

SOUTH AFRICAN SUGAR INDUSTRY

AGRONOMISTS' ASSOCIATION

EXPERIMENT RESULT

CAT.NO.: 1825

CODE: K7/90/Sw UBO 'R'

TITLE: LEVELS OF POTASSIUM APPLICATION FOR EARLY SEASON CANE ON A 'R' SET SOIL

1. PARTICULARS OF PROJECT

This crop	: 12th ratoon	Soil Analysis:	06/07/1990				
Site	: Ubombo Ranches Cascade 1	pH	OM%	Clay%	Silt%	Sand%	
		7.00	3.4	53.1	11.2	35.7	
Region	: Northern Irrigated (Swaziland)	ppm					
		P	Ko	Ca	Mg	(Ca+Mg)/K	
		90	262	5675	1346	27	
Design	: Randomized blocks with split plots, 6 replications	CEC	: 44.0 meq/100g soil				
		KDI	: 0.52				
Soil Set/Series:	'R' Rathbone	Date	: 10/06/90-24/05/91				
		Age	: 11.5 months				
Variety	: NCo376	Rainfall	: 461 mm				
Fertilizer	: N P K	Irrigation:	1350 mm				
Total (kg/ha)	160 0 Treatment	Total	: 1811 mm				

2. OBJECTIVES

- 2.1 To test the new FAS - K threshold for winter cut cane grown on heavy clay soil under irrigated conditions.
- 2.2 To determine the effect of low leaf-K content in Sept - Oct on cane yield and confirm the validity of downgrading leaf-K threshold for winter harvested cane.
- 2.3 To compare the efficiency of granular potassium fertiliser to that of a foliar solution to overcome low leaf-K content of Sept - Oct sampled leaves.

3. TREATMENTS

3.1 Whole plots (granular application)

K <sub>0</sub>	K <sub>1</sub>	K <sub>2</sub>
0	175	350 kg K ha <sup>-1</sup>

Potassium as KCl (50 % K) was surface broadcast on 6/7/1990, 3.5 weeks after harvest.

### 3.2 Subplots (foliar application)

F <sub>0</sub>	0 kg K ha <sup>-1</sup>	
F <sub>1</sub>	10 kg K ha <sup>-1</sup>	on 28/08/1990
	15 kg K ha <sup>-1</sup>	on 26/09/1990
	20 kg K ha <sup>-1</sup>	on 27/11/1990
Total	45 kg K ha <sup>-1</sup>	

Foliar solutions were 10 % with respect to KCl (54 % K commercial grade) and 0.7 % Reverseal 10 (wetting agent).

### 3.3 Notes on Treatments

Nitrogen as Urea (46 % N) at the rate of 80 kg N ha<sup>-1</sup> was applied on the cane row on 12/7/1990 and 12/10/1990, 4 weeks and 4.5 months after harvest respectively.

Foliar solutions of potassium were applied using a hand held spraying boom operating at 2.5 - 3 bars and fitted with twin jets TJ 60 - 8004 or TJ 60 - 6004 ('Teejet') depending on cane height.

### 3.4 Notes on soil sampling

Topsoil: 40 cores were taken in each plot at a ratio of 16 on row to 24 interrow (ie. 1:1.5).

Subsoil: 20 cores were taken from 6 selected plots in the control at a rate of 8 on row to 12 interrow (1:1.5).

## 4. RESULTS

### 4.1 Soil Analysis

Table 1: Properties of the soil profile - July 1990

Depth (cm)	pH	Clay %	OM %	CEC meq/100g soil	TCEC meq/100g clay	KDI
0-15	6.93 (0.03)	53.1 (0.58)	3.4 (0.17)	44.0 (2.66)	82.8	0.52 (0.011)
20-30	7.27 (0.17)	53.9 (0.17)	3.6 (0.52)	45.2 (3.58)	83.8	0.54 (0.012)
40-50	7.60 (0.20)	40.7 (3.40)	2.3 (0.03)	44.4 (3.53)	109.1	0.52 (0.027)

