5	13	6
Mtunzini	8	8	8	9	17	10
Riverview	-1	0	0	0	0	0
Pongola	0	0	0	0	0	0
Tenbosch	-1	0	0	0	0	0
Rain more than 1500 mm/crop						
Jaagbaan	4	5	5	6	5	5
Powerscourt	-2	1	0	2	1	0
Esperanza	1	1	1	1	0	1
Mt Edgecombe	1	1	1	2	14	4
Mtunzini	3	3	3	4	14	6
Riverview	-1	0	0	0	0	0
Pongola	0	0	0	0	0	0
Tenbosch	-	-	-	-	-	-

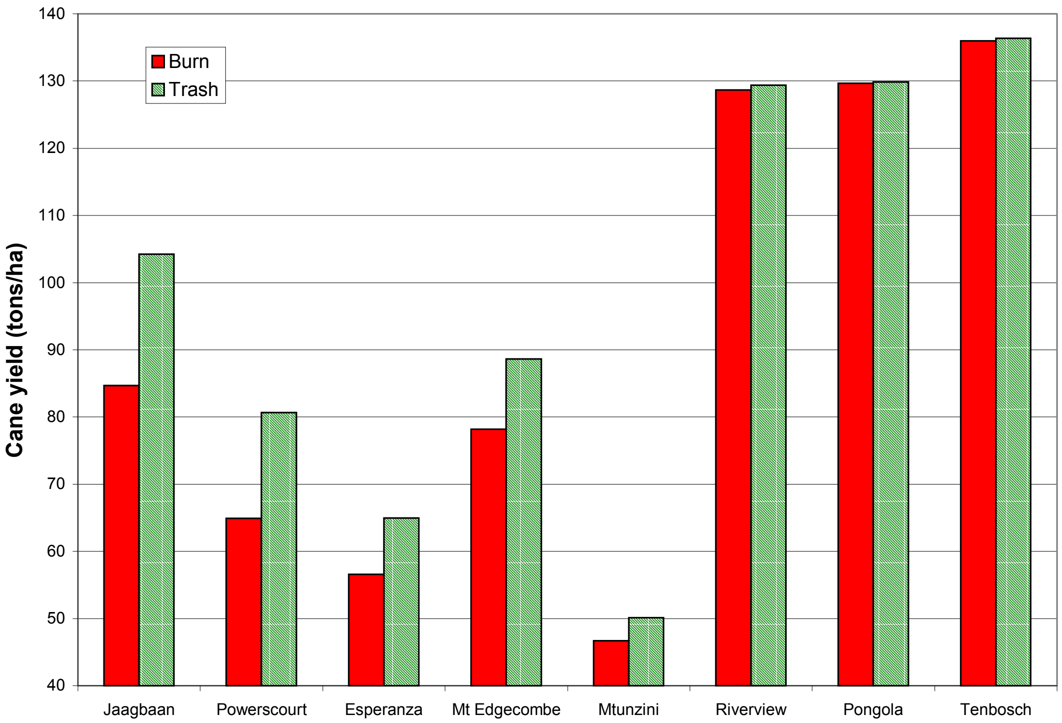

Figure 1. Mean simulated cane yield over all soils for years where the rainfall per crop was less than 900 mm.

Water use
It is evident from Table 5 that water loss due to deep drainage below the rooting zone was exacerbated by trash retention management. This implies that less water is lost through runoff resulting in an improvement in rainfall efficiency. Evaporation from the soil surface was also reduced (Table 4) resulting in more water available to the crop for growth. The overall water saving value of trash was between 90 and 100 mm/crop regardless of the water regime for which the data were analysed. These data support the conclusions reported by Thompson (1966) that a trash blanket can conserve about 100 mm rainfall per crop. Also noteworthy was the increase in drainage as rainfall per crop increased (Table 4). The latter was also true for the irrigated regions despite accurate scheduling, which was possible because an increase in the number of rainfall events also increased the chances that it might rain soon after irrigation.

