

RVA/gb
9 October 1991

**SOUTH AFRICAN SUGAR INDUSTRY
AGRONOMISTS' ASSOCIATION**

Cat.No. : ¹⁷⁸⁵3283
Code No. : VM/86/1

Title: To test the principle of vertical mulching in soils with inherently poor physical properties.

1. Particulars of project:

This crop	: 4th ratoon	Soil analysis Date : 19/07/90					
Site	: Mtunzini Field 013	pH	OM%	Clay%	PDI		
Region	: North coast	5,75	-	14	-		
Soil System	: Umzinto coast Lowlands	ppm					
Soil form / series:	Longlands/ Westleigh	P	K	Ca	Mg	ZN	Al
Design	: Randomised block	80	64	251	78	-	-
Variety	: N12	Age		: 11,6 months			
Fertiliser/ Ameliorants (kg/ha)	: N P K 129 0 129	Dates		: 16/08/90 - 05/08/91			
		Rainfall		: 1482 mm			
		LTM		: 1329 mm			
		Irrigation		: Nil			

2. Objectives

1. To establish whether the practice of vertical mulching can improve production of sugarcane on soils which have poor physical properties.
2. To establish which materials (topsoil, sand or filtercake) are most suitable to use as a vertical mulch.

3. Treatments

1. Control - planting with minimum tillage
2. Vertical mulching with topsoil only fed down the profile

3. Vertical mulching with sand at 150 t/ha fed down the profile
4. Vertical mulching with filtercake at 100 t/ha fed down the profile

Note: There have been four ratoon crops tested for residual effects only

Table 1 Mean stalk heights and populations for all treatments from the plant crop to the fourth ratoon - V M Mtunzini

Treatments	Plant crop April '86 to June '87		1st Ratoon June '87 to June '88		2nd Ratoon June '88 to July '89		3rd Ratoon July '89 to Aug '90		4th Ratoon Aug '90 to Aug '91	
	Mean stalk height (cm)	Mean No. of stalks (x10 ³ /ha)	Mean stalk height (cm)	Mean No. of stalks (x10 ³ /ha)	Mean stalk height (cm)	Mean No. of stalks (x10 ³ /ha)	Mean stalk height (cm)	Mean No. of stalks (x10 ³ /ha)	Mean stalk height (cm)	Mean No. of stalks (x10 ³ /ha)
Control	176	116	190	116	186	123	171	121	176	121
VM + top- soil	185	125	193	112	186	120	176	129	175	120
VM + sand	189	127	194	113	187	120	184	132	178	129
VM + filter cake	201	120	201	118	204	126	197	131	201	143
LSD (0,05)	11,6	10,4	-	7,4	12,5	10,2	15,4	18,5	13,1	7,8
Age -months	14,2		12,6		12,3		13,3		11,6	
Rainfall mm	1134		2559		1113		1477		1482	
LTM (mm)	1329									

Table 2: Table of crop yield from the plant crop to the fourth ratoon - Mtunzini

Treatments	Plant crop		1st Ratoon		2nd Ratoon		3rd Ratoon		4th Ratoon		Mean response		Cumulative response	
	tc/ha /an	ts/ha /an	tc/ha /an	ts/ha /an	tc/ha /an	ts/ha /an	tc/ha /an	ts/ha /an	tc/ha /an	ts/ha /an	tc/ha /an	ts/ha /an	tc/ha /an	ts/ha /an
Control	57,4	6,3	44,6	5,7	55,9	7,7	51,0	8,0	51,6	6,0				
VM + topsoil	66,7	7,2	46,4	6,1	49,2	6,9	52,4	8,2	54,7	6,7	1,8	0,3	8,9	1,4
VM + sand	69,3	7,6	46,1	5,7	56,9	7,5	58,1	9,3	57,3	7,1	5,4	0,7	27,2	3,5
VM + filtercake	77,1	7,8	48,4	6,2	62,9	8,2	64,4	9,9	70,4	8,8	11,3	1,4	56,7	7,2
Mean	66,1	7,2	46,4	5,9	56,3	7,6	56,5	8,9	58,6	7,1				
LSD (0,05)	6,7	1,2	10,1	1,4	11,1	1,3	10,5	1,9	14,0	1,7				
LSD (0,01)	10,1	1,8	15,4	2,2	17,0	1,9	15,9	2,9	21,6	2,5				

Table 3: Salinity/sodicity status of the soil at the Mtunzini vertical mulching trial on 15/05/91

Treatment	Plot No.	Depth mm	pH (water)	EC (mS/m)	SAR	CEC	Treatment	Plot No.	Depth mm	pH (water)	EC (mS/m)	SAR	CEC
Control	3	300	5,35	46	2,3	1,9	VM + sand	2	300	5,55	48	2,1	1,5
		600	5,95	46	2,3	1,9			600	5,90	45	2,4	3,2
		900	5,55	156	7,6	11,3			900	6,35	67	1,8	10,9
	8	300	5,60	69	4,2	2,6		5	300	5,50	210	8,5	3,0
		600	6,15	81	6,3	6,8			600	5,80	320	17,2	9,3
		900	5,50	210	15,5	13,1			900	5,60	260	14,1	9,1
	12	300	5,20	58	2,6	1,7		10	300	5,50	185	12,2	2,4
		600	5,70	40	1,6	3,5			600	6,20	42	2,9	6,8
		900	5,10	175	8,9	16,8			900	5,50	170	9,8	14,0
VM + topsoil	4	300	5,75	61	3,4	2,4	VM + FC	1	300	6,20	60	2,2	2,2
		600	6,15	58	3,9	4,1			600	5,85	44	1,7	2,1
		900	6,00	143	7,2	10,6			900	6,25	55	3,4	4,6
	6	300	5,45	73	3,6	3,0		7	300	6,40	73	3,0	4,9
		600	5,95	113	7,7	4,6			600	6,40	96	7,3	7,0
		900	5,90	270	13,7	15,8			900	5,65	200	14,5	14,2
	9	300	5,50	59	4,1	2,9		11	300	6,40	66	2,5	4,1
		600	6,00	46	4,4	7,5			600	5,90	46	2,2	3,6
		900	5,50	41	2,5	16,1			900	5,95	120	7,4	10,0

4. Cane growth

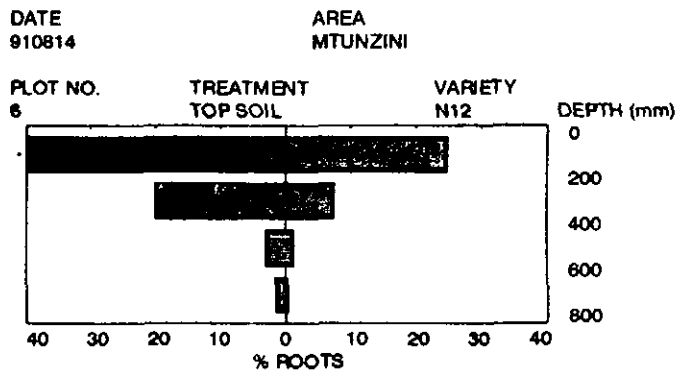
Vertical mulching (VM) with filtercake (FC) in the fourth ratoon again produced a significant response both in terms of stalk height and number of stalks per unit area when compared with the control treatment. The second best response came from VM with sand where the number of stalks produced per unit area was significantly greater than those of the control treatment (Table 1).

