SOUTH AFRICAN SUGAR INDUSTRY

AGRONOMISTS' ASSOCIATION

EXPERIMENT RESULT

CODE: K3/88/Sw SIM 'T'
CAT.NO.: 1713

TITLE: LEVELS AND TIMING OF POTASSIUM APPLICATION FOR EARLY SEASON CANE ON A 'T' SET SOIL

1. PARTICULARS OF PROJECT

This crop	:	9th ratoon
Site	:	Simunye Sugar Estate Field 213
Region	:	Northern Irrigated (Swaziland)
Design	:	Randomised blocks (6 replications)
Soil Set/Series:		'T' Tambankulu
Variety	:	NCo376
Fertilizer Total (kg/ha)	:	N 200, P 40, K Treatment

Soil Analysis : 19/05/1988

pH	OM%	Clay %	KDI
6.48	-	30	0.75

ppm

P	K	Ca	Mg	S
33	277	1989	950	32

Dates : 20/5/88 - 11/5/89
Age : 11.75 months
Rainfall :
Irrigation:
Total :

2. OBJECTIVES

2.1 To determine whether delayed potassium dressings would increase yield if applied just prior to the period of apparent K deficiency (Sept-Oct).

2.2 To establish whether reduced levels of K can achieve yield response of higher rates if applied during periods of high K demand.

2.3 To establish whether third leaf K (%dm) values can be used to identify this period to optimize K utilisation.

2.4 To define more accurately the K threshold for this soil.

3. TREATMENTS

3.1 Control : No Potassium

3.2 K1/E : 75 kg K/ha top-dressed on the 21st May

3.3 K2/E : 150 kg K/ha top-dressed on the 21st May

3.4 K3/E : 225 kg K/ha top-dressed on the 21st May

3.5 K1/L : 75 kg K/ha top-dressed on the 15th August

3.6 K2/L : 150 kg K/ha top-dressed on the 15th August

3.7 K3/L : 225 kg K/ha top-dressed on the 15th August

Notes on Treatments

* Potassium was applied as a single dressing over the cane row in the form of muriate of potash (50 % K).

* Phosphate was applied as single supers (10.5 % P) on the 30th May at the rate of 40 kg P/ha.

* Nitrogen application was split and 66 kg N/ha as urea (46 % N) was top-dressed on the 21st May and 134 kg N/ha as ASN (27 % N) was applied on 22 August 1989.

* Chemical ripening of this site was not carried out as potassium treatments may influence cane quality.

4. RESULTS

4.1 Growth Data

Table 1: Stalk Height and Population Count at 6, 7.5, 8.5, 10 and 11.5 Months of Age

Treatments	Stalk (cm to TVD)					Population (1000 x ha)				
	6 m	7.5 m	8.5 m	10 m	11.5 m	6 m	7.5 m	8.5 m	10 m	11.5 m
Control	70	145	187	230	257	336	193	175	150	130
75 kg K May	79	155	202	252	282	339	195	192	157	149
150 kg K May	78	156	200	250	284	307	206	185	154	132
225 kg K May	77	156	202	244	275	316	181	188	158	144
75 kg K Aug	77	152	201	241	276	357	204	223	164	143
150 kg K Aug	75	155	199	245	277	338	211	173	168	142
225 kg K Aug	76	154	197	246	278	341	198	205	150	142

4.2 Harvest Data

Table 2: Cane Yield, Sucrose % Cane and Sucrose Yield

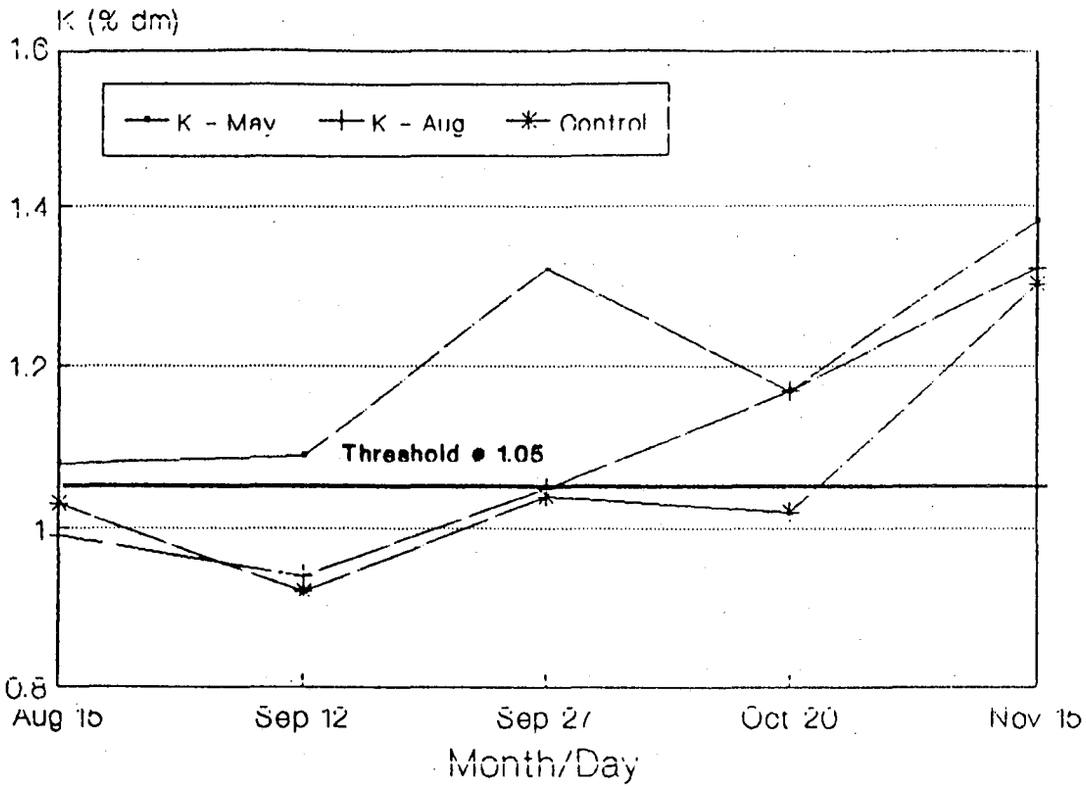
Treatments	T Cane/Ha	% Sucrose	T Suc/Ha
Control	136	14.48	19.6
75 kg K May	160	13.93	22.3
150 kg K May	155	14.12	21.8
225 kg K May	154	14.21	21.8
75 kg K Aug	150	14.04	21.1
150 kg K Aug	151	14.26	21.45
225 kg K Aug	153	14.47	22.2
LSD			
0.05*	14	0.41	2.0
0.01**	19	0.55	2.65
Significance	NS	NS	NS
Mean Trial	151	14.22	21.45
CV %	8	2.50	7.8