Soil biomass C
To analyse the effect of trash on soil organic matter three fractions need to be considered viz. fresh organic matter (the organic matter or residue soon after it becomes part of the soil), biomass carbon (the active part of organic matter from which nutrients can be mineralised) and humus carbon (the inactive fraction). By far the largest amount of fresh organic matter (FOM) enters the soil through mechanical incorporation, which is only possible before replant. Due to the latter, biomass carbon levels reach a maximum during the plant crop, which last for about three years before they slowly decline until the next addition of FOM is incorporated.

Simulated soil biomass carbon results are presented as the difference between Trash and Burnt values (kg/ha) for three periods, namely from plant to harvest of the second ratoon in the first crop cycle (0-2), start of the fourth ratoon to harvest of the sixth ratoon also in the first crop cycle (4-6) and start of the sixth ratoon to harvest of the eighth ratoon in the second crop cycle (6-8) (Table 5). In general the additional biomass carbon from trashing more than doubled from crops 0-2 to 4-6 with a much smaller increase for crops 6-8. Thus, the largest changes in biomass carbon for the topsoil layer (0-100 mm) occurred over the first five cane crops with smaller increases thereafter. The data suggest that about crop five the rate of biomass carbon accumulation was reduced, and that a state of equilibrium had been reached.

Table 4. The difference (Trash–Burn) in water drainage (dr, mm) out of the rooting zone and the difference (Burn-Trash) in soil surface evaporation (es, mm) for three rainfall ranges.

Weather station	Soil										Mean	
	Brown clay		Brown clay loam		Hydric clay		Lonehill		Red earth			
	dr	es	dr	es	dr	es	dr	es	dr	es	dr	es
Rain less than 900 mm/crop												
Jaagbaan	0	125	0	127	0	125	0	104	0	110	0	118
Powerscourt	27	135	26	122	26	134	23	116	27	123	26	126
Esperanza	22	71	24	62	19	70	13	62	19	68	20	67
Mt Edgecombe	21	82	21	75	21	77	16	69	2	74	16	75
Mtunzini	27	66	29	58	31	66	25	58	27	50	28	60
Riverview	18	103	18	100	15	99	15	84	14	104	16	98
Pongola	5	99	9	100	8	93	15	85	8	100	9	95
Tenbosch	5	100	-3	99	3	92	8	86	5	101	4	96
Mean	16	98	16	93	15	95	14	83	13	91	15	92
Rain 900 to 1500 mm/crop												
Jaagbaan	39	116	34	105	41	105	25	93	38	107	36	105
Powerscourt	84	105	75	105	87	106	67	104	76	105	78	105
Esperanza	48	73	44	63	47	67	33	62	48	63	44	65
Mt Edgecombe	73	88	57	80	68	87	52	70	12	86	52	82
Mtunzini	43	101	41	92	43	99	34	88	-13	99	30	96
Riverview	48	96	48	99	45	97	47	89	37	98	45	96
Pongola	56	80	53	77	48	76	39	64	47	75	49	74
Tenbosch	82	101	73	89	76	88	63	70	75	88	74	87
Mean	59	95	53	89	57	91	45	80	40	90	51	89
Rain more than 1500 mm/crop												
Jaagbaan	56	93	50	94	49	97	38	86	52	95	49	93
Powerscourt	124	109	103	110	109	110	100	110	108	113	109	110
Esperanza	103	98	89	85	105	98	101	76	102	93	100	90
Mt Edgecombe	109	82	82	73	109	83	75	67	38	88	83	79
Mtunzini	99	114	89	106	100	116	86	97	18	124	78	111
Riverview	82	118	89	119	106	116	90	113	94	120	92	117
Pongola	122	97	105	97	104	93	98	84	101	95	106	93
Tenbosch*	-	-	-	-	-	-	-	-	-	-	-	-
Mean	99	102	87	98	97	102	84	90	73	104	88	99

*No data because the highest annual rainfall was 1374 mm.

Simulated soil biomass carbon in the topsoil layer (0 to 100 mm) from burning varied after nine crops from 901 kg/ha at Tenbosch to 1198 kg/ha at Powerscourt (Figure 2). The variation due to trashing after nine crops in the first crop cycle was between 1461 kg/ha at Tenbosch to a maximum of 1764 kg/ha at Mount Edgecombe on the coast. The initial biomass carbon used in simulations for burning and trashing across all sites and soils was 1300 kg/ha. The average response after nine crops in soil biomass carbon from trashing over burning varied from 482 kg/ha at Powerscourt to 719 kg/ha at Mount Edgecombe.