Table 4: Third leaf analysis from the plant crop to the fourth ratoon - VM Mtunzini

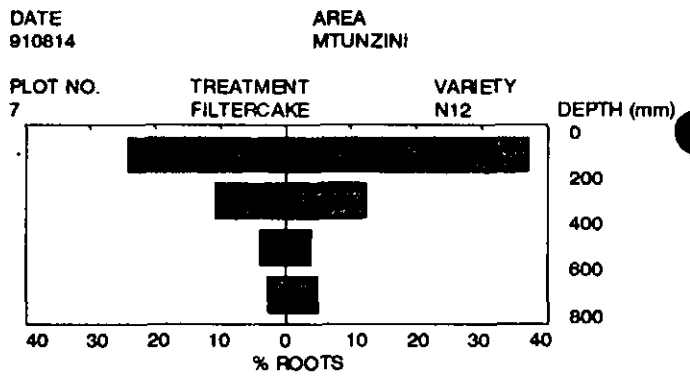
Sample date Age (months)		Plant		1st Ratoon			2nd Ratoon	3rd Ratoon	4th Ratoon	Mean
		06.01.87 9,3	05.03.87 11,2	07.12.87 6,1	14.01.88 7,4	15.03.88 9,4	15.02.89 7,7	20.12.89 5,5	19.03.91 6,1	
Treatments										
N%	Control	1,74	1,59	1,51	1,81	1,67	1,41	1,69	1,48	1,58
	Top soil	1,65	1,60	1,52	1,81	1,76	1,39	1,78	1,45	1,62
	Sand	1,66	1,55	1,55	1,82	1,76	1,42	1,89	1,40	1,63
	Filtercake	1,61	1,65	1,51	1,91	1,76	1,48	1,68	1,46	1,63
P%	Control	0,20	0,19	0,16	0,18	0,15	0,15	0,17	0,16	0,17
	Top soil	0,20	0,18	0,15	0,18	0,16	0,14	0,18	0,16	0,17
	Sand	0,20	0,18	0,15	0,20	0,16	0,15	0,19	0,16	0,17
	Filtercake	0,20	0,19	0,19	0,22	0,17	0,19	0,20	0,19	0,19
K%	Control	1,39	1,39	1,15	1,26	1,16	1,09	1,16	1,14	1,12
	Top soil	1,39	1,39	1,11	1,25	1,24	1,12	1,21	1,21	1,24
	Sand	1,32	1,39	1,15	1,40	1,25	1,13	1,27	1,24	1,27
	Filtercake	1,27	1,35	1,15	1,43	1,23	1,12	1,16	1,26	1,25
Ca%	Control	0,21	0,24	0,13	0,22	0,17	0,23	0,22	0,21	0,20
	Top soil	0,20	0,24	0,13	0,22	0,19	0,22	0,22	0,18	0,20
	Sand	0,21	0,24	0,14	0,21	0,19	0,22	0,21	0,17	0,20
	Filtercake	0,27	0,31	0,17	0,28	0,21	0,29	0,29	0,23	0,26

TABLE 5: Root distribution and counts under various VM and Control treatments (Mtunzini).

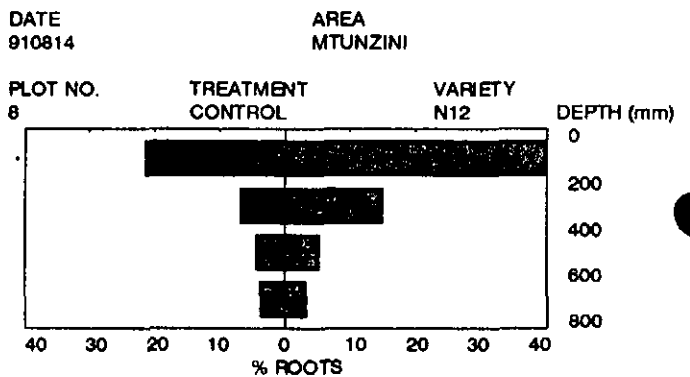
PLOT NO. 6		TREATMENT TOP SOIL		VARIETY N12						
DEPTH (mm)	GRID NO	1	2	3	4	5	TOTAL	%		
0-200	A	7	53	80	19	0	159	67		
200-400	B	9	25	28	4	0	66	28		
400-600	C	0	4	6	0	0	10	4		
600-800	D	0	3	1	0	0	4	2		
800-1000	E						0	0		
TOTAL							239	100		



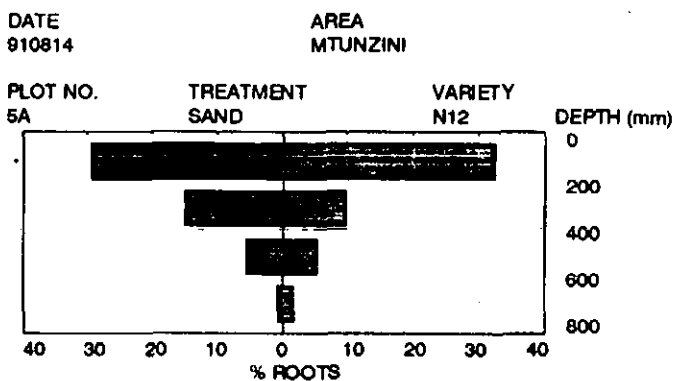
PLOT NO. 7		TREATMENT FILTERCAKE		VARIETY N12						
DEPTH (mm)	GRID NO	1	2	3	4	5	TOTAL	%		
0-200	A	0	15	64	33	7	119	61		
200-400	B	0	12	18	15	0	45	23		
400-600	C	0	5	5	4	1	15	8		
600-800	D	0	3	5	3	4	15	8		
800-1000	E						0	0		
TOTAL							194	100		



PLOT NO. 8		TREATMENT CONTROL		VARIETY N12						
DEPTH (mm)	GRID NO	1	2	3	4	5	TOTAL	%		
0-200	A	7	41	101	81	52	282	61		
200-400	B	4	14	27	31	24	100	22		
400-600	C	5	11	9	7	13	45	10		
600-800	D	4	8	10	3	7	32	7		
800-1000	E						0	0		
TOTAL							459	100		



PLOT NO. 5A		TREATMENT SAND		VARIETY N12						
DEPTH (mm)	GRID NO	1	2	3	4	5	TOTAL	%		
0-200	A	21	80	90	79	36	306	62		
200-400	B	34	29	23	19	18	123	25		
400-600	C	12	11	10	12	9	54	11		
600-800	D	0	2	3	5	2	12	2		
800-1000	E						0	0		
TOTAL							495	100		



number of stalks produced per unit area was significantly greater than those of the control treatment (Table 1).

5. Cane yield

The only treatment to produce yields that differed significantly from those of the control treatment was VM with filtercake where the response was 18,8 tc/ha/an and 2,8 ts/ha/an. VM with FC was also the only treatment to produce cane and sugar yields in the fourth ratoon that were equivalent to or higher than those of the plant crop (Table 2). The highest mean response over 5 crops came from VM with FC (11,3 tc/ha/an and 1,4 ts/ha/an) followed by VM with sand (5,4 tc/ha/an and 0,7 ts/ha/an) and VM with top soil (1,8 tc/ha/an and 3 ts/ha/an).

The lowest mean yields were obtained in the first ratoon where the annual rainfall was almost double that of the long term mean (Table 1 and 2).

6. Soil analysis

EC values are generally low except where the soil samples were taken within the clay layer in the subsoil (Table 3). SAR values recorded indicated possible sodicity problems for all plots except 1 and 2 which are those with the deepest soil. No correlation could be found between the sodicity/salinity status of soil and the VM treatment applied.

7. Leaf analysis

Third leaf analysis from the fourth ratoon showed a slight nitrogen deficiency on all treatments and a higher phosphorus, potassium and calcium content in the VM with FC treatment when compared with the other treatments (Table 4). The overall mean results showed nutrient differences in terms of higher phosphorus and calcium for the VM with FC treatment when compared with the other treatments.

8. Root distribution

Root distribution studies were conducted on plots 5 to 8 in the fourth ratoon (Table 5). The lowest total number of roots counted was for plot 7 (VM with FC) which was not the case for the VM + FC treatments in the third ratoon. Also evident, when comparing results from the third and fourth ratoons, was the very large number of roots found in the VM with sand treatments and the fact that 80% or more of the roots were found within a soil depth of 400 mm in all plots.

9. **Gypsum block readings**

Gypsum blocks were installed in the fourth ratoon under all treatments to a depth of 900 mm. There were no clear differences in water use between treatments though the control treatment at a depth of 900 mm was apparently drier during the period from February to May 1991 than were other treatments.

10. **Conclusion**

The trial has clearly shown the benefits of filtercake as an ameliorant with vertical mulching (VM). It appears that the better soil physical properties together with the improved nutrient status of the soil with filtercake, could be the main reasons for the significant increase in cane yield under this treatment.

Also evident from this trial is that cane growing under a VM tillage was not able to cope with the very wet conditions (June '87 to June '88) experienced in the first ratoon (see Tables 1 and 2). This was also the only crop where no significant yield response were obtained. However, ridging trials at La Mercy and Mtunzini (2nd and 5th ratoon respectively) has shown highly significant yield increases under very wet conditions over the same period.

30 March 1993

**SOUTH AFRICAN SUGAR INDUSTRY
AGRONOMISTS' ASSOCIATION**

Progress Report on Vertical Mulching Trial - Mtunzini - 5th Ratoon

Project No. : 3283
Code : VM 86/1
Cat No : 1785

Title: To test the principle of vertical mulching in soils with inherently poor physical properties.