Table 3: Mean Differences Between Treatments and Control

Treatments	T Cane/Ha	% Sucrose	T Suc/Ha
75 kg K May	24 **	- 0.55 **	2.7 **
150 kg K May	19 **	- 0.36 NS	2.2 *
225 kg K May	18 *	- 0.27 NS	2.2 *
75 kg K Aug	14 *	- 0.44 *	1.5 NS
150 kg K Aug	15 *	- 0.22 NS	1.85 NS
225 kg K Aug	17 *	- 0.01 NS	2.6 *

** Significant of (P = 0.01) NS: Not significant
* Significant of (P = 0.05)

Fig 1: The Effect of Time on the Mean Content of K (% dm) in Third Leaf



5. COMMENTS

5.1 Growth Measurements

Growth measurement reflected the effect of treatments on yield. Both stalk height and population counts were increased where K had been applied. Stalk heights tended to be slightly lower where K application was delayed.

5.2 Yield of cane

Yield of cane responded significantly to K application and the optimum rate was 75 kg/ha (Table 2 & 3). Yield associated with the early application tended to be higher than that for late application but the difference was not significant.

5.3 Quality

Quality tended to be suppressed where K had been applied but the difference were not significant except at the low rate of potassium.

5.4 Yield of Sucrose

Yield of sucrose were higher where K had been applied. However, only where K had been applied early or where the highest rate was applied later in the season was the response significant (Table 2).

5.5 Foliar Analysis

K content in leaves appeared to reflect K applications. The leaf K content in the control plots was below the current threshold value during the first 5 months of growth thus confirming the inadequacy of the current soil K threshold value.

Leaf K content was consistently above threshold where K had been applied early in the season. Later applications of k in August were not detected in leaf samples until October, $\pm$ 2 months after application.

The decline in leaf K in September was apparent in this trial but was not as marked as in previous trials. It was clear that applications of K in August were too late to prevent this decline.

6. CONCLUSION

* Sucrose yields were significantly increased by applications of K despite the fact that soil levels averaged 277 ppm. These results confirm the need to revise soil K thresholds for these soils where harvesting takes place in winter.

* Best response was achieved at 75 kg K/ha and early applications were more effective than delayed applications.

* The responses in this trial may have been influenced by the unusually cool, overcast and wet conditions during the Spring months of 1988.

* This trial is being continued to assess the residual effects of K applications.

PCH/aw/ynm
24 May 1990

SOUTH AFRICAN SUGAR INDUSTRY

AGRONOMISTS' ASSOCIATION

CODE: K3/88/Sw SIM 'T'

CAT. NO.: 1713

EXPERIMENT RESULT

TITLE: LEVELS AND TIMING OF POTASSIUM APPLICATION FOR EARLY SEASON CANE ON A 'T' SET SOIL

1. PARTICULARS OF PROJECT

This crop	:	10th ratoon			
Site	:	Simunye Sugar Estate Field 213			
Region	:	Northern Irrigated (Swaziland)			
Design	:	Randomized blocks (6 replications)			
Soil Set/Series:		'T' Tambankulu			
Variety	:	NCo376			
Fertilizer Total (kg/ha)	:	N 180	P 20	K Treatment	

Soil Analysis: 18/05/1989

pH	OM%	Clay %	KDI
6.48	4.20	47	0.89

ppm

P	K	Ca	Mg
16	See Treatments (page 2)		

Dates : 11/05/89-3/05/90

Age : 11.75 months

Rainfall : 863 mm
Irrigation: 851 mm
Total : 1714 mm

2. OBJECTIVES

2.1 To determine the residual effect of previous K fertilizer applications.

2.2 To determine the effect of low leaf-K content in September/November on yield and confirm the adequacy of new FAS leaf-K threshold for winter harvested cane.

2.3 To define more accurately the soil-K threshold for this soil type.

3. TREATMENTS

The treatments were applied to the previous crop as follows:

1. No potassium
2. 75 kg K ha^{-1} applied in May 1988
3. 150 kg K ha^{-1} applied in May 1988
4. 225 kg K ha^{-1} applied in May 1988
5. 75 kg K ha^{-1} applied in August 1988
6. 150 kg K ha^{-1} applied in August 1988
7. 225 kg K ha^{-1} applied in August 1988

Notes on treatments

* Potassium source was KCl (50 % K) and was applied over the cane row.

* Nitrogen as Urea (46 % N) was applied as a single application on 6/06/1989 at the rate of 180 kg N ha^{-1}.

* Phosphate was applied as Single Supers (10.5 % P) on 7/07/1989 at the rate of 20 kg P ha^{-1}.

