SOUTH AFRICAN SUGAR INDUSTRY
AGRONOMISTS' ASSOCIATION

CODE.: NK16/86/Sw UBO SOM
CAT. NO.: 1650

TITLE: LEVELS OF NITROGEN AND POTASSIUM FOR RATOON CANE ON A SOMERLING SERIES SOIL

1. PARTICULARS OF PROJECT

This crop	:	9th Ratoon
Site	:	Ubombo Ranches Field - Speculation 4
Region	:	Northern Irrigated (Swaziland)
Soil Set/Series:		S/Somerling
Design	:	6 x 3 factorial 2 replications
Variety	:	NCo376
Fertilizer	:	See treatments

Soil Analysis : Date 13/8/1987

pH	OM%	Clay %	PDI
6,97	-	30	0,35

ppm

P	K	Ca	Mg	S	Zn
25	190	2459	587	20	0,69

K0 = 18
K1 = 20
K2 = 18

Age	:	11,7 months
Dates	:	14/7/87 - 5/7/88
Rainfall	:	593 mm
Irrigation	:	768 mm
Total	:	1361 mm

2. OBJECTIVES

2.1 To determine the optimum levels of nitrogen and potassium for ratoon cane on a Somerling series soil.

2.2 To confirm results to earlier N K trials on similar shallow 'S' set soils.

2.3 To test the availability of exchangeable potassium.

3. TREATMENTS

N (Kg/ha)	K (Kg/ha)
N0 = Nil	K0 = Nil
N1 = 80	K1 = 150
N2 = 120	K2 = 300
N3 = 160	
N4 = 200	
N5 = 240	

Notes on treatments

* Nitrogen as ammonium sulphate (21% N + 24% S) was applied as a single dressing 3 weeks after cutting.

* Potassium as KCL (50% K) was top-dressed 8 weeks after harvesting.

* Phosphate was not applied to this ratoon.

* All fertilizing was done by hand as a band over the cane row.

4. RESULTS

4.1 Growth data

Table 1. Treatment effects on stalk heights (mm to TVD) and populations (X 1000/ha) at 6,4 months of age.

TREATMENTS	STALK HEIGHTS (mm to TVD)	POPULATIONS (X 1000/ha)
Nitrogen		
N0	950	193
N1	1200	191
N2	1340	193
N3	1310	199
N4	1480	193
N5	1390	203
Potassium		
K0	1270	194
K1	1300	197
K2	1270	190

4.2 Harvest Data

Table 2. Cane yield, sucrose % cane and sucrose yield.

TREATMENT	TONS CANE/HA	SUC % CANE	TONS SUC/HA
N0	76	14,3	10,9
N1	106	14,1	15,0
N2	125	13,3	16,7
N3	130	13,2	17,1
N4	145	12,7	18,5
N5	144	13,0	18,7
LSD N Means (0,05)*	13	0,5	1,6
(0,01)**	18	0,6	2,2
Significance	*/**	*/**	*/**
K0	118	13,6	15,8
K1	127	13,3	16,8
K2	119	13,5	15,8
LSD K Means (0,05)*	9	0,3	1,1
(0,01)**	13	0,5	1,6
Significance	*	*	N.S
Trial Mean	121	13,5	16,2
S.E. Single Plot	11,0	0,4	1,3
CV %	9,1	2,8	8,3

4.3 Foliar analysis

Table 3. Third leaf N and K (%dm) values

TREATMENTS	5 MONTHS (DEC)	6 MONTHS (JAN)
Nitrogen (%dm)		
N0	1,52 **	1,46 **
N1	1,67 **	1,51 **
N2	1,87 *	1,68 *
N3	2,04	1,75 *
N4	1,99	1,84
N5	2,16	1,85
Potassium (%dm)		
K0	1,08	1,17
K1	1,12	1,24
K2	1,16	1,23

* = low to marginal)
** = very deficient) SASA thresholds

Table 4. Third leaf P and S (%dm)

TREATMENT	PHOSPHORUS		SULPHUR	
	5 MONTHS (DEC)	6 MONTHS (JAN)	5 MONTHS (DEC)	6 MONTHS (JAN)
Nitrogen				
N0	0,21	0.18**	0,14	0,12*
N1	0,21	0,18**	0,15	0,14
N2	0,20	0,19*	0,16	0,14
N3	0,22	0,21	0,18	0,16
N4	0,21	0,20	0,18	0,16
N5	0,22	0,20	0,18	0,16
Potassium				
K0	0,22	0,20	0,17	0,15
K1	0,21	0,19*	0,16	0,15
K2	0,21	0,19*	0,16	0,15

* = Marginal
** = Low

5. COMMENTS

5.1 Cane growth at this site was above average for these soils and CV % for the trial were good.

5.2 Nitrogen

5.2.1 Applied nitrogen increased cane yields significantly up to the N2 level while higher rates appeared to produce further responses but were not as marked (Table 2). Stalk height measurements recorded at 6,4 months of age were generally in accordance with cane yield responses (Table 1).