1. Particulars of the project

<p>This crop : 5th ratoon</p> <p>Site : Mtunzini Field 013</p> <p>Region : North coast</p> <p>Soil System : Umzinto coast Lowlands</p> <p>Soil form/series : Longlands/ Westleigh</p> <p>Design : Randomised block</p> <p>Variety : N12</p> <p>Fertilizer/ Ameliorants : <u> N P K</u></p> <p>(kg/ha) 25.10.91 82 16 82 26.12.91 82 16 82</p>	<p>Soil analysis Date : 20.08.92</p> <hr/> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;">pH</td> <td style="text-align: center;">OM%</td> <td style="text-align: center;">Clay%</td> <td style="text-align: center;">PDI</td> </tr> <tr> <td style="text-align: center;">5,80</td> <td style="text-align: center;">-</td> <td style="text-align: center;">14</td> <td style="text-align: center;">-</td> </tr> </table> <p style="text-align: center;">ppm</p> <hr/> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;">P</td> <td style="text-align: center;">K</td> <td style="text-align: center;">Ca</td> <td style="text-align: center;">Mg</td> <td style="text-align: center;">Zn</td> <td style="text-align: center;">Al</td> </tr> <tr> <td style="text-align: center;">60</td> <td style="text-align: center;">88</td> <td style="text-align: center;">254</td> <td style="text-align: center;">84</td> <td style="text-align: center;">-</td> <td style="text-align: center;">-</td> </tr> </table> <p>Age : 12,5 months</p> <p>Dates : 05.08.91 - 20.08.92</p> <p>Rainfall : 770 mm L.T.M: 1329 mm</p> <p>Irrigation : Nil</p>	pH	OM%	Clay%	PDI	5,80	-	14	-	P	K	Ca	Mg	Zn	Al	60	88	254	84	-	-
pH	OM%	Clay%	PDI																		
5,80	-	14	-																		
P	K	Ca	Mg	Zn	Al																
60	88	254	84	-	-																

2. Objectives

- 2.1 To establish whether the practice of vertical mulching can improve production of sugarcane on soils which have poor physical properties.
- 2.2 To establish which materials (topsoil, sand or filtercake) are most suitable for use as a vertical mulch.

3. Treatments

- 3.1 Control - planting with minimum tillage
- 3.2 Vertical mulching with topsoil only fed down the profile
- 3.3 Vertical mulching with sand at 150 t/ha fed down the profile
- 3.4 Vertical mulching with filtercake at 100 t/ha fed down the profile.

4. **Results**

Table 1: Mean stalk heights and populations for all treatments from the plant crop to the fifth ratoon - VM Mtunzini

Treatments	Plant Crop April '86 to June '87		1st Ratoon June '87 to June '88		2nd Ratoon June '88 to July '89		3rd Ratoon July '89 to August '90		4th Ratoon Aug '90 to Aug '91		5th Ratoon Aug '91 to Aug '92	
	Mean Stalk Height (cm)	Mean No. of stalks (x10 ³ /ha)	Mean Stalk Height (cm)	Mean No. of stalks (x10 ³ /ha)	Mean Stalk Height (cm)	Mean No. of stalks (x10 ³ /ha)	Mean Stalk Height (cm)	Mean No. of stalks (x10 ³ /ha)	Mean Stalk Height (cm)	Mean No. of stalks (x10 ³ /ha)	Mean Stalk Height (cm)	Mean No. of stalks (x10 ³ /ha)
Control	176	116	190	116	186	123	171	121	176	121	99	116
VM + top- soil	185	125	193	112	186	120	176	129	175	120	106	113
VM + sand	189*	127*	194	113	187	120	184	132	178	129*	103	116
VM + filter cake	201*	120	210	118	204*	126	197*	131	201*	143*	111*	115
LSD (0,05)	11,6	10,4	-	7,4	12,5	10,2	15,4	18,5	13,1	7,8	11,6	16,0
Age -months	14,2		12,6		12,3		13,3		11,6		12,5	
Rainfall (mm)	1134		2559		1113		1477		1482		770	
LTM (mm)	1329											

Table 2: Table of crop yield from the plant crop to the fifth ratoon - Mtunzini

Treatments	Plant Crop		1st Ratoon		2nd Ratoon		3rd Ratoon		4th Ratoon		5th Ratoon		Yield Mean		Cumulative response	
	tc/ha /an	ts/ha /an	tc/ha /an	ts/ha /an	tc/ha /an	ts/ha /an	tc/ha /an	ts/ha /an	tc/ha /an	ts/ha /an	tc/ha /an	ts/ha /an	tc/ha /an	ts/ha /an	tc/ha /an	ts/ha /an
Control	57,4	6,3	44,6	5,7	55,9	7,7	51,0	8,0	51,6	6,0	17,1	2,3	46,4	6,1		
VM + topsoil	66,7*	7,2	46,4	6,1	49,2	6,9	52,4	8,2	54,7	6,7	21,7	2,8	48,7	6,4	13,5	1,9
VM + sand	69,3*	7,6*	46,1	5,7	56,9	7,5	58,1	9,3	57,3	7,1	18,8	2,5	51,2	6,7	28,9	3,7
VM + filtercake	77,1*	7,8*	48,4	6,2	62,9	8,2	64,4*	9,9	70,4	8,8*	24,5*	3,6*	57,0	7,4	64,1	8,5
Mean	66,1	1,2	46,4	5,9	56,3	7,6	56,5	8,9	58,6	7,1	20,5	2,8	50,8	6,7		
LSD (0,05)	6,7	1,2	10,1	1,4	11,1	1,3	10,5	1,9	14,0	1,7	6,6	0,9	-	-		
LSD (0,01)	10,1	1,8	15,4	2,2	17,0	1,9	15,9	2,9	21,6	2,5	10,0	1,4	-	-		

Table 3: Third leaf analysis from the plant crop to the fifth ratoon - VM Mtunzini

Sample date Age (months)		Plant		1st Ratoon			2nd Ratoon	3rd Ratoon	4th Ratoon	5th Ratoon	Mean
		06.01.87 9,3	05.03.87 11,2	07.12.87 6,1	14.01.88 7,4	15.03.88 9,4	15.02.89 7,7	20.12.89 5,5	19.03.91 6,1	15.03.92 7,5	
Treatments											
N%	Control	1,74	1,59	1,51	1,81	1,67	1,41	1,69	1,48	1,67	1,60
	Top soil	1,65	1,60	1,52	1,81	1,76	1,39	1,78	1,45	1,63	1,62
	Sand	1,66	1,55	1,55	1,82	1,76	1,42	1,89	1,40	1,69	1,64
	Filtercake	1,61	1,65	1,51	1,91	1,76	1,48	1,68	1,46	1,68	1,63
P%	Control	0,20	0,19	0,16	0,18	0,15	0,15	0,17	0,16	0,18	0,17
	Top soil	0,20	0,18	0,15	0,18	0,16	0,14	0,18	0,16	0,17	0,17
	Sand	0,20	0,18	0,15	0,20	0,16	0,15	0,19	0,16	0,19	0,17
	Filtercake	0,20	0,19	0,19	0,22	0,17	0,19	0,20	0,19	0,18	0,19
K%	Control	1,39	1,39	1,15	1,26	1,16	1,09	1,16	1,14	1,36	1,16
	Top soil	1,39	1,39	1,11	1,25	1,24	1,12	1,21	1,21	1,27	1,25
	Sand	1,32	1,39	1,15	1,40	1,25	1,13	1,27	1,24	1,35	1,28
	Filtercake	1,27	1,35	1,15	1,43	1,23	1,12	1,16	1,26	1,33	1,26
Ca%	Control	0,21	0,14	0,13	0,22	0,17	0,23	0,22	0,21	0,15	0,19
	Top soil	0,20	0,24	0,13	0,22	0,19	0,22	0,22	0,18	0,16	0,19
	Sand	0,21	0,24	0,14	0,21	0,19	0,22	0,21	0,17	0,16	0,19
	Filtercake	0,27	0,31	0,17	0,28	0,21	0,29	0,29	0,23	0,20	0,25

Table 4: The mean gravimetric soil moisture content for each treatment determined from soil samples taken on 12.8.92 (VM trial - Mtunzini)

Depth (mm)	Treatment	Gravimetric Moisture (%)			
		Control	Topsoil	Sand	Filtercake
300		4,60	4,25	4,43	4,29
600		5,55	8,86	8,09	5,36
900		15,11	19,26	23,37	15,01

5. Cane growth

In fifth ratoon crop VM with FC treatment has produced the tallest stalks but the difference between treatments in terms of stalk population was negligible (Table 1). Comparing the fourth and fifth ratoons it was evident that the drought had caused a 10% reduction in stalk population and resulted in cane stalks that were on average 78 cm shorter. The fifth ratoon received 712 mm less rain than the fourth ratoon crop.