4. RESULTS

4.1 Soil Analysis

Table 1: Mean K, Ca and Mg soil content (ppm) in May 1989

Treatment	Soil level (ppm)			Ca + Mg / K
	K	Ca	Mg	
Control	198	2570	818	16.8
75kg K ha^{-1}	214	2702	846	16.6
150kg K ha^{-1}	226	2508	857	14.9
225kg K ha^{-1}	229	2592	856	15.0
LSD (0.05)	47	230	64	-
Control (0.01)	63	309	87	-
Significance	NS	NS	NS	-
Mean	219	2596	848	15.7
CV %	20.6	8.7	7.5	-

4.2 Harvest Data

Table 2: Cane Yield, Sucrose % Cane and Sucrose Yield

Treatments	T Cane/ha	% Sucrose	T Suc/ha
Control	136	15.15	20.4
75kg K ha^{-1} May	156	15.06	23.5
150kg K ha^{-1} May	147	15.11	22.3
225kg K ha^{-1} May	142	14.86	21.0
75kg K ha^{-1} August	151	15.03	22.8
150kg K ha^{-1} August	143	15.04	21.5
225kg K ha^{-1} August	152	14.95	22.7
Mean	147	15.03	22.0
LSD Treatments(0.05)	15	0.55	2.1
(0.01)	21	0.74	2.8
Significance			
Treatments	NS	NS	NS
May-August	NS	NS	NS
K levels	NS	NS	NS/*
Interaction(Rates x dates)	NS	NS	NS
Control vs K levels	**	NS	**
SE one plot	13	0.46	0.8
CV %	8.9	3.1	8.0

Table 3: Responses to K application rates

Treatments	T Cane ha^{-1}	Sucrose %	T Sucrose ha^{-1}
75kg ha^{-1}	18**	-0.11	2.75**
150kg ha^{-1}	9	-0.08	1.5
225kg ha^{-1}	11	-0.24	1.5
LSD			
Control xK(0.05)	13	0.47	1.8
(0.01)	18	0.63	2.5

4.3 Leaf Analysis

Table 3: General third leaf nutrient content (% dm) at 6 months of age in November

	% dm						ppm
	N	P	K	Ca	Mg	S	Zn
Mean	2.23	0.21	0.87	0.46	0.30	0.19	21.3
S.E.+/-	0.095	0.011	0.18	0.030	0.020	0.0085	2.4

Table 4: Third leaf K, Ca and Mg content (% dm) at 4 and 6 months of age

Treatments	Sept.(4 months)			Nov.(6 months)		
	K	Ca	Mg	K	Ca	Mg
Control	0.76	0.54	0.33	0.84	0.26	0.22
75kg K/ha	0.84	0.48	0.30	1.04	0.25	0.21
150kg K/ha	0.89	0.44	0.31	0.98	0.26	0.21
225kg K/ha	0.94	0.44	0.29	1.05	0.25	0.21
Mean	0.87	0.46	0.30	1.00	0.25	0.21
LSD						
Control xK(0.05)	0.11	0.064	0.027	0.18	0.031	0.020
(0.01)	0.15	0.086	0.037	0.25	0.041	0.027
Significance	**	*	*	*	NS	NS
CV %	12.4	13.5	8.8	18.4	11.8	9.3

Table 5: Ratios of third leaf nutrient content (K, Ca and Mg)

Treatment	Sept.(4 months)		Nov.(6 months)	
	Ca + Mg	K Saturation *	Ca + Mg	K Saturation *
Control	0.87	0.47	0.48	0.64
75kg K/ha	0.78	0.52	0.46	0.69
150kg K/ha	0.75	0.54	0.47	0.68
225kg K/ha	0.73	0.56	0.46	0.70
Mean	0.76	0.53	0.46	0.68

* $\frac{K \times 100}{K+Ca+Mg}$

5. COMMENTS

5.1 Soil Analysis

Soil-K content tended to be higher in the plots where K had been applied than in the control although the differences were not significant (Table 1).

The level of soil-K did not reflect the differences in rates of K applied. This, together with the high variability, underlines the difficulty of obtaining representative soil samples when fertilizer is banded, as was the case in this trial.

The mean soil-K value (219 ppm) in this trial was marginally below the new F.A.S. soil-K threshold of 225 ppm for soil with >40 % clay. The level of soil-K in the control (192 ppm) was well below the threshold.

5.2 Cane Yield

Residual effects of Potassium applied in 1988 were still evident in this trial. Yield responses were smaller than last year, were variable and were apparently independent of rate of K applied. There were no differences between May and August applications and the interaction between dates and rates of application was non significant. The results were meaned for comparisons with the control (Table 3) and the only significant response occured at 75 kg K/ha. This is a surprising result in view of the fact that levels of soil-K associated with this rate were on average still deficient (Table 1) and one could have expected response to improve with increasing rate.

5.3 Cane Quality

Sucrose content tended to be lower where K had been applied but the differences were small and non significant. The effects were less significant than in the previous crop.

5.4 Sucrose Yield

Sucrose yields were significantly higher where K had been applied to the previous crop and the responses reflected the effects on cane yield.

5.5 Leaf Analysis

Third leaf nutrient contents were generally satisfactory in this trial and were above threshold level for all nutrients except K.

Leaf K levels in the control treatments were clearly deficient and were below the new threshold (0.85 %) in September and although levels had increased by November they were still marginal.

Leaf K levels in the fertilized plots were generally above the new leaf threshold levels in September and were close to the old threshold level (1.05 %) by November. Leaf K levels generally increased with increasing rate of K applied in the September sample but the relationship had disappeared by November.

Levels of Ca and Mg were significantly lower where K had been applied to the previous crop and K levels were negatively correlated to combined Ca and Mg levels in the September sample. This effect had also disappeared by November.

5.6 Discussion

Leaf K Threshold

There were significant responses to applied K in this trial last year despite the fact that leaf K levels in the control were well above the new threshold level.

In terms of the new leaf threshold the K nutritional status in all K treatments this year should have been adequate whereas in terms of the old threshold it would have been deficient/marginal. Responses to K application were variable and generally non significant, a pattern expected when the nutritional status is deficient/marginal rather than when it is adequate.

Both these results tend to question the validity of the recent downgrading of the FAS leaf K threshold level for spring sampled cane.

