SOUTH AFRICAN SUGAR INDUSTRY
AGRONOMISTS' ASSOCIATION

Code No: FT12L/85
Cat. No: 1554

Title: LIME APPLICATION IN MINIMUM TILLAGE SITUATION

Particulars of project

This crop : Plant
Site : Misty Ridge Farm
Entumeni
Region : Zululand
Soil system : Nottingham
Soil form/series: Kranskop/Kranskop
Design : Randomised blocks
x 5 replications
Variety : N12
Fertilizer/
Ameliorants :

	N	P	K	Zn
i.f. kg ha^{-1}	19	61	-	5
t/d kg ha^{-1}	50	-	-	-
* t/d kg ha^{-1}	±185	-	185	-
TOTAL	254	61	185	5

* Top-dressed by co-operator

Soil analysis Date: 20/10/84

pH	O.M.%	Clay%	Silt%	P.D.I.	T.Sand%	CEC
4,90	3,9	23	11	0,56	66	7,6

ppm

P	K	Ca	Mg	Zn	S	AL
15	102	216	43	0,6	37	140

Age: 18,8 months **Dates:** (26/3/85-21/10/86)
Rainfall: 1083mm 76% of L.T.M.: 1424mm
Irrigation: Nil

Objectives : To test the effectivness of :-

- Incorporating limestone with a rotary hoe in the minimum tillage situation.
- Applying lime with a tined implement to a depth of about 700 mm in addition to the lime incorporated with a rotary hoe.

Motivation

Where the minimum tillage system is advocated for the purpose of soil conservation, agricultural limestone (to eliminate toxic levels of AL) cannot be incorporated in the conventional way and therefore an alternative system of using a slip flange rotary hoe before and after planting requires testing. It is also an opportunity to test applications of lime to depth.

Treatments

1. Dolomitic limestone (DL) at 6 t ha^{-1} no incorporation except that which occurred at ridging and covering.

2. DL at 6 t ha^{-1} incorporated with rotary hoe to a depth of about 200 mm in the old cane interrow prior to planting and in the new cane interrow ater planting.

3. As for T_2 with an extra 4 t ha^{-1} applied to depth in the new sugarcane interrows using a Waletz deep lime applicator.

Notes on treatments

- Old ratoon was sprayed with roundup by the co-operator.
- Dolomitic limestone at 6 t ha^{-1} was applied broadcast by the co-operator.
- *Incorporation of lime in treatment 2 and 3 with a rotary hoe at 600 mm width and 200 mm deep.*
- Ridged with 3 tined ripper with wings attached forming a deep furrow at 0,9 m spacing.
- Trial planted with double whole stick and chopped in the furrow.
- Soon after closing the planting furrow 4 t ha^{-1} dolomitic limestone was applied to about 700 mm depth with a Waletz deep lime applicator into the previously undisturbed interrow of treatment 3 plots.
- Five and half weeks later interrows in treatments 2 and 3 were rotavated to a depth of about 150 mm. Some damage was caused to the closely spaced cane rows by this operation.

N.B.

New lines were drawn independently of old cane lines and therefore this technique did not simulate precisely the recommended minimum tillage system. Also the narrow row spacing of 0,9 m made the operation of interrow rotary hoeing difficult without causing some damage to the cane (4-5 leaf stage).

Rainfall (mm)

Table 1.

Months	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb
1985-86	4	10	4	12	11	14	35	300	89	102	154	81
LTM	18	68	48	24	22	38	69	108	130	149	150	144
1986	78	59	1	38	9	17	37	40	**TOTAL** :1083 mm			
LTM	113	68	48	24	22	38	69	73	**TOTAL** :1424 mm			

Results

Table 2. **Yield and crop characteristics at harvest**

Treatments		t ha^{-1} cane	Sucrose % cane	t ha^{-1} sucrose	Stalk Counts $X10^3 ha^{-1}$	Stalk length (cm)	Stalk mass (kg)
1 DL at 6 t ha^{-1}	No incorporation Rotary hoe	72	16,67	12,0	120	149	0,61
2 DL at 6 t ha^{-1}	Incorporation (200 mm) Waletz	58	16,71	9,6	107	144	0,54
3 As in T_2+4 t ha^{-1} DL	Incorporation (700 mm)	56	16,70	9,2	113	138	0,49
MEAN		62	16,69	10,3	113	143	0,54
CV %		12,1	1,3	11,5	7,1		
S.E. of treatment mean	±	3,04	0,92	0,48	3,28		
L.S.D.	(0,05)	10,54	0,32	1,67	11,36		
	(0,01)	16.02	0,48	2,54	17,27		