( ) Standard error

Note: Samples taken before fertilization from 3 control plots

Table 2: K, Ca, Mg status of the soil profile - July 1990

Depth (cm)	K	Ca	Mg	(Ca+Mg)/K
	ppm			
0-15	262 (9)	5675 (364)	1346 (48)	27
20-30	180 (3)	6801 (671)	993 (114)	43
40-50	121 (6)	6925 (720)	773 (144)	64

( ) Standard error

Note: Samples taken before fertilization from 6 control plots

Table 3: K, Ca, Mg status of the topsoil - November 1990

Treatment	K	Ca	Mg	(Ca+Mg)/K
	ppm			
Control	290	5388	1190	23
175 kg K ha <sup>-1</sup>	361	5603	1050	19
350 kg K ha <sup>-1</sup>	432	5130	1205	15
LSD (0.05)	60	1017	161	
(0.01)	85	1447	229	
Significance	**	NS	NS	
Mean	361	5374	1149	
SE one plot	46	790	125	
CV %	12.8	14.7	10.9	

#### 4.2 Harvest Data

No harvest data is available as the trial was harvested in error by the Estate.

#### 4.3 Leaf Analysis

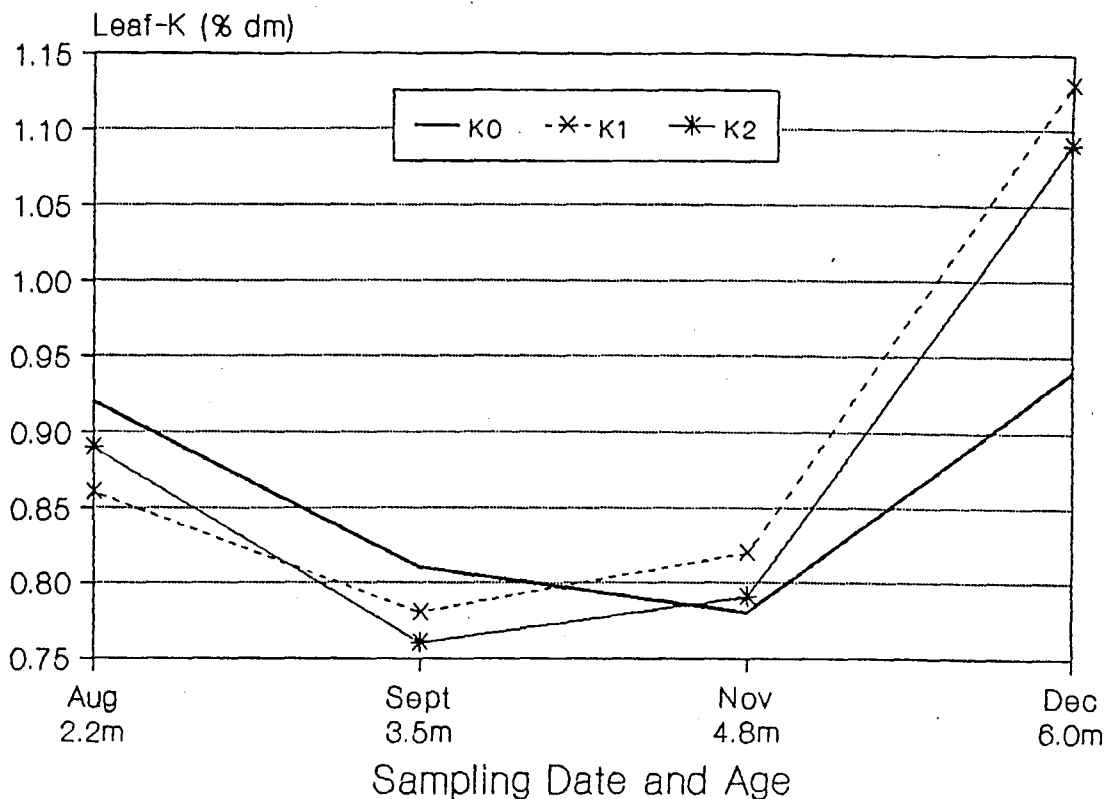
Table 4: Third Leaf Analysis (% dm) at 4.5 months in November