Simulated biomass carbon following burning at Mount Edgecombe decreased over the first five crops from 1300 kg/ha to stabilize at about 1000 kg/ha for the remainder of the crop cycle. Simulated soil biomass carbon following trashing increased slowly over the first five crops from around 1300 kg/ha to 1800 kg/ha. This effect was similar for all soils simulated although biomass carbon for the Red earth soil only reached a simulated value of 1700 kg/ha. Thorburn *et al.* (2001a) reported results from a field trial in Mackay (brown clay loam soil), which showed similar trends for burning and trashing. The current simulated trends were similar for all climatic regions although the magnitude of organic matter retention levels for the northern irrigated areas was less.

The smallest difference between the trash and burn management options was for Jaagbaan in the midlands (Table 5). Of all the weather stations used for simulations, Jaagbaan is at the highest altitude and cane growth is slow, average age at cutting being 24 months. Residue production and accumulation is therefore slow. In general topsoil biomass carbon was higher for the coastal regions compared with the irrigated cane areas (Table 5). However, simulated trashing under irrigation was capable of maintaining the active fraction of organic matter in the soil (Data not shown). No significant differences in biomass carbon accumulation were apparent between soils (Table 5).

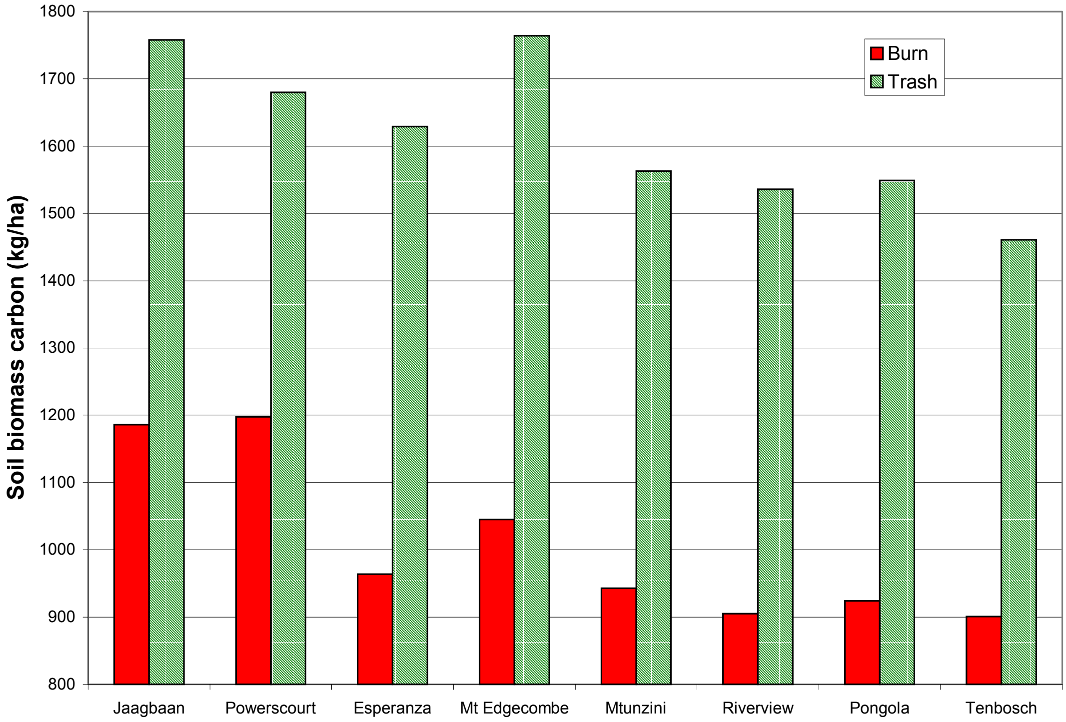

Figure 2. Mean simulated soil biomass carbon for the topsoil layer (0 to 100 mm) over all soils after the eighth ratoon.