Table 3. **Third leaf % dm analysis at 10,4 and 11,3 months sampled on 21/1/86 and 4/3/86 respectively**

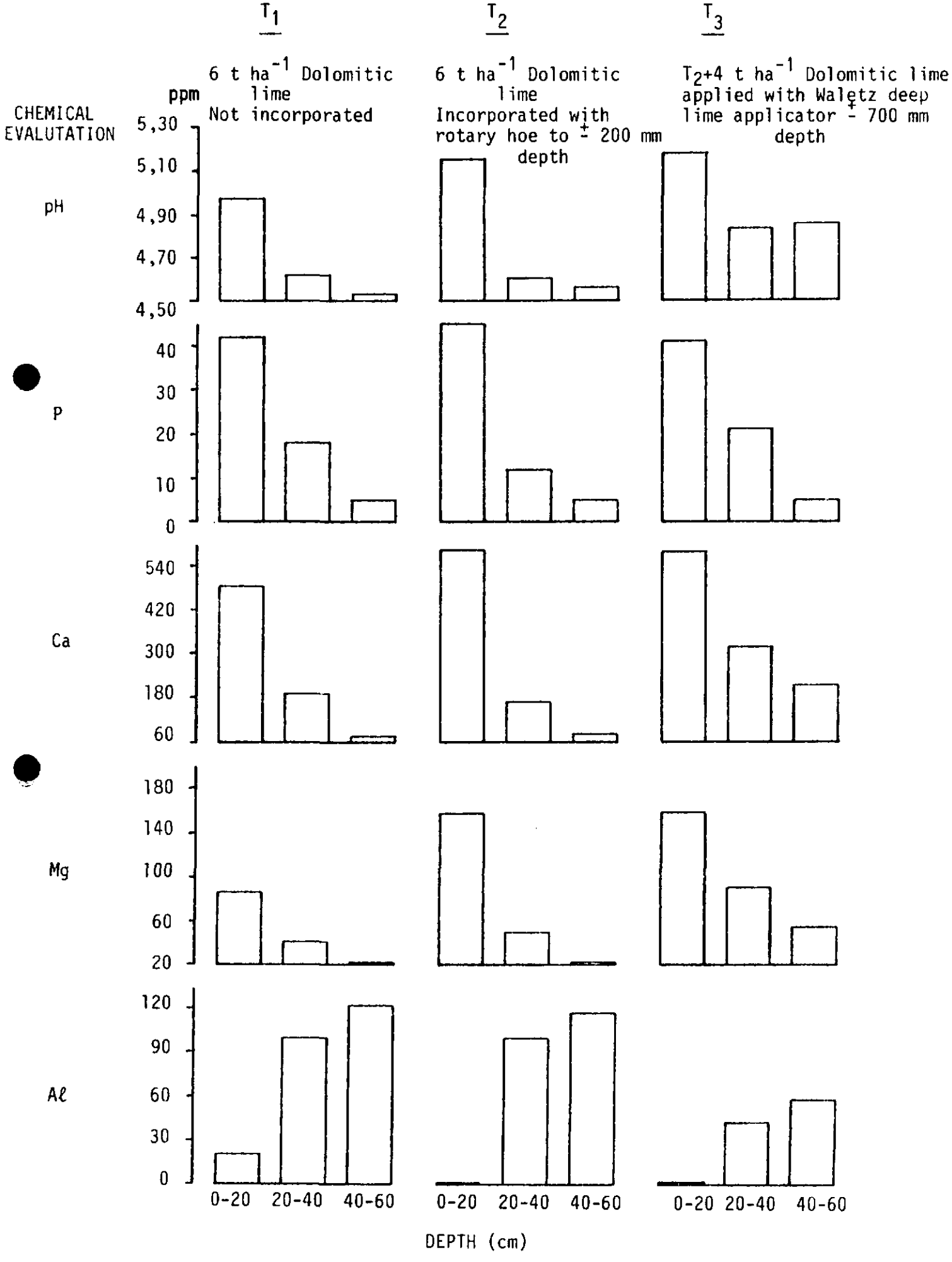
Treatments		N		P		K		Ca	
		10 m	11 m	10 m	11 m	10 m	11 m	10 m	11 m
1 DL at 6 t ha^{-1}	No incorporation Rotary hoe	1,83	1,65	0,17	0,18	1,04	1,10	0,24	0,25
2 DL at 6 t ha^{-1}	Incorporation (200 mm) Waletz	1,82	1,68	0,18	0,18	1,04	1,10	0,24	0,24
3 As in T_2+4 t ha^{-1} DL	Incorporation (700 mm)	1,82	1,65	0,19	0,18	1,06	1,11	0,25	0,24