Treatment	N	P	K	Ca	Mg
K <sub>0</sub> Control	2.07	0.23	0.78	0.47	0.27
K <sub>1</sub> 175 kg K ha <sup>-1</sup>	2.13	0.24	0.82	0.46	0.26
K <sub>2</sub> 350 kg K ha <sup>-1</sup>	2.08	0.24	0.79	0.46	0.27
LSD (0.05)	0.041	0.010	0.076	0.057	0.041
(0.01)	0.058	0.013	0.10	0.082	0.058
Significance	**	NS	NS	NS	NS
Mean	2.09	0.24	0.80	0.47	0.27
SE one plot	0.022	0.005	0.046	0.040	0.031
CV %	1.1	2.0	5.7	8.5	11.6

Table 5: Effect of Foliar K solution on 3<sup>rd</sup> leaf-K content (%dm)

Sampling Month Cane Age Spray to Sampling	September 3.5 m 3.5 weeks	November 4.75 m 4.5 weeks	December 6 m 2 weeks
F <sub>1</sub> Cumulated rate	10 kg K ha <sup>-1</sup>	25 kg K ha <sup>-1</sup>	45 kg K ha <sup>-1</sup>
F <sub>0</sub>	0.77	0.78	1.02
F <sub>1</sub>	0.79	0.81	1.09
LSD (0.05)	0.039	0.032	0.039
(0.01)	0.054	0.044	0.054
Significance	NS	*	**

Figure 1: The effect of season on Leaf-K content



## 5. COMMENTS

### 5.1 Soil Analysis

Soil-K status of the control was above the new FAS threshold for soils containing more than 40 % clay. However, the  $(Ca + Mg)/K$  ratio was high indicating that the availability of K might be limited by the high content of Ca and Mg.

Increasing K rates resulted in a significant increase in soil-K levels which reduced the  $(Ca + Mg)/K$  ratio.

Analysis of the soil profile showed that the soil-K status of the subsoil decreased to levels below the FAS threshold and that the  $(Ca + Mg)/K$  increased, indicating a decreasing availability of K reserves with depth.

The reduction in soil-K between the topsoil and subsoil was sharp implying that leaching was slow. Hence, surface application of K to this soil is likely to remain positionally unavailable to the bulk of the root system.

### 5.2 Leaf Analysis

Leaf analysis at 4.5 months of age showed nutrient content to be above threshold except for K. This is surprising in view of the high soil-K status of the control and questions the adequacy of the new FAS soil-K threshold for heavy clay soils. Leaf-K showed the depression pattern characteristic of winter cut cane (Fig. 1).

K treatments were reflected by leaf-K content only in December. This suggests that a considerable delay existed before the applied K was taken up by the cane and confirms that surface applied K remains positionally unavailable to the root system.

Leaf-K was higher where foliar solutions of KCl were applied. The differences were generally significant and increased as the cumulated rate of applied K increased. The improvement in K uptake, however, was small in relation to the amount of K applied.

## 6. CONCLUSION

- \* Harvest data were not available for this trial and only leaf-K analysis could be used as index of cane response.
- \* FAS recently upgraded the soil-K threshold to a value of 225 ppm for soils containing more than 40 % clay. It was apparent that this value was still too low for this heavy soil (55 % clay).
- \* Evidence from soil and leaf analysis appeared to question the effectiveness of surface application of K fertilizer as a means of replenishing the root zone with K.
- \* The use of foliar solution of KCl resulted only in small improvement in K uptake. Disappointing results were also achieved in the past with either  $\text{KNO}_3$  or Potaspray (Fol 1/81 and Fol 2/82) and it is concluded that there is no advantage in using foliar sprays as K does not seem to be effectively absorbed by the cane foliage.
- \* This trial has been continued and is now in its 13th ratoon.