5.2.2 Increased nitrogen decreased cane quality significantly.

5.2.3 Sucrose yields were highest at the high N levels but responses were only significant up to the N2 rate.

5.2.4 Third leaf sampling results showed similar trends to the previous season where increased N rates influenced N(%dm) values in a linear fashion (Table 3). Again the lower N(%dm) values for certain treatments indicates low N mineralization and possibly high nitrogen leaching on the shallow soils.

5.2.5 The apparent yield responses to the highest N rates does not fully agree with previous findings where the N2 rate on average was found to be optimum. Responses for this particular season however may not have been totally attributed to this nutrient alone. Table 4 shows the influence that nitrogen rates had on phosphate and sulphur uptake by the crop and yield increases at the high N rates may be particularly due to a phosphate or sulphur response, or both. The 10th ratoon has been top-dressed with urea with all treatments having sufficient P and S as single superphosphate in an attempt to illiminate further responses to these nutrients that may mask true N responses.

5.3 Potassium

5.3.1 Soil K levels before potassium top-dressing were still above threshold. Sampling after this 9th ratoon however showed no change for K0 treatments but K1 and K2 had increased to 252 and 293 ppm respectively.

5.3.2 Cane yields increased significantly up to K1 but judging by the K2 yields this response was probably unreal. The suspected soil K threshold level is ± 150 ppm for these soils with 30% of non-swelling clays and this trial should continue so as to verify this.

5.3.3 The significant decrease in cane quality from K0 to K1 should be treated with caution as the K2 rate did not have the same influence.

5.3.4 Sucrose yields were non-significantly effected by the rates of K applied.

5.4 Phosphorus

Initial soil P levels were high at 25 ppm but the moderate PDI value for this site may have negatively influenced P availability.

5.5 This trial has been re-established and is now in its 10th ratoon.

NBL/cg
Feb 1989.

SOUTH AFRICAN SUGAR INDUSTRY

AGRONOMISTS' ASSOCIATION

EXPERIMENT RESULT

CODE: NK16/86/Sw UBO Som

CAT. NO.: 1650

TITLE: LEVELS OF NITROGEN AND POTASSIUM FOR RATOON CANE ON A SOMERLING SERIES SOIL

1. PARTICULARS OF PROJECT

This crop	:	11th Ratoon	Soil Analysis : Date 21/07/1989			
Site	:	Ubombo Ranches Field Speculation 4	pH	OM %	Clay %	
			6.70	-	+/- 30	
Region	:	Northern Irrigated (Swaziland)		ppm		
			P	K	Ca	Mg
Soil Set/Series:		S/Somerling	33	K_0-164	2740	831
				K_1-237	2634	850
Design	:	6 x 3 factorial		K_2-282	2333	822
		2 replications				
Variety	:	NCo376	Age : 12.5 months			
			Dates : 5/07/89 - 17/07/90			
Fertiliser	:	N&P: See treatments P: 20 kg ha^{-1}	Rainfall : 397 mm			
			Irrigation: 864 mm			
			Total : 1261 mm			

2. OBJECTIVES

2.1 To determine the optimum levels of Nitrogen and Potassium for ratoon cane on a Somerling series soil.

2.2 To confirm results to earlier N*K trials on similar shallow 'S' set soils.

2.3 To test the availability of exchangeable Potassium.

3. **TREATMENTS**

N (Kg/Ha)		K (Kg/Ha)
N0 = Nil	N3 = 160	K0 = Nil
N1 = 80	N4 = 200	K1 = 150
N2 = 120	N5 = 240	K2 = 300

Notes on Treatments

* Nitrogen as Urea (46% N) and Potassium as KCl (50 %) were applied as a single dressing on 22/08/1989.
* Phosphate as single supers (10.5 % P) at the rate of 20 kg P/Ha was top dressed on 24/08/1989.
* All fertilisers were applied by hand over the cane row.

4. **RESULTS**

4.1 Harvest Data

Table 1: Cane Yield, Sucrose % Cane and Sucrose Yield

Treatment	Tons Cane/Ha	Sucrose % Cane	Tons Sucrose/Ha
N0 0kg N ha^{-1}	57	14.41	8.3
N1 80kg "	90	14.61	13.2
N2 120kg "	106	14.62	15.5
N3 160kg "	110	14.58	16.1
N4 200kg "	124	14.33	17.8
N5 240kg "	126	14.45	18.2
LSD N Means (0.05)	11	0.53	1.8
(0.01)	15	0.73	2.4
Significance	**	NS	**
K0 0kg K ha^{-1}	95	14.33	13.7
K1 150kg "	103	14.40	14.9
K2 300kg "	108	14.77	15.9
LSD K Means (0.05)	8	0.38	1.2
(0.01)	11	0.52	1.7
Significance	**	*	**
N * K Interaction	NS	NS	NS
Trial Mean	102	14.50	14.8
S.E.	9	0.43	1.4
CV%	8.7	3.0	9

4.2 Leaf Analysis

Table 2: Third Leaf Analysis (%dm) in November and December at 3.8 and 5 months of age