6. Cane yield

The seriousness of the 1992 drought was reflected in the fifth ratoon yield results which only averaged 20,5 tc/ha/an or 2,8 ts/ha/an (Table 2). However, the benefits of using filtercake as an ameliorant with vertical mulching were apparent despite the drought, there being 43% and 56% yield response over the control treatment in terms of tc/ha/an and ts/ha/an respectively.

7. Leaf analysis

After the fourth ratoon was harvested 800 kg/ha of 5:1:5 (45) was applied to remove any possible confounding effects of P from filtercake in the VM with FC treatment (see folio on the fourth ratoon). Third leaf analysis for the fifth ratoon (see Table 3) indicated that the differences in P content between treatments were negligible. However, the benefits of the extra Ca in filtercake in the VM with FC treatment were still evident.

8. Soil moisture content

Soil samples taken on 12.8.92 to determine gravimetric moisture content indicated that to a depth of 300 mm there were no differences between treatments, but differences existed between treatments below this depth (see Table 4). Surprisingly the control treatment and the VM with FC treatment had the driest profiles, indicating that they contained more roots to a depth of 900 mm than the VM with topsoil and sand treatments.

9. Discussion

The VM with FC treatment showed that even under severe drought conditions sugarcane planted with this treatment can produce significantly higher yields when compared with those obtained from conventional tillage practices.

The high fertilizer application rate removed any major nutrient deficiencies that might have existed so that any additional benefits of VM with FC can now be attributed to an improvement in soil physical properties. Various physical parameters are therefore currently being evaluated.

10. Future work

The trial is continued to test whether the P from filtercake has a confounding effect on yield in a year with normal rainfall.

**SOUTH AFRICAN SUGAR INDUSTRY
AGRONOMISTS ASSOCIATION**

Cat no : 1785
Code no: VM 86/1
Project: 3283

Title: To test the principle of vertical mulching in soils with inherently poor physical properties.

1. Particulars of project:

This crop	6th ratoon	Soil analysis : 12/08/93
Site	Mtunzini	pH OM% Clay PDI
Region	North Coast	5.7 - 14 -
Soil system	Umzinto Lowlands	ppm
Soil form	Longlands/Westleigh	P K Ca Mg Al
Design	Randomised block	40 113 182 68 -
Varieties	N12	-----
Fertilizer	N P K	Dates :20/08/92-12/08/93
3/11/92	164 33 164	Age :11.8
Rainfall (mm)	874	LTM (mm):1319

2. Objectives

- 2.1 To establish whether the practice of vertical mulching can improve production of sugarcane on soils which have poor physical properties.
- 2.2 To establish which materials (topsoil, sand or filtercake) are most suitable for use as a vertical mulch.

3. Treatments

- 3.1 Control - planting with minimum tillage
- 3.2 Vertical mulching with topsoil only fed down the profile
- 3.3 Vertical mulching with sand at 150 t/ha fed down the profile
- 3.4 Vertical mulching with filtercake at 100 t/ha fed down the profile.

4. Results

Table 1 : Mean stalk heights and populations for all treatments from the second to the sixth ratoon - VM Mtunzini

Treatments	2nd Ratoon June '88 to July '89		3rd Ratoon July '89 to August '90		4th Ratoon Aug '90 to Aug '91		5th Ratoon Aug '91 to Aug '92		6th Ratoon Aug '92 to Aug '93	
	Mean Stalk Height (cm)	Mean No. of stalks (x10 ³ /ha)	Mean Stalk Height (cm)	Mean No. of stalks (x10 ³ /ha)	Mean Stalk Height (cm)	Mean No. of stalks (x10 ³ /ha)	Mean Stalk Height (cm)	Mean No. of stalks (x10 ³ /ha)	Mean Stalk Height (cm)	Mean No. of stalks (x10 ³ /ha)
Control	186	123	171	121	176	121	99	116	139	127
VM + top- soil	186	120	176	129	175	120	106	113	139	132
VM + sand	187	120	184	132	178	129*	103	116	146	129
VM + filter cake	204*	126	197*	131	201*	143*	111*	115	146	128
LSD (0,05)	12,5	10,2	15,4	18,5	13,1	7,8	11,6	16,0	15,5	17,6
Age - months	12,3		13,3		11,6		12,5		11,8	
Rainfall mm	1113		1477		1482		770		874	
WUE ⁺	5.65		4.36		4.77		3.18		5.16	
LTM (mm)	1319									

⁺ Water use efficiency (tc/ha/an/100mm)

Table 2 : Table of crop yield from the plant crop to the sixth ratoon - Mtunzini

Treatments	Plant Crop		1st Ratoon		2nd Ratoon		3rd Ratoon		4th Ratoon		5th Ratoon		6th Ratoon		Yield Mean		Cumulative response	
	tc/ha /an	ts/ha /an	tc/ha /an	ts/ha /an	tc/ha /an	ts/ha /an	tc/ha /an	ts/ha /an	tc/ha /an	ts/ha /an	tc/ha /an	ts/ha /an	tc/ha /an	ts/ha /an	tc/ha /an	ts/ha /an	tc/ha /an	ts/ha /an
Control	57,4	6,3	44,6	5,7	55,9	7,7	51,0	8,0	51,6	6,0	17,1	2,3	35,0	5,3	44,7	6,0		
VM + topsoil	66,7*	7,2	46,4	6,1	49,2	6,9	52,4	8,2	54,7	6,7	21,7	2,8	40,0	6,2	47,3	6,4	18,5	2,8
VM + sand	69,3*	7,6*	46,1	5,7	56,9	7,5	58,1	9,3	57,3	7,1	18,8	2,5	39,7	5,9	49,5	6,6	33,6	4,3
VM + filtercake	77,1*	7,8*	48,4	6,2	62,9	8,2	64,4*	9,9	70,4	8,8*	24,5*	3,6*	45,1	6,9	55,3	7,3	74,2	10,1
Mean	66,1	1,2	46,4	5,9	56,3	7,6	56,5	8,9	58,6	7,1	20,5	2,8	40,0	6,1	49,2	6,6		
LSD (0,05)	6,7	1,2	10,1	1,4	11,1	1,3	10,5	1,9	14,0	1,7	6,6	0,9	11,5	1,9	-	-		
LSD (0,01)	10,1	1,8	15,4	2,2	17,0	1,9	15,9	2,9	21,6	2,5	10,0	1,4	17,4	2,9	-	-		

Table 3 : Third leaf analysis from the plant crop to the sixth ratoon - VM Mtunzini

Sample date Age (months)		Plant	1st Ratoon	2nd Ratoon	3rd Ratoon	4th Ratoon	5th Ratoon	6th Ratoon	Mean
		06.01.87 9,3	07.12.87 6,1	15.02.89 7,7	20.12.89 5,5	19.03.91 6,1	15.03.92 7,5	11.02.93 5,4	
Treatments									
N%	Control	1,74	1,51	1,41	1,69	1,48	1,67	1,64	1,62
	Top soil	1,65	1,52	1,39	1,78	1,45	1,63	1,61	1,62
	Sand	1,66	1,55	1,42	1,89	1,40	1,69	1,66	1,65
	Filtercake	1,61	1,51	1,48	1,68	1,46	1,68	1,67	1,65
P%	Control	0,20	0,16	0,15	0,17	0,16	0,18	0,17	0,17
	Top soil	0,20	0,15	0,14	0,18	0,16	0,17	0,17	0,17
	Sand	0,20	0,15	0,15	0,19	0,16	0,19	0,17	0,17
	Filtercake	0,20	0,19	0,19	0,20	0,19	0,18	0,19	0,19
K%	Control	1,39	1,15	1,09	1,16	1,14	1,36	1,17	1,17
	Top soil	1,39	1,11	1,12	1,21	1,21	1,27	1,13	1,19
	Sand	1,32	1,15	1,13	1,27	1,24	1,35	1,16	1,22
	Filtercake	1,27	1,15	1,12	1,16	1,26	1,33	1,16	1,21
Ca%	Control	0,21	0,13	0,23	0,22	0,21	0,15	0,16	0,18
	Top soil	0,20	0,13	0,22	0,22	0,18	0,16	0,16	0,18
	Sand	0,21	0,14	0,22	0,21	0,17	0,16	0,17	0,18
	Filtercake	0,27	0,17	0,29	0,29	0,23	0,20	0,21	0,23