PCH/fkd  
05.03.92

## Appendix 1

## Effect of Season on Leaf-K content (% dm)

Sampling Date	22/08/90	26/09/90			01/11/90			12/12/90		
Cane Age	2.25 m	3.5 m			4.75 m			6 m		
Treatment	Whole Plot	F <sub>0</sub>	F <sub>1</sub>	Whole Plot	F <sub>0</sub>	F <sub>1</sub>	Whole Plot	F <sub>0</sub>	F <sub>1</sub>	Whole Plot
K <sub>0</sub> Control	0.92	0.81	0.81	0.81	0.77	0.78	0.78	0.91	0.96	0.94
K <sub>1</sub> 175 kg K ha <sup>-1</sup>	0.86	0.75	0.81	0.78	0.81	0.83	0.82	1.10	1.16	1.13
K <sub>2</sub> 350 kg K ha <sup>-1</sup>	0.89	0.75	0.76	0.76	0.74	0.83	0.79	1.04	1.14	1.09
Mean	0.89	0.77	0.79	0.78	0.78	0.81	0.80	1.02	1.09	1.05
Interaction F* rate	-	NS			NS			NS		
LSD Whole plot (0.05)	0.081	0.069			0.070			0.10		
(0.01)	0.11	0.098			0.10			0.14		
Significance	-	NS			NS			**		
LSD Subplot (0.05)	-	0.039			0.032			0.039		
(0.01)	-	0.054			0.044			0.054		
Significance	-	NS			*			**		
SE one plot	0.062	0.054			0.046			0.055		
CV %	6.9	7.0			5.7			5.3		

## Effect of Season on Leaf-Ca content (% dm)

Treatment	Whole Plot	F <sub>0</sub>	F <sub>1</sub>	Whole Plot	F <sub>0</sub>	F <sub>1</sub>	Whole Plot	F <sub>0</sub>	F <sub>1</sub>	Whole Plot
K <sub>0</sub> Control	0.49	0.49	0.44	0.47	0.49	0.44	0.47	0.37	0.37	0.37
K <sub>1</sub> 175 kg K ha <sup>-1</sup>	0.49	0.43	0.40	0.41	0.43	0.49	0.46	0.35	0.36	0.35
K <sub>2</sub> 350 kg K ha <sup>-1</sup>	0.49	0.47	0.47	0.47	0.45	0.46	0.46	0.36	0.35	0.36
Mean	0.49	0.46	0.44	0.45	0.46	0.46	0.46	0.36	0.36	0.36

## Effect of Season on Leaf-Mg content (% dm)

Treatment	Whole Plot	F <sub>0</sub>	F <sub>1</sub>	Whole Plot	F <sub>0</sub>	F <sub>1</sub>	Whole Plot	F <sub>0</sub>	F <sub>1</sub>	Whole Plot
K <sub>0</sub> Control	0.25	0.27	0.25	0.26	0.28	0.27	0.27	0.19	0.21	0.20
K <sub>1</sub> 175 kg K ha <sup>-1</sup>	0.22	0.25	0.23	0.24	0.27	0.25	0.26	0.18	0.19	0.19
K <sub>2</sub> 350 kg K ha <sup>-1</sup>	0.25	0.28	0.27	0.28	0.27	0.26	0.27	0.20	0.19	0.19
Mean	0.24	0.27	0.25	0.26	0.27	0.26	0.27	0.19	0.20	0.19

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TITLE: LEVELS OF POTASSIUM APPLICATION FOR EARLY SEASON CANE ON A 'R' SET SOIL