Fertilizer Placement

It is of interest to note that leaf K increased with increasing rate of K fertilizer in the September sample but that this effect had disappeared by November. The old fertilizer bands were clearly important sources of K for the crop up to September but the results indicate that the roots may have grown out of the fertilizer band by November and had to rely on soil reserves. Since the reserves did not vary between treatments (Table 1) it may explain why yield responses bore no relationship to the rate of K applied.

The optimum yield response was achieved by 75 kg K ha^{-1}. The above leaf-K evidence, however, implies that any K in excess of 75 kg K ha^{-1} was positionally unavailable. It seems likely that responses to higher rates may have occured had the fertilizer been broadcast instead of banded on the cane row.

6. CONCLUSION

* There were some significant residual responses to applied Potassium in this trial where soil K level in the control plots was 198 ppm. These results in a 'T' set soil with more than 40% clay confirm the new Soil Threshold for these soils (225 ppm).

* Results of this trial question the validity of the recent downgrading the Leaf K threshold value (from 1.05 to 0.85%) for winter harvested cane on these heavy clay soils.

* The residual effects of 75 Kg K/ha in the previous crop appeared to give the optimum response although evidence suggests that additional benefit to yield could occur if the fertilizer is broadcast instead of banded on the cane row.

* This trial will be continued but applications of K fertilizer will be broadcast.

PCH/AGK/fjs
10 May 1991

SOUTH AFRICAN SUGAR INDUSTRY

AGRONOMISTS' ASSOCIATION

EXPERIMENT RESULT

CAT.NO.: 1713
CODE: K3/88/Sw SIM 'T'

TITLE: LEVELS AND TIMING OF POTASSIUM APPLICATION FOR EARLY SEASON CANE ON A 'T' SET SOIL

1. PARTICULARS OF PROJECT

This crop	:	11th ratoon	Soil Analysis: 03/10/1990			
Site	:	Simunye Sugar Estate Field 213	pH	OM%	Clay %	KDI
			6.5	4.20	47	0.89
Region	:	Northern Irrigated (Swaziland)		ppm		
			P	K	Ca	Mg
Design	:	Randomized blocks (6 replications)	45	See Treatments (page 3)		
Soil Set/Series:		'T' Tambankulu	Dates	:	3/5/90 - 25/4/91	
Variety	:	NCo376	Age	:	11.75 months	
			Rainfall	:	502 mm	
Fertilizer	:	N P K	Irrigation	:	966 mm	
Total (kg/ha)		180 40 Treatment	Total	:	1468 mm	

2. OBJECTIVES

2.1 To determine the effect of splitting Potassium applications for winter harvested cane.

2.2 To determine the effect of low leaf-K content in September/November yield and confirm the adequacy of new FAS leaf-K threshold for winter harvested cane.

2.3 To define more accurately the K threshold for this soil type.

3. TREATMENTS

1. Control : No Potassium
2. 75 kg K ha^{-1} : Single application
3. 150 kg K ha^{-1} : " "
4. 225 kg K ha^{-1} : " "
5. 75 kg K ha^{-1} : Split application
6. 150 kg K ha^{-1} : " "
7. 225 kg K ha^{-1} : " "

3.1 Notes on Treatments

* Potassium was applied in the form of KCl (50% K) and was broadcast. Single applications and half the split applications were applied on 23/5/90, 3 weeks after harvest. The remainder of the split applications were applied on 15/7/90, 10 weeks after harvest.

* Nitrogen as Urea (46% N) was applied over the cane row as a split application. 80kg N ha^{-1} was applied on 24/5/90, 3 weeks after harvest and 100kg N ha^{-1} was applied on 7/9/90, 16 weeks after harvest.

* Phosphorous was applied as Single Supers (10.5 % P) on 5/6/90 at the rate of 40 kg P ha^{-1}.

3.2 Notes on Soil Sampling

Topsoil: 40 cores were taken from each plot at a ratio of 16 on row to 24 interow (ie 1:1.5). This ratio was different to previous samples (1:8).

Subsoil: 20 cores were taken from 3 selected plots in the control and 225kg K ha^{-1} treatments at a ratio of 8 on row to 12 interow (1:1.5).

4. RESULTS

4.1 Soil Analysis

Table 1: K, Ca and Mg status of the topsoil - October 1990

Treatment	Soil level (ppm)			Ca + Mg / K
	K	Ca	Mg	
Control	264	3145	848	15.1
75kg K ha^{-1}	288	2989	915	13.5
150kg K ha^{-1}	324	2841	935	11.6
225kg K ha^{-1}	345	3156	935	11.8
Significance	NS	NS	NS	-
Mean	311	3817	917	13.0
SE one plot	597	1145	82.5	-
CV %	13.2	30.0	9.0	-

Note: All plots sampled.

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

Depth (cm)	Control				225 kg K ha^{-1}		
	K	Ca	Mg	Ca + Mg/K	K	Ca	Mg
0-15	228 (53)	3117 (632)	838 (13)	14.5	270 (18)	3493 (284)	934 (70)
20-30	176 (23)	2525 (54)	1093 (109)	20.5	177 (5)	3566 (603)	1075 (124)
40-50	139 (5)	2868 (194)	1091 (76)	28.5	137 (9)	3274 (830)	1297 (20)

( ) Standard error
Note: Samples taken from 3 plots in each treatment.

Table 3: Properties of the soil profile - October 1990

Depth (cm)	pH	Clay %	OM %	CEC meq/100g soil	TCEC meq/100g clay	KDI
0-15	6.4(0.11)	47.5 (0.98)	4.2(0.11)	23.6 (0.23)	49.7	0.89 (0.04)
20-30	6.6(0.11)	48.7 (1.61)	3.8(0.11)	23.8 (0.98)	48.9	0.80 (0.02)
40-50	6.9(0.11)	51.2 (5.90)	2.3(0.11)	25.2 (0.98)	49.2	0.77 (0.05)

( ) Standard error
Note: Samples taken from 3 control plots.