Table 4 : Mean soil moisture retention data - VM trial, Mtunzini

DEPTH 0-50mm	10 kPa	33 kPa	1500 kPa	BULK DENSITY g/cm ³	AMCmm/m		CLAY %	SILT %
					10 to 1500kPa	33 to 1500kPa		
FILTERCAKE	20.74	16.57	11.28	1.468	140	78	8	9
	6.22	7.36	7.49	0.127	42	27	2	4
SAND	16.47	12.65	8.96	1.553	117	58	5	6
	3.02	3.33	2.59	0.049	31	13	1	2
CONTROL	18.16	14.15	9.41	1.473	128	69	7	6
	1.31	0.49	1.15	0.121	13	6	1	1
TOPSOIL	16.03	13.66	8.49	1.517	115	78	5	5
	3.56	4.51	3.29	0.172	21	31	1	1
DEPTH 50-100mm	10 kPa	33 kPa	1500 kPa	BULK DENSITY g/cm ³	AMCmm/m		CLAY %	SILT %
					10 to 1500kPa	33 to 1500kPa		
FILTERCAKE	16.99	12.80	7.26	1.649	158	90	9	7
	3.19	2.04	1.93	0.140	27	15	1	1
SAND	14.45	11.27	7.82	1.635	108	56	6	5
	0.91	2.01	1.63	0.068	10	24	1	1
CONTROL	17.15	13.79	10.58	1.613	106	52	8	7
	1.25	1.49	0.62	0.085	11	17	2	1
TOPSOIL	14.10	11.51	8.49	1.628	91	49	8	7
	1.44	2.48	1.75	0.041	17	24	2	1

Note : Standard deviations are shaded

5. Cane growth

The sixth ratoon received about 100mm more rain than the previous crop, but this total was still about 450mm below the long term mean. The shortage of rain was reflected in the stalk length with a mean height of 1430mm, which is about 400mm shorter when compared to heights from normal years (Table 1). The population values, however, compared favourable with the best from years with normal rainfall. No significant responses were recorded for the 6th ratoon.

6. Cane yield

Cane yield (tc/ha/an) obtained with the 6th ratoon was in general double that recorded for the previous crop (Table 2). A possible reason for this large increase with the relative small amount of about 100mm additional rain (compared to the previous crop) are to be found in the rainfall intensity and distribution (see Figure 1). The rainfall intensity (measured as mm/month) was initially high for the 5th ratoon with a low percentage canopy cover compared to the 6th ratoon which could have resulted in a higher run-off value, thus reducing the rainfall efficiency. Water use efficiency (WUE) was 3.18 tc/ha/an/100mm for the 5th ratoon compared to 5.16 tc/ha/an/100mm recorded for the 6th ratoon (see Table 1). Rainfall distribution for the 6th ratoon was also less variable than that of the 5th ratoon.

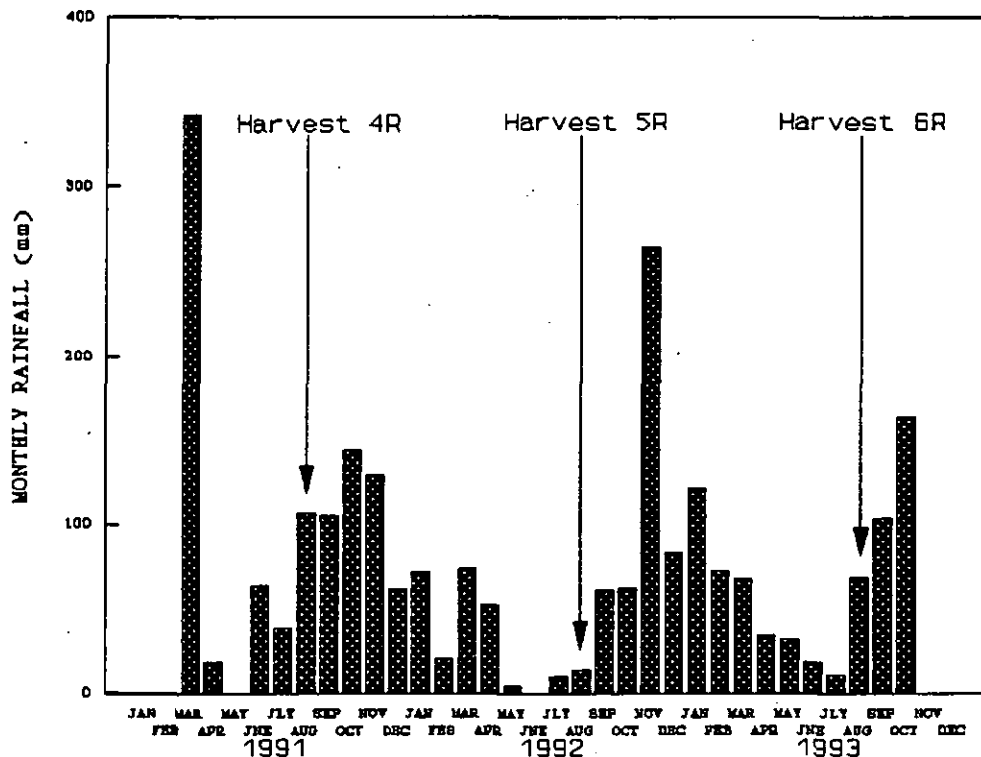


Figure 1: Monthly rainfall distribution for 5R and 6R.

7. Third leaf analysis

After harvesting the 5th ratoon, 800 kg/ha of 5:1:5(45) was applied to remove any possible confounding effects of P in the VM with filtercake treatment (see reports on 4R and 5R). Third leaf analysis for P indicated that there was still a small difference between treatments despite the relative high application of P to the whole trial (Table 3). Drought related stress could be the reason for the difference between treatments.

8. Soil moisture retention

Undisturbed soil samples were taken in the beginning of the 6th ratoon at depth intervals of 0-50 and 50-100mm for AMC determination in the laboratory. Soil moisture retention capacities were determined at 10, 33 and 1500kPa and AMC calculated between 10 & 1500 and 33 & 1500kPa (Table 4). Results indicated that the VM with filtercake treatment had the highest AMC for both depth intervals and that the bulk densities were about the same for all treatments and were generally lower at the surface than the layer directly below. Texture analysis showed that the VM with filtercake treatment contained the highest clay percentage although still below 10%. Soil organic matter was highest for the VM with filtercake treatment in the 0 - 50mm layer, but in the 50 - 100mm layer VM with topsoil showed the highest organic matter content (Table 5). It is possible that the undisturbed cores contained fresh roots which explains the lack of a clear trend in organic matter content between treatments.

Table 5: Organic matter and carbon percentages for two depth intervals - VM trial, Mtunzini.

Depth(mm)	0-50	50-100	0-50	50-100
Treatment	%OM	%OM	%C	%C
Filtercake	1.27	0.99	0.74	0.58
Sand	0.92	0.85	0.54	0.50
Control	0.99	0.93	0.58	0.54
Topsoil	0.89	1.41	0.52	0.82
Mean	1.02	1.05	0.60	0.61

9. Root growth

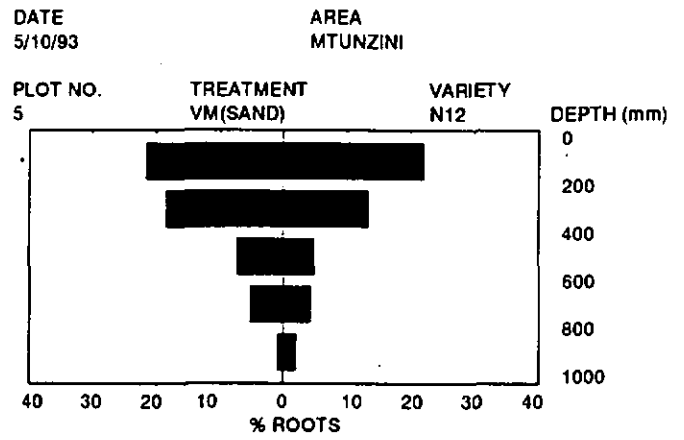
Rooting studies were conducted on plots 5 to 8 in the beginning of the 7th ratoon (Table 6). Results indicated that the VM with filtercake had the lowest number of roots counted which is in accordance with those found for the 5th ratoon. The amount of roots found in the 0 - 400mm soil layer was below 80% for the 6th ratoon and above 80% for the 5th ratoon, illustrating the effect of the drought to force roots to greater depths in the search for water.