Soil biomass N

The soil biomass N parameter was used for analysis as most of the organic N due to trashing enters the soil via the residue left on the soil surface after harvest. The data were divided into five groups based on time elapsed since cane was first established, in order to analyse for the effect that trashing had had on reserves of soil N. The times used were at harvest of the plant crop, second ratoon, fourth ratoon and a mean value from the sixth to the eighth ratoon, all from the first crop cycle, with the final time period taken from the mean of the sixth to the eighth ratoon of the second crop cycle.

The benefit from trashing in the topsoil layer (0 to 100 mm) after the plant crop was negligible but showed a sharp increase to the fourth ratoon, though thereafter the increases were relatively small (Table 6). At the end of the second ratoon, soil biomass N from accumulated trash was already 30% higher than that from burning and the mean difference increased to 50% after the fourth ratoon, then to a mean of 61% between the sixth and the eighth ratoons in the first cycle and finally to a mean of 69% for the sixth to the eighth ratoons in the second cycle.

The mean N percentage advantage across climatic regions for the various soils varied little but the soil that consistently showed the largest buildup in biomass N was the Red earth or Shortlands form soil. The relatively low values for the Jaagbaan climatic region were due to slow cane growth and residue production at high altitudes (see Table 1).

Table 5. Differences in simulated biomass carbon (Trash–Burn, kg/ha) in the topsoil layer (0 to 100 mm) for three periods started after sugarcane was established for the first time in a field.

Weather station	Soil					Mean
	Brown clay	Brown clay loam	Hydric clay	Lonehill	Red earth	
First crop cycle: plant to harvest of the second ratoon (0-2)						
Jaagbaan	100	115	184	210	216	165
Powerscourt	266	273	322	287	291	288
Esperanza	225	230	268	265	287	255
Mt Edgecombe	241	254	312	318	339	293
Mtunzini	266	256	333	294	319	294
Riverview	200	227	280	331	335	275
Pongola	236	250	294	321	337	288
Tenbosch	244	261	274	290	303	274
Mean	222	233	283	290	303	266
First crop cycle: fourth ratoon to harvest of the sixth ratoon (4-6)						
Jaagbaan	367	372	415	397	448	400
Powerscourt	632	650	689	669	676	663
Esperanza	649	643	694	682	678	669
Mt Edgecombe	655	689	724	713	619	680
Mtunzini	583	586	644	597	586	599
Riverview	557	569	619	591	609	589
Pongola	612	601	668	643	645	634
Tenbosch	538	530	574	541	575	552
Mean	574	580	628	604	605	598
Second crop cycle: sixth ratoon to harvest of the eighth ratoon (6-8)						
Jaagbaan*	-	-	-	-	-	-
Powerscourt	671	698	710	716	702	699
Esperanza	808	819	858	777	832	819
Mt Edgecombe	767	784	814	802	743	782
Mtunzini	681	697	718	685	682	693
Riverview	590	600	651	617	663	624
Pongola	611	611	651	623	661	631
Tenbosch	553	564	589	561	615	576
Mean	669	682	713	683	700	689

*No data because the simulated period (Table 1) was too short for this 24 month cutting cycle area (see Table 4 for cutting cycle length of other regions).

Table 6. Soil biomass N (Trash–Burn, %) for five periods after cane was established for the first time.