1. PARTICULARS OF PROJECT

<p>This crop : 13th ratoon</p> <p>Site : Ubombo Ranches Cascade 1</p> <p>Region : Northern Irrigated (Swaziland)</p> <p>Design : Randomized blocks 6 replications</p> <p>Soil set/series: 'R' Rathbone</p> <p>Variety : NCo376</p> <p>Fertilizer : N P K Total (kg/ha) 160 0 Treatment</p>	<p><u>Properties of topsoil - July 1990</u></p> <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;">CEC*</td> <td style="text-align: center;">KDI**</td> </tr> <tr> <td style="text-align: center;">6.93</td> <td style="text-align: center;">3.4(0.3)</td> <td style="text-align: center;">53.1(1.0)</td> <td style="text-align: center;">44.0(4.6)</td> <td style="text-align: center;">0.52(0.019)</td> </tr> <tr> <td colspan="2" style="text-align: center;">* mg/100g soil</td> <td colspan="3" style="text-align: center;">** for control plots</td> </tr> </table> <p><u>Soil nutrient status (topsoil) - January 1992</u></p> <table style="width: 100%; border-collapse: collapse;"> <tr> <th colspan="5" style="text-align: center; border-top: 1px solid black; border-bottom: 1px solid black;">ppm</th> </tr> <tr> <th style="text-align: center;">P</th> <th style="text-align: center;">K</th> <th style="text-align: center;">Ca</th> <th style="text-align: center;">Mg</th> <th style="text-align: center;">(Ca+Mg)/K</th> </tr> <tr> <td colspan="5" style="text-align: center;">62 Treatments</td> </tr> </table> <p>Date : 24/05/91 - 02/05/92 Age : 11.3 months</p> <p>Rainfall : 424 mm Irrigation: 1192 mm Total : 1616 mm</p>	pH	OM%	Clay	CEC*	KDI**	6.93	3.4(0.3)	53.1(1.0)	44.0(4.6)	0.52(0.019)	* mg/100g soil		** for control plots			ppm					P	K	Ca	Mg	(Ca+Mg)/K	62 Treatments				
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2. OBJECTIVES

- 2.1 To test the new FAS threshold for winter cut cane grown on heavy clay soil under irrigated conditions.
- 2.2 To determine the effect of low leaf K content in Sept - Oct on cane yield and confirm the validity of downgrading leaf K threshold for winter cut cane.

3. TREATMENTS

3.1 Fertilizer Application

Potassium as KCl (50% K) was broadcast and incorporated by interrow cultivation at 2,5 weeks after harvesting at the following rate:

K <sub>0</sub>	K <sub>1</sub>	K <sub>2</sub>
0	175	350 kg K/ha

Nitrogen as Urea (46% N) at the rate of 160kg N/ha was applied on the on the cane row. This was divided into two equal applications one at 2.5 weeks after harvesting and the other 3.8 months thereafter.

### 3.2 Notes on soil sampling

Topsoil: 40 cores were taken in each plot at a ratio of 16 on row to 24 interrow (ie. 1:1.5).

Subsoil: 20 cores were taken from 6 selected plots in the control at a rate of 8 on row to 12 interrow (1:1.5).

## 4. RESULTS

### 4.1 Soil Analysis

Table 1: K, Ca, Mg Status of the topsoil - January 1992

Treatment	ppm			Ca+Mg/K
	K	Ca	Mg	
Control	189	5567	1170	35.6
175 Kg K/ha	215	6263	1148	34.5
350 Kg K/ha	314	5325	1267	21.0
LSD (0.05)	97	913	204	
LSD (0.01)	138	1298	290	
Significance	*	NS	NS	
Mean	239	5718	1195	
CV%	31.6	12.4	13.3	
SE of Mean	31	290	65	
SE of Diff.	44	409	91	

### 4.2 Leaf Analysis

Table 2: Third Leaf Analysis (% dm) at 4.5 months in October

Treatment	N	P	K	Ca	Mg
Control	2.13	0.25	0.60	0.61	0.31
175 kg K/ha	2.09	0.23	0.65	0.59	0.27
350 kg K/ha	2.03	0.24	0.78	0.58	0.25
LSD (0.05)	0.12	0.02	0.11	0.08	0.06
(0.01)	0.17	0.03	0.15	0.12	0.08
Significance	NS	*	*	NS	NS
Mean	2.08	0.24	0.67	0.59	0.27
CV %	4.6	4.2	12.7	11.0	17.5
SE of Mean	0.04	0.005	0.03	0.03	0.02
SE of Diff.	0.05	0.007	0.05	0.04	0.03