10. Future work

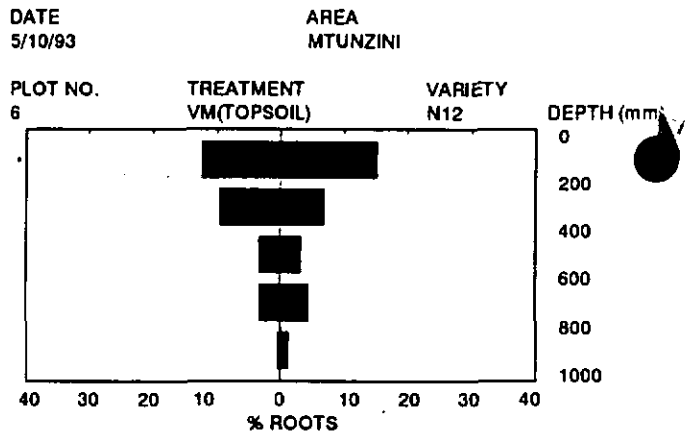
The trial is to continue to test the response in a year with near LTM rainfall.

Table 6: Root distribution and counts for vertical mulching trial – Mtunzini

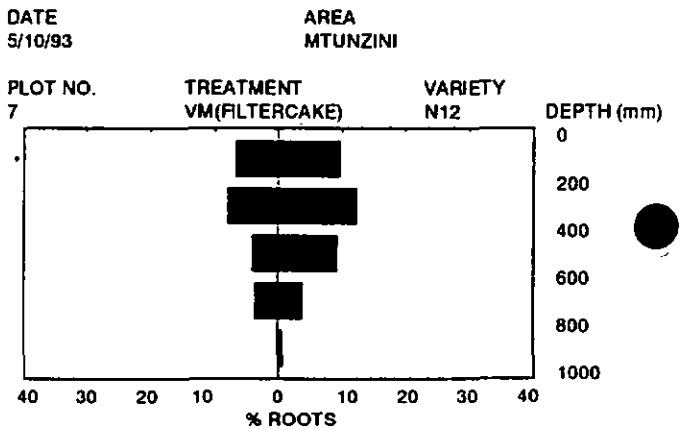
PLOT NO. 5		TREATMENT VM(SAND)					VARIETY N12	
DEPTH (mm)	GRID NO	1	2	3	4	5	TOTAL	%
0-200	A	23	70	101	62	34	290	44
200-400	B	30	58	68	35	20	211	32
400-600	C	15	18	31	10	7	81	12
600-800	D	7	20	16	9	11	63	9
800-1000	E	0	3	6	4	6	19	3
TOTAL							664	100



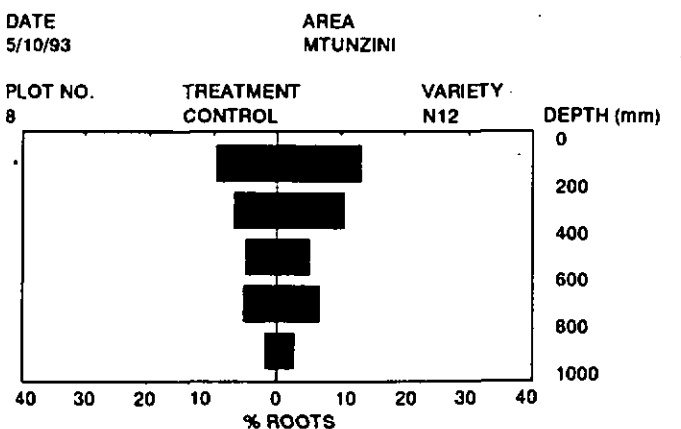
PLOT NO. 6		TREATMENT VM(TOPSOIL)					VARIETY N12	
DEPTH (mm)	GRID NO	1	2	3	4	5	TOTAL	%
0-200	A	12	33	74	37	26	182	46
200-400	B	17	34	24	22	11	108	27
400-600	C	3	15	6	10	9	43	11
600-800	D	7	9	10	12	13	51	13
800-1000	E	1	0	4	2	4	11	3
TOTAL							395	100



PLOT NO. 7		TREATMENT VM(FILTERCAKE)					VARIETY N12	
DEPTH (mm)	GRID NO	1	2	3	4	5	TOTAL	%
0-200	A	2	22	40	21	23	108	28
200-400	B	11	26	32	39	26	134	35
400-600	C	10	11	13	26	29	89	23
600-800	D	9	12	6	9	13	49	13
800-1000	E	0	0	0	1	3	4	1
TOTAL							384	100



PLOT NO. 8		TREATMENT CONTROL					VARIETY N12	
DEPTH (mm)	GRID NO	1	2	3	4	5	TOTAL	%
0-200	A	8	22	65	34	20	149	34
200-400	B	13	15	32	21	32	113	26
400-600	C	7	18	14	8	18	65	15
600-800	D	11	13	21	20	14	79	18
800-1000	E	4	6	5	7	8	30	7
TOTAL							436	100



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**SOUTH AFRICAN SUGAR INDUSTRY
AGRONOMISTS' ASSOCIATION**

Cat No : 1785
Code : VM 1/86
Project: 3283

Title: To test the principle of vertical mulching in soils with inherently poor physical properties.

1. Particulars of project:

This crop	7th ratoon	Soil analysis :	12/08/93		
Site	Mtunzini	pH	OM%	Clay	PDI
Region	North Coast	5.7	-	14%	-
Soil system	Umzinto Lowlands			ppm	
Soil form	Longlands/Westleigh	P	K	Ca	Mg
Design	Randomised block	40	113	182	68
Varieties	N12				
Fertilizer	N P K	Dates	:12/08/93-23/08/94		
3/11/92	164 33 164	Age	:12.4 months		
Rainfall (mm)	1067	LTM (mm)	:1319		

2. Objectives

- 2.1 To establish whether the practice of vertical mulching can improve production of sugarcane on soils which have poor physical properties.
- 2.2 To establish which materials (topsoil, sand or filtercake) are most suitable for use as a vertical mulch.

3. Treatments

- 3.1 Control - planting with minimum tillage
- 3.2 Vertical mulching with topsoil only fed down the profile
- 3.3 Vertical mulching with sand at 150 t/ha fed down the profile
- 3.4 Vertical mulching with filtercake at 100 t/ha fed down the profile.

4. Results

Table 1 : Mean stalk heights and populations for all treatments from the second to the seventh ratoon - VM Mtunzini.

Treatments	2nd Ratoon June '88 to July '89		3rd Ratoon July '89 to August '90		4th Ratoon Aug '90 to Aug '91		5th Ratoon Aug '91 to Aug '92		6th Ratoon Aug '92 to Aug '93		7th Ratoon Aug '93 to Aug '94	
	Mean Stalk Height (cm)	Mean No. of stalks (x10 ³ /ha)	Mean Stalk Height (cm)	Mean No. of stalks (x10 ³ /ha)	Mean Stalk Height (cm)	Mean No. of stalks (x10 ³ /ha)	Mean Stalk Height (cm)	Mean No. of stalks (x10 ³ /ha)	Mean Stalk Height (cm)	Mean No. of stalks (x10 ³ /ha)	Mean Stalk Height (cm)	Mean No. of stalks (x10 ³ /ha)
Control	186	123	171	121	176	121	99	116	139	127	130	120
VM + top- soil	186	120	176	129	175	120	106	113	139	132	138	116
VM + sand	187	120	184	132	178	129*	103	116	146	129	140	120
VM + filter cake	204*	126	197*	131	201*	143*	111*	115	146	128	139	129
LSD (0.05)	12.5	10.2	15.4	18.5	13.1	7.8	11.6	16.0	15.5	17.6	11.8	6.0
Age - months	12.3		13.3		11.6		12.5		11.8		12.4	
Rainfall mm	1113		1477		1482		770		874		1067	
WUE*	5.65		4.36		4.77		3.18		5.16		4.44	
LTM (mm)	1319											

* Water use efficiency (tc/ha/an/100mm)

Table 2 : Table of crop yield from the plant crop to the seventh ratoon - Mtunzini.