Weather station	Soil					Mean
	Brown clay	Brown clay loam	Hydric clay	Lonehill	Red earth	
Plant crop						
Jaagbaan	0	0	0	0	0	0
Powerscourt	0	0	0	0	0	0
Esperanza	0	0	0	0	0	0
Mt Edgecombe	0	0	0	0	3	1
Mtunzini	0	0	0	0	3	1
Riverview	0	0	0	0	1	0
Pongola	0	0	0	0	0	0
Tenbosch	0	0	0	0	0	0
Mean	0	0	0	0	1	0
2nd ratoon						
Jaagbaan	9	10	18	18	24	16
Powerscourt	26	25	35	28	34	30
Esperanza	26	23	32	30	36	30
Mt Edgecombe	24	25	32	32	32	29
Mtunzini	33	31	43	33	37	36
Riverview	22	26	33	36	40	31
Pongola	26	27	34	34	40	32
Tenbosch	31	33	34	33	40	34
Mean	25	25	33	31	35	30
4th ratoon						
Jaagbaan	25	25	30	25	36	28
Powerscourt	46	46	50	44	54	48
Esperanza	50	46	59	52	63	54
Mt Edgecombe	55	50	64	50	55	55
Mtunzini	55	53	64	46	55	54
Riverview	53	51	63	50	64	56
Pongola	53	49	61	51	62	55
Tenbosch	50	49	55	44	62	52
Mean	48	46	56	45	56	50
First cycle: Mean 6th to 8th ratoon						
Jaagbaan	38	40	43	36	48	41
Powerscourt	54	56	59	48	61	56
Esperanza	67	67	69	59	74	67
Mt Edgecombe	63	69	69	64	61	65
Mtunzini	62	63	70	56	69	64
Riverview	61	64	68	56	76	65
Pongola	65	64	70	59	77	67
Tenbosch	60	60	66	53	69	62
Mean	59	60	64	54	67	61
Second cycle: Mean 6th to 8th ratoon						
Jaagbaan*	-	-	-	-	-	
Powerscourt	60	63	64	60	64	62
Esperanza	76	74	84	66	90	78
Mt Edgecombe	70	72	77	69	72	72
Mtunzini	70	71	76	62	75	71
Riverview	64	65	72	61	81	69
Pongola	65	66	69	60	79	68
Tenbosch	62	64	66	57	77	65
Mean	67	68	73	62	77	69

*No data because the simulated period (Table 1) was too short for this 24 month cutting cycle area (see Table 4 for cutting cycle length of other regions).

Conclusions

Although the results obtained were primarily from a computer-simulated exercise using APSIM, the generally good agreement with results obtained from the BT1 trial suggest that similar trends may have been obtained had actual trials had been conducted.

The magnitude of the effect of trashing in improving yields increased under conditions of drought due to reduced water loss through evaporation. The effect of trashing on yield was reduced however with an increase in total rainfall per crop. No yield loss under trashing (Trash–Burn) was obtained due to large amounts of rain received per crop. The water saving effect of trashing is probably the overriding characteristic determining yield response although part of the response to trashing came from the additional 50 to 100 kg N/ha present in the topsoil layer.

A surprising and important outcome from the simulation exercise was the positive yield response to trashing at high altitudes (1018 m) with 24 month-old cane. It supports observations by extension officers of ‘greener cane’ in the second growth year where trash was left unintentionally in fields. Initial cane germination and growth in the high altitude region was slower in the trashed parts of the fields but appeared to be healthier than the areas without trash in the second year (G Maher, Extension officer, personal communication). However it was also noted that where the trash layer was too thick cane growth was severely restricted.

The simulated retention of sugarcane trash enables the active part of soil organic matter to be maintained in all climatic regions and soils. This is consistent with trial results from Mackay, Australia but not with that observed in trial BT1 (Thorburn *et al.*, 2001a). One of the main differences between these trial sites was their soil organic matter (SOM) content. Currently the SOM from BT1 has declined from about 7% to 4.3%, which is still significantly higher than the 1% reported for the Mackay brown clay loam soil (Holz and Shields, 1985). Thus it is likely that trash loads of between 15 and 25 t/ha will be insufficient to maintain the high SOM levels of BT1, but sufficient where SOM is in the order of 1%.

These simulations also showed that measurable yield, soil biomass carbon and N responses could be expected from the second crop onwards after trashing was introduced. The largest continual response increase in terms of topsoil biomass carbon and N occurred over the first five crops while the increase was much smaller after the fifth crop. At least five crops were required in a newly introduced cane managed system before the accumulation rate of biomass carbon and N started to decline, which equates to 10 years in high altitude areas (Midlands) and as little as five years for crops cut annually. The simulated biomass carbon was marginally higher for the coastal regions compared with the irrigated areas. However, simulated trashing under irrigation was also capable of maintaining the active fraction of organic matter in soils.

In general the simulated results showed that trashing is capable of maintaining the active fraction of organic matter in topsoil, which is not possible under conventional burning practice. Trash is a free source of organic matter that is available to all growers and maintaining organic matter levels in soils is crucial in sustaining soil quality.

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