4.2 Harvest Data

Table 4: Cane Yield, Sucrose % Cane and Sucrose Yield

Treatments	Tons Cane ha^{-1}			Sucrose % C			Tons Suc. ha^{-1}		
	Sg.	Sp.	Mean	Sg.	Sp.	Mean	Sg.	Sp.	Mean
Control	-	-	123	-	-	14.25	-	-	17.5
75kg K ha^{-1}	151	134	142	13.77	14.46	14.12	20.8	19.4	20.1
150kg K ha^{-1}	139	135	137	14.01	14.03	14.02	19.5	18.9	19.2
225kg K ha^{-1}	135	139	137	13.79	14.37	14.08	18.5	20.0	19.2
Mean	142	136	137	13.86	14.29	14.10	19.6	19.4	19.2
Significance									
Treatments		NS			NS			NS	
Single vs Split		NS			*			NS	
K Levels		NS			NS			NS	
Rate x Method		NS			NS			NS	
Control vs K rates		*			NS			NS	
SE one plot		16			0.59			2.5	
CV %		11.7			4.2			13.1	

Note: Sg = Single application
Sp = Split application

Table 5: Responses to K application rates

Treatments	T Cane ha^{-1}	Sucrose % Cane	Tons Suc. ha^{-1}
75kg ha^{-1}	19*	-0.13	2.6*
150kg ha^{-1}	14	-0.23	1.7
225kg ha^{-1}	14	-0.17	1.7
LSD Control * K			
(0.05)	16	0.60	2.5
(0.01)	22	0.81	3.4

4.3 Leaf Analysis

Table 6: General third leaf nutrient content (% dm) in September (4 months)

	N	P	K	Ca	Mg
Mean	1.39	0.21	0.72	0.35	0.22
SE ±	0.087	0.010	0.059	0.050	0.048
CV %	4.4	4.9	8.2	14.9	21.7

Table 7: Effect of rate and method of application on third leaf K content (% dm)

Treatments	July 2.2 m			August 4 m			September 4.8 m			October 6 m			December 7.2 m		
	Sg(1)	Sp(2)	Mean	Sg	Sp	Mean	Sg	Sp	Mean	Sg	Sp	Mean	Sg	Sp	Mean
Control	-	-	0.85	-	-	0.61	-	-	0.79	-	-	0.89	-	-	0.98
75kg K/ha^{-1}	0.95	0.91	0.93	0.74	0.68	0.71	0.99	0.90	0.92	1.12	1.08	1.10	1.05	1.08	1.07
150kg K/ha^{-1}	0.91	0.94	0.92	0.74	0.72	0.73	0.88	0.90	0.89	1.06	1.21	1.13	1.16	1.21	1.18
225kg K/ha^{-1}	0.96	0.90	0.93	0.81	0.75	0.76	1.02	1.03	1.02	1.06	1.27	1.16	1.10	1.09	1.09
Mean	0.94	0.92	0.91	0.76	0.72	0.70	0.95	0.94	0.90	1.08	1.19	1.07	1.10	1.13	1.08
Significance															
Treatments		NS			**			NS			NS			NS	
K rates		NS			NS			NS			NS			NS	
Control vs K rates		NS			**			*			**			**	
Single vs Split		NS			NS			NS			*			NS	
SE one plot		0.12			0.059			0.084			0.12			0.093	
CV %		13.3			8.5			9.4			11.3			8.7	

(1) Sg: Single application (2) Sp: Split application

5. COMMENTS

5.1 Soil Analysis

Soil K levels tended to increase with increasing rate of applied K although the data were variable and the differences were not statistically significant (table 1). The soil K content of the control plots averaged 264 ppm which is above the current FAS threshold for these soils (225 ppm) and is higher than last year's level. This apparent increase is likely to be a reflection of the modified soil sampling procedure which increased the proportion of cores taken from the cane row.

Sampling at depth indicated that K levels were highest in the topsoil, decreased with depth and were clearly below F.A.S. threshold level at 20-30 cm depth in control and treated plots (Table 2 and 3).

The benefits of recent Potassium application were only apparent in the top soil and it is clear that there is little leaching of K. Surface applications of K appear, therefore, to remain positionally unavailable to the bulk of the root system.

Ca levels remained constant with depth while Mg levels increased with the net effect that the (Ca + Mg)/K ratio increased with depth. This tendency, together with the apparent increase in K fixation, (lower KDI) indicate that not only do the K reserves decrease with depth but that they also become less available.

It is of interest to note that KDI decreased with depth although clay content was constant, suggesting a change in mineralogy.

5.2 Harvest Data

Cane Yield

Cane yield responded significantly to applied K but there were no apparent differences between rates or methods of application (table 4 and 5).

Cane Quality

Sucrose contents were variable and differences between the control and K treatments were not significant. Split applications tended to give higher sucrose content then single applications.

Sucrose Yield

Sucrose yields were higher where K had been applied although the responses were apparently not significant. There were no differences between rates and methods of application and the most effective treatment was apparently 75kg K applied shortly after harvesting.

5.3 Leaf Analysis

General

Leaf nutrient contents were above threshold for all nutrients except K (table 6). K content was clearly effected by season and K levels declined to a minimum in late August before increasing progressively in September, October and December. Ca and Mg content remained relatively constant until September and declined thereafter. (Appendix 1)

Leaf sampling started earlier than is normally recommended and K levels can only be related to the new F.A.S. threshold values in the October and December samples where levels were apparently satisfactory against thresholds of 0.85% and 0.95% respectively.

Effects of Treatment

Topdressings of K increased leaf K content at all sampling dates and differences were generally significant (table 7) although there were no significant differences between levels of K application. Application of K tended to suppress uptake of Mg in August and September and Ca in September and October (Appendix 1).

Single applications of K tended to result in higher leaf K content than split applications up to the end of September while the converse was true from the end of September to December. The differences were generally non significant.