Treatments	Plant Crop		1st Ratoon		2nd Ratoon		3rd Ratoon		4th Ratoon		5th Ratoon		6th Ratoon		7th ratoon		Cumulative response	
	tc/ha /an	ts/ha /an	tc/ha /an	ts/ha /an	tc/ha /an	ts/ha /an	tc/ha /an	ts/ha /an	tc/ha /an	ts/ha /an	tc/ha /an	ts/ha /an	tc/ha /an	ts/ha /an	tc/ha /an	ts/ha /an	tc/ha /an	ts/ha /an
Control	57.4	6.3	44.6	5.7	55.9	7.7	51.0	8.0	51.6	6.0	17.1	2.3	35.0	5.3	44.6	5.5		
VM + topsoil	66.7*	7.2	46.4	6.1	49.2	6.9	52.4	8.2	54.7	6.7	21.7	2.8	40.0	6.2	45.7	6.3	19.6	3.6
VM + sand	69.3*	7.6*	46.1	5.7	56.9	7.5	58.1	9.3	57.3	7.1	18.8	2.5	39.7	5.9	47.4	6.3	36.4	5.1
VM + filtercake	77.1*	7.8*	48.4	6.2	62.9	8.2	64.4*	9.9*	70.4	8.8*	24.5*	3.6*	45.1	6.9	52.0	6.7	87.6	11.3
Mean	66.1	7.2	46.4	5.9	56.3	7.6	56.5	8.9	58.6	7.1	20.5	2.8	40.0	6.1	47.2	6.2		
LSD (0.05)	6.7	1.2	10.1	1.4	11.1	1.3	10.5	1.9	14.0	1.7	6.6	0.9	11.5	1.9	9.5	1.4		
LSD (0.01)	10.1	1.8	15.4	2.2	17.0	1.9	15.9	2.9	21.6	2.5	10.0	1.4	17.4	2.9	-	-		

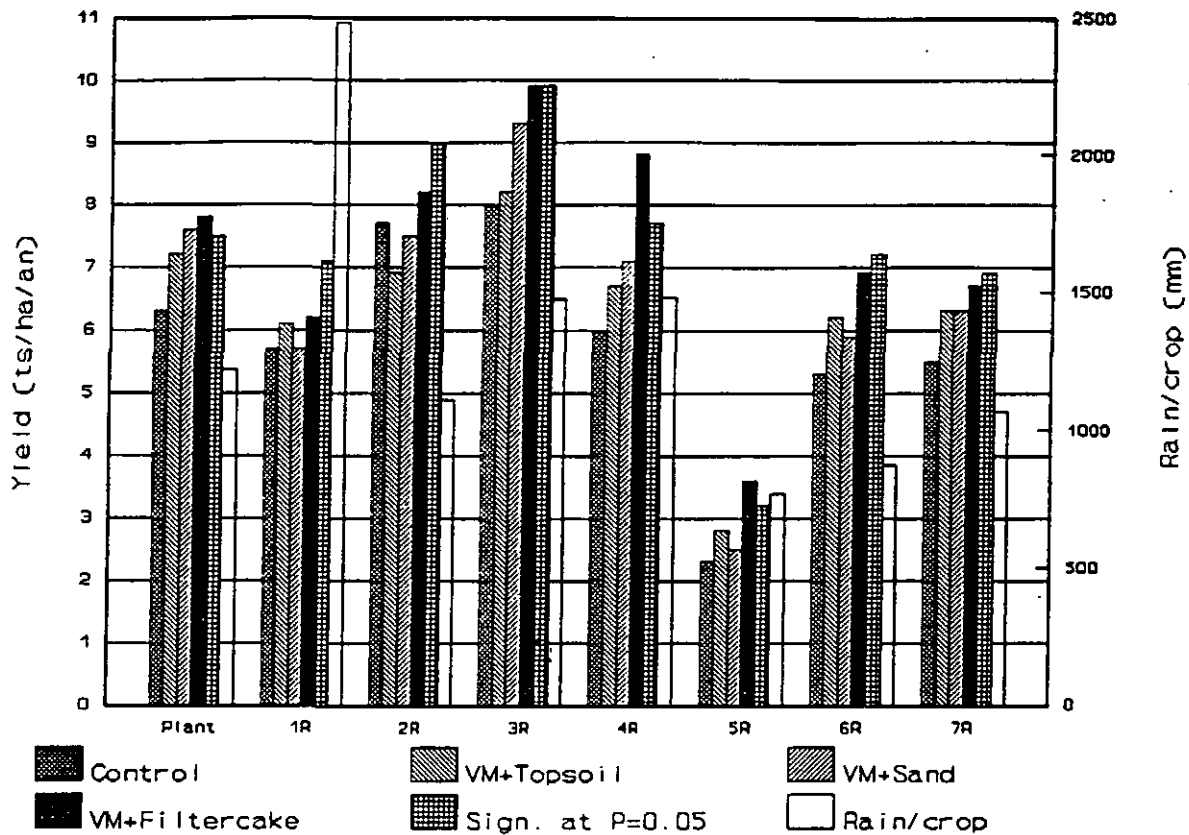
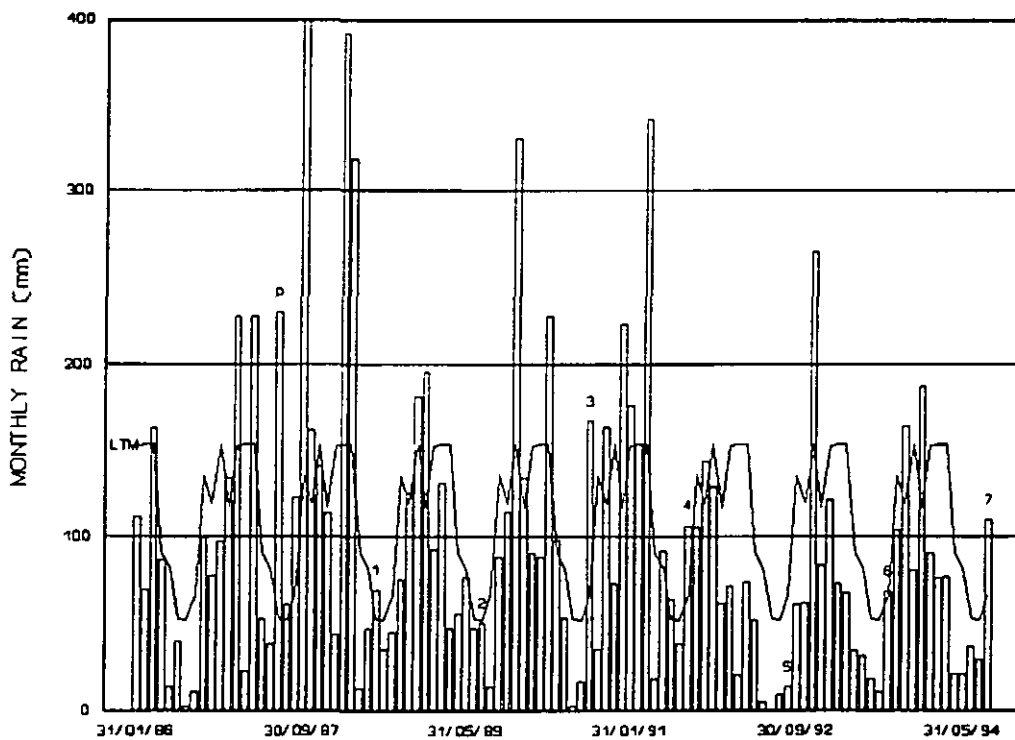


Fig. 1: Sucrose yield and rainfall per crop. Significant response over the control treatment is obtained where the treatment bar is taller than that of the $P = 0.05$ bar.



2: Monthly rainfall distribution per crop. LTM = Long term mean. P, 1 to 7 indicates the times that the plant and ratoon crops were harvested.

5. Cane growth

The seventh ratoon received about 200mm more rain than the previous crop, but this total was still about 250mm below the long term mean. This increased rainfall was not reflected in the growth analysis done at harvest as the population and stalk length were respectively 6 and 4 % lower than that of the previous ratoon (Table 1). However, dry matter % cane was 2 % lower and mass of the sample per stalk 14 % heavier for this crop compared with the previous ratoon due to the increased rainfall.