Changes in soil status from start of trial (no lime 20/10/84 to sampling on 4/3/86 to end of plant crop 21/10/86

Treatments			pH			ppm								
						K			Ca			Al		
			20 Oct 1984	4 Mar 1986	21 Oct 1986	20 Oct 1984	4 Mar 1986	21 Oct 1986	20 Oct 1984	4 Mar 1986	21 Oct 1986	20 Oct 1984	4 Mar 1986	21 Oct 1986
1	DL 6 t	No incorporation Rotary hoe		4,97	5,15		149	187		485	635		19	12
2	DL 6 t	Incorporation (200 mm) Waletz	4,90	5,15	5,24	102	167	197	216	585	582	140	4	10
3	As in T_2+4 t DL	Incorporation (700 mm)		5,17	5,25		178	174		583	560		5	14

Figure 1. **FT12/L/85/P ENTUMENI** **SOIL FORM/SERIES** Kranskop/Magwa 26% Clay

LIME APPLIED : 26/03/85 **DATE SAMPLED** : 04/03/86



Comments

Rainfall

Rainfall distribution was poor with stress occurring in the first six months of growth when the trial received only 36% of the long term mean.

Yield

Cane yields were severly depresed by treatments in which lime was incorporated into the new interrows. The reason is suspected of being largely due to physical damage to cane stools during this operation as the growth in treatment 1 plots was relatively good.

There were no noticeable effects on cane quality and sucrose yields therefore reflected cane yield trends.

Crop measurements

Differences in stalk length and population were apparent from an early stage with both being depresed by treatments 2 and 3 in which lime was incorporated on the new cane interrows.

3rd leaf nutrients

There were no meaningful differences between treatments but levels were marginal for P and K at 10 months.

Soil Nutrients

Aluminium values were decreased from toxic to non-toxic levels in the topsoil (0-200 mm) of all treatments. At depth (see figure 1) the levels of P, Ca, and Mg were increased by deep soil disturbance while the A levels were decreased.

Conclusion

Under the conditions of this experiment (change in row alignment and narrow row spacing resulting in physical damage from interrow lime incorporation) there was no benefit to deep lime placement or to interrow lime incorporation in spite of a decrease in aluminium levels at depth.

Future

This trial has been continued into the first ratoon.

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Title: LIME APPLICATION IN MINIMUM TILLAGE SITUATION

Particulars of project

This crop	: 1st ratoon
Site	: Misty Ridge Farm Entumeni
Region	: Zululand
Soil system	: Nottingham
Soil form/series	: Kranskop/Kranskop
Design	: Randomised blocks x 5 replications
Variety	: N12

Fertilizer/ Ameliorants :	N	P	K
t/d kg ha^{-1}	80	20	175

Soil analysis **Date:** 21/10/86

pH	O.M.%	Clay %	P.D.I.
5,21	5,63	28	0,42

ppm

P	K	Ca	Mg	Zn	Al
49	186	592	125	1,2	12

Age: 18,9 months **Dates:** (21/10/86-19/5/88)
Rainfall: 2794mm 139% of L.T.M.: 2009 mm
Irrigation: Nil

Objectives : To test the effectiveness of:-

- Incorporating limestone with rotary hoe in the minimum tillage situation.
- Applying lime with a tined implement to a depth of about 700 mm in addition to the lime incorporated with rotary hoe.

Motivation

Where the minimum tillage system is advocated for the purpose of soil conservation, agricultural limestone (to eliminate toxic levels of Aℓ) cannot be incorporated in the conventional way and therefore an alternative system of using a slip flange rotary hoe before and after planting requires testing. It is also an opportunity to test applications of lime to depth.

Treatments

1. Dolomitic limestone (DL) at 6 t ha^{-1} no incorporation except that which occurred at ridging and covering.
2. DL and 6 t ha^{-1} incorporated with rotary hoe to a depth of about 200 mm in the old cane interrow after planting.

3. As in treatment 2 + 4 t ha^{-1} DL applied to a depth of about 700 mm in the new sugarcane interrows with Waletz deep lime applicator.

Rainfall (mm)

Table 1.