5.4 Discussion

K Uptake

The lack of a clear response of leaf K levels to increasing amounts of applied K is cause for concern and indicates that relatively large amounts of fertilizer are not available to the plant. Last year's data suggested that the availability to the plant may be improved by broadcasting the fertilizer rather than banding it on the cane row. Application procedure was changed accordingly but did not result in improved uptake.

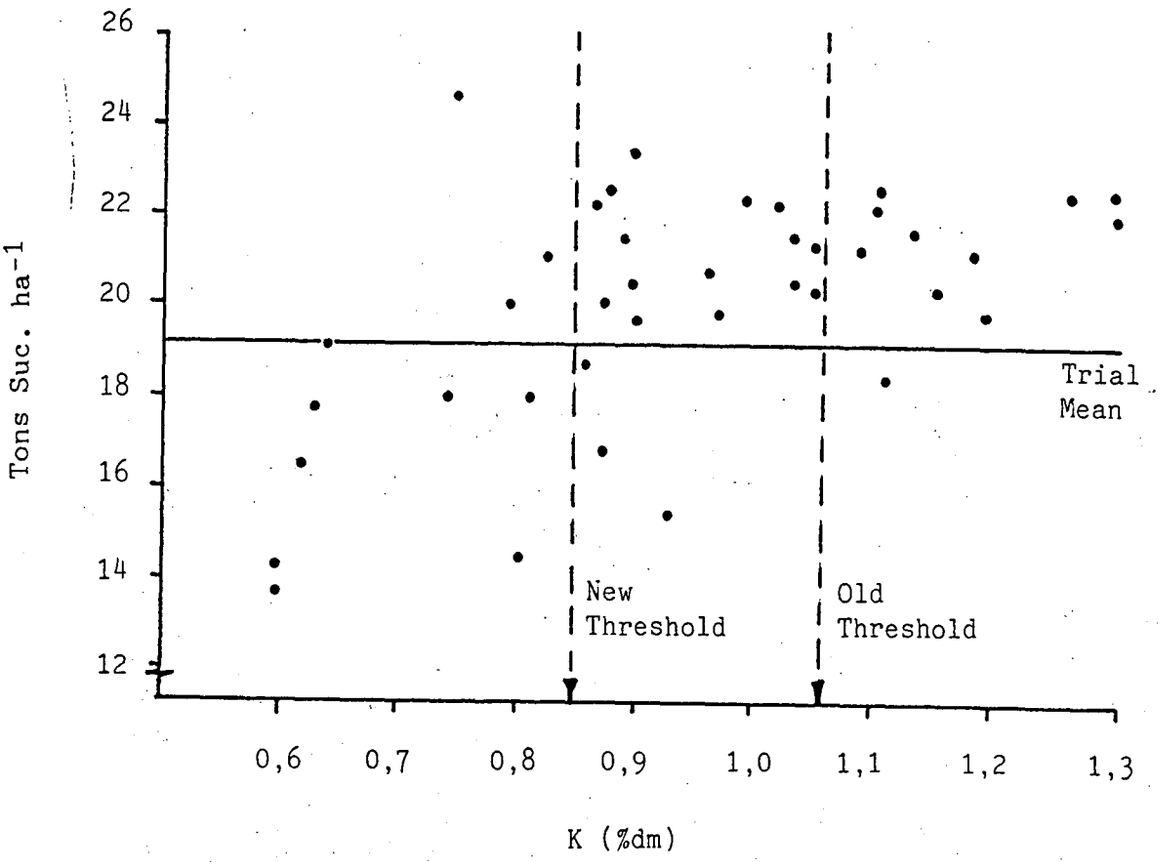
Soil sampling at depth indicates that there is little leaching of applied K and that this may account for the poor uptake of applied fertilizer.

Leaf K Threshold

There is considerable variability in this trial, particularly in terms of soil K levels and individual plot data have been presented to determine the relationship between leaf K levels and sucrose yields (Fig 1).

The plot shows a definite trend to increasing sucrose yields with increasing leaf K levels. While the data is too variable for an accurate determination of leaf K threshold level it suggests that the probability of diagnosing K deficiency may be improved by using a threshold above 0.85% so as to minimize the proportion of points below the trial mean.

Figure 1: Relationship between leaf K content at 4.8 months in September and sucrose yield



6. CONCLUSIONS

* There were significant responses to applied Potassium in this trial despite the fact that soil and leaf K levels were apparently above the new thresholds.

* Soil K levels in this trial are too variable to be used to ascertain the soil K threshold. Leaf K levels indicate that the new leaf K threshold levels may need to be reassessed.

* Soil sampling at depth showed that subsoil K levels were below threshold and that replenishment from surface application was slow in these soils.

* This trial is being continued to assess the effect of incorporating K by interow cultivation.

AGK/PCH/fkd
7th August 1991

Appendix 1. Third Leaf K, Ca and Mg Values (dm %) at Various Ages

Treatments	July (2.2 m)			Aug (4 m)			Sept. (4.8 m)			Oct (6 m)			Dec (7.2 m)		
	K	Ca	Mg	K	Ca	Mg	K	Ca	Mg	K	Ca	Mg	K	Ca	Mg
Control	0.85	0.35	0.26	0.61	0.37	0.26	0.79	0.40	0.28	0.89	0.30	0.24	0.98	0.29	0.20
75kg K ha^{-1} Single	0.95	0.39	0.26	0.74	0.37	0.20	0.95	0.32	0.23	1.12	0.29	0.27	1.05	0.27	0.19
150 " "	0.91	0.41	0.26	0.74	0.36	0.21	0.88	0.35	0.27	1.06	0.25	0.24	1.16	0.28	0.19
225 " "	0.96	0.37	0.23	0.81	0.34	0.21	1.02	0.34	0.26	1.06	0.27	0.24	1.10	0.28	0.17
Means	0.94	0.39	0.25	0.76	0.36	0.21	0.95	0.34	0.25	1.08	0.27	0.25	1.10	0.28	0.18
75kg K ha^{-1} Split	0.91	0.39	0.25	0.68	0.36	0.23	0.90	0.37	0.24	1.08	0.30	0.22	1.08	0.29	0.19
150 " "	0.94	0.40	0.27	0.72	0.36	0.21	0.90	0.35	0.24	1.21	0.28	0.22	1.21	0.26	0.20
225 " "	0.90	0.37	0.25	0.75	0.33	0.23	1.03	0.34	0.24	1.27	0.26	0.23	1.09	0.27	0.17
Means	0.92	0.39	0.26	0.72	0.35	0.22	0.94	0.35	0.24	1.19	0.28	0.22	1.13	0.27	0.19