No significant ($P = 0.05$) treatment responses were measured for the parameters mentioned although the VM with filtercake treatment came close.

6. Cane yield

Mean cane yield increase from the 6th to the 7th ratoon was 7.2 tc/ha/an or 0.1 ts/ha/an. VM with filtercake was the only treatment to show a decrease in sucrose yield from the 6th to the 7th ratoon - it never the less produced the highest sucrose and cane yields of all treatments (see Table 2).

The higher rainfall recorded for the 7th ratoon compared to the 6th ratoon (Table 1 and Figure 1) is misleading as rainfall just after harvesting the 6th ratoon was probably too high and could have resulted in a high runoff value at a time when there was no canopy (Figure 2). For the rest of the growing period monthly rainfall distribution was more or less the same as that for the 6th ratoon. This, coupled with the yield decline phenomena, are possible reasons why the sucrose increase was so limited with an additional 200mm rain.

A question regularly asked is: how does the yield trend of the control treatment compare with that of the VM with filtercake treatment? Figure 1 indicates that the absolute response distance between these treatments stays within reasonable limits and does not increase or decrease.

7. Soil moisture content

Relative soil moisture content was determined using gypsum blocks at depths of 300, 600 and 900mm. In general no large differences in soil water content existed between treatments (Figures 3 & 4). However, the smaller area under the VM with filtercake graph compared to the other treatments suggested that the profile was drier. If this is linked to the previously reported trend of a lower number of roots counted per profile for VM with filtercake, using the profile washing technique, then these roots must be more effective in the uptake of water compared to the other treatments. The P enriched profile for the VM with filtercake treatment (see report on the 6th ratoon) could explain why the roots from this treatment are more effective in taking up water.

8. Future work

This trial will continue for one more crop to provide a possible answer on the question of yield decline effect between treatments in a year with rainfall near LTM.

Fig.

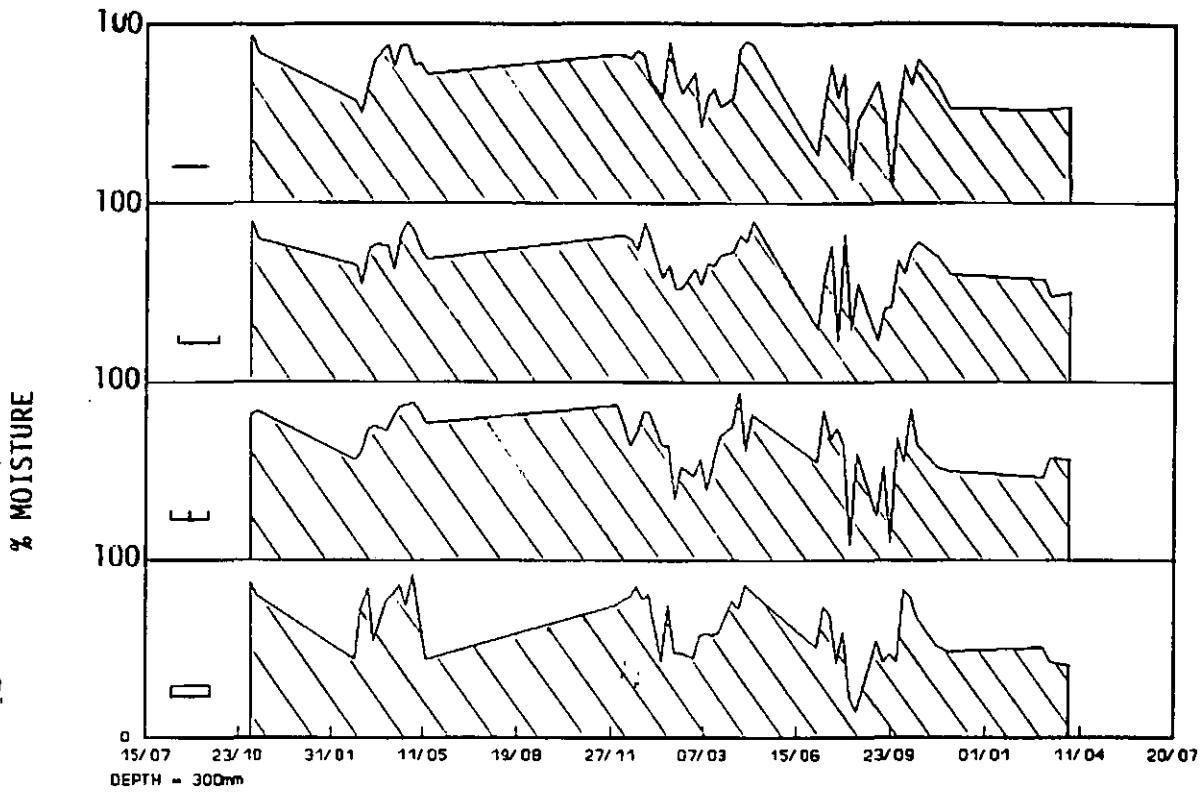


Fig. 3: Relative soil water content between treatments measured with gypsum blocks installed at 300mm depth.

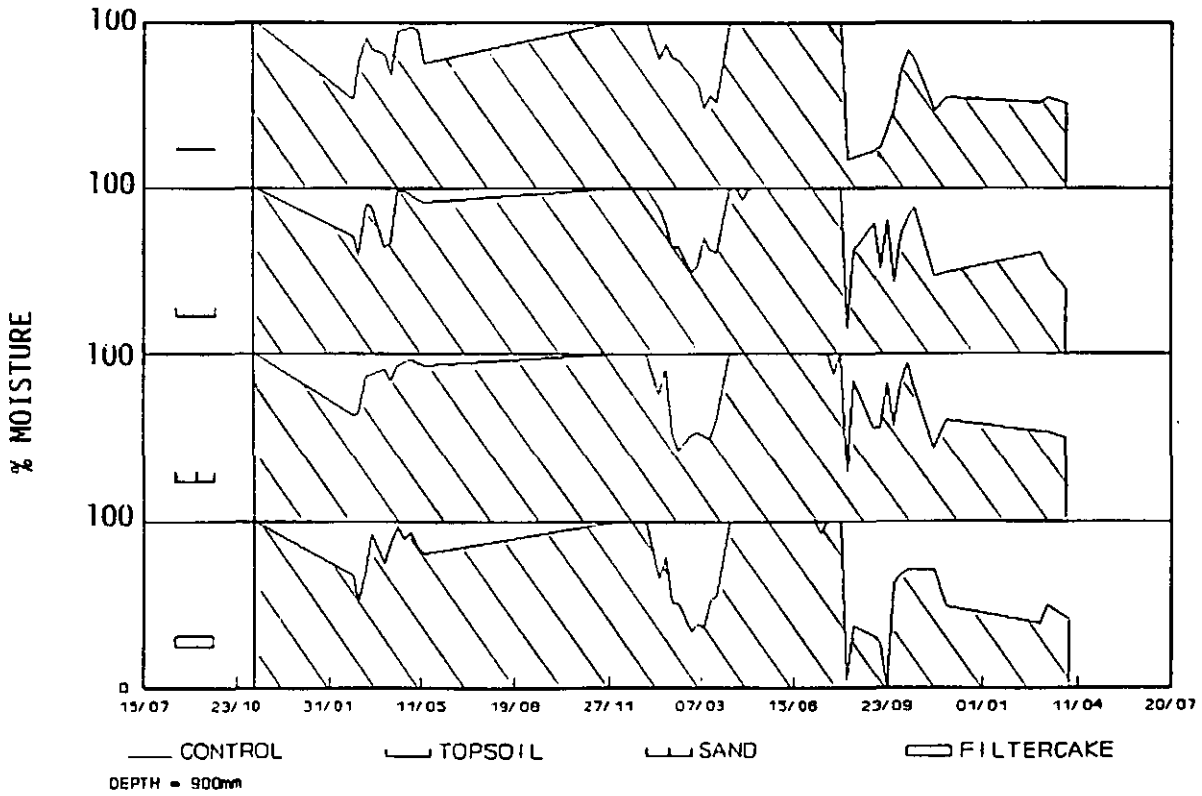


Fig. 4: Relative soil water content between treatments measured with gypsum blocks installed at 900mm depth.