Table 3: Effect of Season on Leaf-K, Ca and Mg (%dm)

Sampling Date	16-09-91			07-10-91			19-11-91			Ca + Mg/K		
Cane Age (months)	3.8m			4.5m			5.9m			3.8m	4.5m	5.9m
Treatment	K	Ca	Mg	K	Ca	Mg	K	Ca	Mg			
Control	0.71	0.56	0.35	0.60	0.61	0.31	0.86	0.43	0.28	1.29	1.56	0.83
175 Kg K/ha	0.81	0.55	0.30	0.65	0.59	0.27	1.03	0.42	0.23	1.07	1.34	0.63
350 Kg K/ha	0.84	0.50	0.35	0.78	0.58	0.25	1.15	0.39	0.23	1.02	1.07	0.55
LSD (0.05)	0.09	0.06	0.07	0.11	0.08	0.06	0.13	0.07	0.04	0.19	0.27	0.10
(0.01)	0.13	0.08	0.10	0.15	0.12	0.08	0.18	0.10	0.06	0.28	0.38	0.14
Significance	*	NS	NS	*	NS	NS	**	NS	*	*	**	**
Mean	0.79	0.54	0.33	0.67	0.59	0.27	1.01	0.41	0.25	1.13	1.33	0.67
CV%	9.3	9.0	17.3	12.7	11.0	17.5	9.8	12.9	11.7	13.3	15.7	11.5
SE of Mean	0.03	0.02	0.02	0.03	0.03	0.02	0.04	0.02	0.01	0.06	0.08	0.03
SE of Difference	0.04	0.03	0.03	0.05	0.04	0.03	0.06	0.03	0.02	0.09	0.12	0.04

4.3 Harvest DataTable 4: Cane Yield, Cane Quality and Sucrose Yield

Treatment	Tons Cane/ha	Sucrose % Cane	Tons Sucrose/ha
Control	85	15.61	13.2
175 kg K/ha	94	15.35	14.4
350 kg K/ha	94	15.13	14.3
LSD (0.05)	11	0.46	2.0
LSD (0.01)	16	0.66	2.9
Significance	NS	NS	NS
Mean	91	15.36	14.0
CV %	9.5	2.3	11.4
SE of mean	3.54	0.15	0.65
SE of Diff.	5.01	0.21	0.92

Table 5: Response to K Application rates

Treatment	Tons Cane/ha	Sucrose % Cane	Tons Sucrose/ha
175 Kg K/ha	9	-0.26	1.2
350 Kg K/ha	9	-0.40	1.1

## 5. COMMENTS

### 5.1 Soil Analysis

As applications of K were increased, higher levels of K were measured in the soil (Table 1). In the 175 kg K/ha treatment, a soil K level marginally lower than the threshold level of 225 ppm was measured. Levels measured in the 350 kg K/ha treatment, were well above this threshold.

### 5.2 Leaf Analysis

Leaf K levels declined from September to October, but rose again in November. Although levels measured in November were above the interim leaf K threshold level of 0.85 %dm, this was not the case in September and October (Table 3).

### 5.3 Harvest Data

Treatments receiving K produced higher cane and sucrose yields than treatments receiving no K, although responses were not statistically significant (Table 4 and 5). Higher soil and leaf K levels, associated with the higher K application of 350 kg/ha, did not increase yields, implying that no yield responses to different rates of K occurred.

## 6. CONCLUSION

- \* K application increased yields and the 175 kg K/ha application proved optimal.
- \* In the optimal treatment, soil K levels were marginally lower than the FAS threshold level of 225 ppm.
- \* Leaf K levels in the optimal treatment were below the interim threshold value of 85 %dm in September and October, but increased above it in November.

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10.08.92