Ratios	Ca + Mg	Ca + Mg/K	Ca + Mg	Ca + Mg/K	Ca + Mg	Ca + Mg/K	Ca + Mg	Ca + Mg/K	Ca + Mg	Ca + Mg/K
Control	0.61	0.72	0.63	1.03	0.68	0.86	0.54	0.61	0.50	0.51
Single Applications	0.64	0.68	0.57	0.75	0.59	0.62	0.52	0.48	0.46	0.42
Split Applications	0.65	0.71	0.57	0.79	0.59	0.63	0.50	0.42	0.46	0.41

SOUTH AFRICAN SUGAR INDUSTRY
AGRONOMISTS' ASSOCIATION

EXPERIMENT RESULT

CODE: K3/88/Sw SIM 'T'

CAT No: 1713

TITLE: LEVELS AND METHODS OF POTASSIUM APPLICATION FROM EARLY SEASON CANE ON A 'T' SET SOIL

1. PARTICULARS OF PROJECT

This crop	:	12th ratoon
Site	:	Simunye Sugar Estate Field 213
Region	:	Northern Irrigated (Swaziland)
Design	:	Randomised blocks (6 replications)
Soil Set/Series:		'T' Tambankulu
Variety	:	NCo376
Fertilizer Total (kg/ha)	:	N 180 P 40 K Treatment

Soil Analysis :

	pH	OM%	Clay %	KDI
1992	*	*	*	*
1990	6.5	4.20	47	0.89

ppm

P	K	Ca	Mg
45 (1990)	(See treatments P3)		

Dates : 25.04.91- 24.04.92
Age : 12 Months
Rainfall : 411 mm
Irrigation: 1058 mm
Total : 1398 mm

* = not analysed

2. OBJECTIVES

2.1 To determine the effect of the incorporation of Potassium fertilizer into the soil for winter harvested cane.

2.2 To determine the effect of low leaf-K content in Sept./Nov. on yield and confirm the adequacy of new FAS leaf K threshold of 0.85 (DM%) for winter harvested cane.

2.3 To define more correctly, the K threshold for this soil type.

3. TREATMENTS

1. Control :
2. 75 Kg K/ha Application before cultivation
3. 150 Kg K/ha " "
4. 225 Kg K/ha " "
5. 75 Kg K/ha Application after cultivation
6. 150 Kg K/ha " "
7. 225 Kg K/ha " "

3.1 Notes on treatments

* Application of K (KCl) was broadcasted on half of the treatments (1, 2, 3) at the different rates as specified. Fertilization was then followed by cultivation over the whole trial in order to:

    1. Incorporate the fertilizer into the soil on the plots that had received K.

    2. To even out the effect cultivation might have had on cane stools e.g. root pruning.

  After 3 weeks, the rest of the treatments (5, 6 and 7) were fertilized by broadcasting, as well.

* Nitrogen as Urea (46% N) was applied over the cane row at the rate of 180 kg N/ha split into two equal parts on 14.05.91 (3 weeks after harvesting) and on 26.08.91 at 18 weeks after harvesting.

* Phosphorous was applied as single supers (10.5% P) on 20.05.91 (4 weeks after harvesting) at the rate of 40 kg P/ha.

3.2 Notes on Soil Sampling

Topsoil: 40 cores were taken from each plot at a ratio of 16 on row to 24 interrow. This ratio was different to samples taken previous to the 1990/91 harvest which was 1:8 .

Subsoil: 20 cores were taken from 3 selected plots in the control and 225 kg K/ha treatments at a ratio of 8 on row to 12 on the interrow.

4. RESULTS

4.1 Soil Analysis

Table 1: K, Ca and Mg status of the topsoil in January 1992

Treatments	Levels (ppm)			$\frac{Ca + Mg}{K}$
	K	Ca	Mg	
Control	191	3175	983	21.8
75 kg K/ha	202	2733	880	17.9
150 kg K/ha	244	2790	849	14.9
225 kg K/ha	278	2852	852	13.3
Significance	**	NS	**	-
LSD (0.05)	43	434	80	
Mean	234	2847	878	17.0
SED	21	212	39	
CV%	15.8	12.9	7.8	

NB: All plots sampled

4.2 Harvest Data

Table 2: Cane Yield, Sucrose % Cane and Sucrose Yield

Treatments	Tons cane/ha			Sucrose % cane			Tons Sucrose/ha		
	Inc.	N. Inc.	Mean	Inc.	N. Inc.	Mean	Inc.	N. Inc.	Mean
Control	-	-	119	-	-	15.64	-	-	18.7
75 kg K/ha	136	132	134	15.91	15.89	15.90	21.6	21.0	21.3
150 kg K/ha	134	129	132	15.34	15.73	15.54	20.5	20.2	20.4
225 kg K/ha	132	126	129	15.57	16.09	15.83	20.7	20.2	20.5
Mean	134	129	129	15.61	15.90	15.73	20.9	20.5	20.2
Mean 90/91	137			14.10			19.2		
Significance									
Treatments	NS			NS			NS		
Inc. vs N. Inc.	NS			NS			NS		
K rates	NS			NS			NS		
Rates vs. App. Method	NS			NS			NS		
Control vs. K rates	*			NS			NS		
SE of Diff.	8.22			0.28			1.32		
CV %	10.97			3.06			11.21		

NOTE: Inc. = Fertilizer was incorporated into soil
N. Inc. = Fertilizer was not incorporated into soil