Months	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept
1986-87	78	113	217	195	55	163	31	49	84	20	99	666
LTM	41	127	139	193	159	121	55	48	19	24	46	86
1987-88	110	113	180	66	367	145	24	19	**TOTAL** : 2794 mm			
LTM	127	127	139	193	159	121	55	30	**TOTAL** : 2009 mm			

Results

Table 2. **Yield and other crop characteristics at Harvest**

Treatments		t ha^{-1} cane	sucrose % cane	t ha^{-1} sucrose	Stalk * counts $X10^3$ ha^{-1}	Stalk * length (cm)	Stalk mass (kg)
T_1 DL 6 t ha^{-1}	No incorporation	114	13,00	14,9	148	185	0,85
T_2 DL 6 t ha^{-1}	rotary hoe incorporation 200 mm	109	13,14	14,2	142	187	0,86
T_3 As in T_2+4 t DL	Deep Incorporation 700 mm	117	12,63	14,7	150	185	0,86
MEAN		113	12.92	14,6	146	186	0,86
CV%		5.6	2,6	5,3	* Measurement on 22/1/88 at 15 months		
S.E. of treatment mean	±	2.59	0,14	0,32			
L.S.D. (0,05)		8,96	0,48	1,09			
(0,01)		13,62	0,73	1,66			

Table 3. **Third leaf dm % analysis at 4, 6 and 15 months of age**

Treatments	4,1m 23/2/87			6,1m 23/4/87			15,1m 22/1/88		
	N	K	Ca	N	K	Ca	N	K	Ca
T_1 DL at 6 t ha^{-1} No incorporation	2.13	1,34	0,23	1,82	1,18	0,27	1,66	1,15	0,19
T_2 DL at 6 t ha^{-1} Incorporation (200 mm)	2,13	1,33	0,25	1,84	1,18	0,28	1,62	1,14	0,18
T_3 As in T_2+4 t ha^{-1} DL Deep incorp. (700mm)	2,12	1,31	0,24	1,80	1,15	0,27	1,62	1,14	0,20

Table 4. **Changes in soil status from start of trial (no lime) 20/10/84 to samplings on 4/3/86, 21/10/86 to end of 1st ratoon 19/5/88**

Treatments		Pre plant 21/10/84	After lime 4/3/86	End Plant 21/10/86	End 1R 19/5/88
			pH		
T_1 DL at 6 t ha^{-1}	No incorporation	↑	4,97	5,15	5,53
T_2 DL at 6 t ha^{-1}	Incorporation rotary hoe 200 mm	4,90	5,15	5,24	5,85
T_3 As in T_2+4 t ha^{-1} DL	Deep incorporation Waletz 700 mm	↓	5,17	5,25	5,69
			Kppm		
T_1 DL at 6 t ha^{-1}	No incorporation	↑	149	187	159
T_2 DL at 6 t ha^{-1}	Incorporation rotary hoe 200 mm	102	167	197	205
T_3 As in T_2+4 t ha^{-1} DL	Deep incorporation Waletz 700 mm	↓	178	174	189
			Ca ppm		
T_1 DL at 6 t ha^{-1}	No incorporation	↑	485	635	771
T_2 DL at 6 t ha^{-1}	Incorporation rotary hoe 200 mm	216	585	582	866
T_3 As in T_2+4 t ha^{-1} DL	Deep incorporation Waletz 700 mm	↓	583	560	763
			Al ppm		
T_1 DL at 6 t ha^{-1}	No incorporation	↑	19	12	2
T_2 DL at 6 t ha^{-1}	Incorporation rotary hoe 200 mm	140	4	10	3
T_3 As in T_2+4 t ha^{-1} DL	Deep incorporation Waletz 700 mm	↓	5	14	2

Comment

Rainfall

Rainfall was 139% of the long term mean due to the heavy falls in September 1987 and February 1988. Apart from this distribution of rainfall was fair.

Yield

Although cane and sucrose yields of plots which experienced incorporation were not better than where lime was not incorporated with a rotary hoe, the yields were not depressed as they had been in the plant crop.

Crop measurements

There were no indications of treatment differences in stalk length or population at any time in this first ratoon crop.

3rd leaf nutrients

There were no meaningful differences in leaf nutrients and all values were above threshold in this crop at 6 months of age.

Soil nutrients

pH increased after lime incorporation and this trend continued into the end of the first ratoon crop.

Results were similar for calcium for all three treatments.

Aluminium levels were concernly lower in each succeeding crop.

Conclusion

These results indicate that the physical damage was the likely cause of reduction in yield in the plant crop, but no benefit is apparent to incorporation of lime in this first ratoon.

Future

The trial has been continued for a further crop.

PETT/1b
14 September 1988