Table 3: Responses to K application rates

Treatments	Tons cane/ha^{-1}	Sucrose % cane	Tons Sucrose/ha
75 kg K/ha	15*	0.26	2.6*
150 kg K/ha	13	-0.10	1.7
225 kg K/ha	10	0.19	1.8
LSD control *K			
(0.05)	14	0.48	2.3
(0.01)	20	0.67	3.2

4.3 Leaf Analysis

Table 4: General third leaf nutrient content (% dm) in August (4 months)

	N	P	K	Ca	Mg
Mean	2.12	0.20	0.64	0.43	0.24
SE ±	0.11	0.008	0.11	0.06	0.05
CV%	5.2	4.8	17.6	13.2	23.0

Table 5: Effect of rate and incorporation/non incorporation on third leaf K content (%dm)

	August 4 m			September 4.8 m			October 5.7 m			November 6.7 m		
Treatments	Inc.	N Inc.	Mean	Inc.	N Inc.	Mean	Inc.	N Inc.	Mean	Inc.	N Inc.	Mean
Control	-	-	0.61	-	-	0.60	-	-	0.75	-	-	0.91
75 kg K/ha	0.59	0.69	0.64	0.71	0.63	0.63	0.97	0.81	0.84	0.98	0.95	0.96
150 kg K/ha	0.66	0.64	0.64	0.77	0.71	0.74	0.87	0.94	0.90	0.98	1.01	0.99
225 kg K/ha	0.65	0.64	0.64	0.81	0.78	0.79	0.95	0.90	0.92	1.08	0.97	1.02
Mean	0.63	0.66	0.64	0.76	0.71	0.69	0.90	0.88	0.85	1.01	0.98	0.97
Significance												
Treatments		NS			‡			NS			NS	
K-rates		NS			‡‡			‡‡			NS	
Cont.vs K rates		NS			‡			‡			NS	
Inc. vs N.Inc		NS			NS			NS			NS	
SED		0.06			0.06			0.07			0.06	
CV%		17.6			14.5			14.1			10.3	

NOTE: Inc. = Incorporated
N. Inc. = Non - incorporated
‡ Significant (P=0.05)
‡‡ Significant (P=0.01)

Table 6: Third leaf K, Ca and Mg values (% dm) at various ages

Treatments	August (4 mths)			September (4.8 mths)			October (5.7 mths)			November (6.7 mths)		
	K	Ca	Mg	K	Ca	Mg	K	Ca	Mg	K	Ca	Mg
Control	0.61	0.45	0.25	0.61	0.38	0.25	0.75	0.39	0.25	0.91	0.29	0.19
75 kg K/ha Inc	0.59	0.42	0.25	0.71	0.33	0.25	0.88	0.32	0.23	0.98	0.27	0.16
150 " Inc	0.66	0.43	0.23	0.77	0.33	0.22	0.87	0.28	0.21	0.98	0.27	0.17
225 " Inc	0.65	0.42	0.23	0.81	0.35	0.26	0.95	0.35	0.20	1.08	0.25	0.16
Mean	0.63	0.42	0.24	0.76	0.34	0.24	0.90	0.32	0.21	1.01	0.26	0.16
75 kg K/ha N. Inc	0.69	0.45	0.25	0.63	0.38	0.25	0.81	0.37	0.25	0.95	0.28	0.18
150 " N. Inc	0.64	0.45	0.23	0.71	0.34	0.26	0.94	0.28	0.24	1.01	0.26	0.17
225 " N. Inc	0.64	0.40	0.25	0.79	0.32	0.24	0.90	0.33	0.21	0.97	0.27	0.17
Mean	0.66	0.43	0.24	0.71	0.35	0.25	0.88	0.33	0.23	0.98	0.27	0.17

Ratios	Ca + Mg	Ca + Mg/K	Ca + Mg	Ca + Mg/K	Ca + Mg	Ca + Mg/K	Ca + Mg	Ca + Mg/K
Control	0.7 0	1.15	0.63	1.03	0.64	0.85	0.48	0.53
Inc applications	0.6 6	1.05	0.58	0.76	0.53	0.59	0.42	0.42
N. Inc applications	0.6 7	1.02	0.60	0.85	0.56	0.64	0.44	0.54

NOTE: Inc. = Incorporated K
N. Inc = K non incorporated

5. COMMENTS

5.1 Soil Analysis

The application of Potassium increased soil K levels, although these levels were lower than last season. The soil K levels of the 75 kg K/ha treatment remained lower than the FAS threshold value of 225 ppm. Ca + Mg/K ratios were higher compared to last season, and this reflected the sharp decrease in the soil K levels (Table 1). The benefits of incorporating Potassium into the soil could not be confirmed, because soil samples were not taken at different soil depths.

5.2 Harvest data

Treatments that received Potassium yielded more cane and sucrose than treatments receiving no K (Table 2). The 75 kg K/ha treatment gave the highest cane and sucrose yield (Table 3). Incorporation did not make a notable difference in the cane and sucrose yield (Table 2).

5.3 Leaf Analysis

Leaf K levels were very low when first analysed (August, 4 months after harvest) but at an age of 4.8 months (September), significant response to K application was measured and reflected applications of K. Leaf K values in all treatments exceeded the interim threshold value of 0.85 % dm for the first time in October. Incorporation increased leaf K levels marginally.

6. CONCLUSION

1. Yields did not benefit significantly from the incorporation of Potassium into the soil. Doubts arise as to whether the depth to which the fertilizer was incorporated to was sufficient, as a shallow-working tine implement was used.

2. The highest yields were obtained by an application of 75 kg K/ha.

3. The highest yields came from treatments with soil K levels marginally lower than the FAS soil K threshold levels of 225 ppm.

4. Leaf K levels of the highest yield measured in October, were near to the interim threshold of 0.85 % dm, but did not rise above the old threshold level of 1.05 % dm.

5. This trial will be continued as a K rate trial.

AJD/fkn
24.07.92