TREATMENTS	N		P		K		S		Ca		Mg		Zn (ppm)	
	Nov	Dec	Nov	Dec	Nov	Dec	Nov	Dec	Nov	Dec	Nov	Dec	Nov	Dec
N0 0 kg N/ha	1.56[D]	1.20[D]	0.25	0.21	1.07	0.97	0.19	0.15	0.25	0.21	0.18	0.13	18.5	14.3
N1 80 kg "	1.81	1.42[D]	0.21	0.19	1.05	1.04	0.18	0.14	0.27	0.23	0.21	0.15	17.5	14.0
N2 120 kg "	1.92	1.57[D]	0.21	0.20	0.99	1.11	0.17	0.15	0.29	0.25	0.21	0.17	17.7	15.3
N3 160 kg "	2.08	1.72[D]	0.22	0.22	1.06	1.25	0.18	0.16	0.29	0.24	0.24	0.18	19.2	13.8
N4 200 kg "	2.03	1.84	0.21	0.21	0.92	1.23	0.18	0.16	0.31	0.26	0.23	0.18	19.2	16.0
N5 240 kg "	2.12	1.91	0.21	0.22	1.05	1.41	0.18	0.17	0.30	0.25	0.23	0.19	18.3	15.7
LSD N (0.05)	0.20	0.11	0.022	0.032	0.21	0.13	0.009	0.009	0.050	0.021	0.036	0.018	2.9	2.2
(0.01)	0.27	0.14	0.030	0.044	0.29	0.18	0.012	0.013	0.068	0.028	0.049	0.024	4.0	3.0
Significance	**	**	*	*	NS	**	NS	**	NS	**	*	**	NS	NS
K0 0 kg K/ha	1.93	1.57	0.22	0.27	0.89	1.01	0.18	0.16	0.31	0.25	0.24	0.18	19.5	15.1
K1 150 kg "	1.93	1.59	0.22	0.21	1.05	1.19	0.18	0.15	0.28	0.24	0.021	0.16	17.7	14.9
K2 300 kg "	1.90	1.66	0.22	0.21	1.14	1.30	0.18	0.15	0.27	0.23	0.21	0.16	18.0	14.6
LSD K (0.05)	0.14	0.075	0.015	0.13	0.15	0.095	0.006	0.007	0.035	0.015	0.025	0.012	2.1	1.5
(0.01)	0.19	0.10	0.021	0.018	0.21	0.13	0.009	0.010	0.048	0.020	0.024	0.017	2.8	2.1
Significance	NS	NS	NS	NS	**	**	NS	NS	NS	*	*	*	NS	NS
Interaction N*K	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Mean	2.00	1.61	0.17	0.21	0.78	1.17	0.19	0.16	0.46	0.24	0.22	0.17	19.4	14.9
SE	0.12	0.087	0.012	0.015	0.058	0.11	0.007	0.008	0.052	0.017	0.020	0.015	3.4	1.8
CV%	6.1	5.4	7.4	7.3	7.4	9.5	4.0	5.2	11.2	7.1	9.4	8.7	17.3	12.0

D: Deficient

5. COMMENTS

5.1 General

The interaction between N and K in the harvest data was non significant allowing for the main effect of N to be examined separately from the effect of K.

5.2 Nitrogen

5.2.1 Cane Yield

The effect of Nitrogen on cane yield was highly significant (Table 1). Cane yield increased with increasing rate of N up to a maximum at 200 kg ha^{-1} and tended to level off thereafter.

Cane yields in the N3 treatment have always been abnormally low at this site due to low yields in some of the K_0 plots which have below average soil K levels. The difference between the N3 and N4 treatments is thus exaggerated and appears significant thus confusing the determination of the optimum rate of Nitrogen.

The responses to Nitrogen in the last four crops have been meaned (Appendix 1) and a curve has been fitted to the data from which a derived value at N3 has been determined. From this curve it is apparent that the optimum rate of Nitrogen is nearer 160 kg

5.2.2 Cane Quality

Effects of Nitrogen on sucrose content were variable and non significant.

5.2.3 Sucrose Yield

The effect of Nitrogen on sucrose yield was highly significant and reflected the effects on cane yield (Table 1). Sucrose yield increased with increasing rate of Nitrogen up to 200 kg/ha and increases above this level were apparently due to variable effects on sucrose content.

Examination of meaned data (Appendix 1) indicates that the optimum rate of Nitrogen for this site is between 160 and 180 kg/ha.

5.2.4 Leaf Analysis

Application of Nitrogen tended to stimulate the uptake of all nutrients with the exception of Zn. The effect tended to be more pronounced at the later sampling date.

Levels of Nitrogen were deficient in the control treatments at 3.8 months and deficiencies had spread to all Nitrogen treatments, except the two highest rates, by 5 months.

5.3 Potassium

5.3.1 Cane Yield

The effect of K on cane yield was significant and the response increased with increasing rate of K.

5.3.2 Cane Quality

Sucrose content was increased by the K treatments and the response to the high rate of K was significant.

5.3.3 Sucrose Yield

Yields of sucrose were improved significantly by the K treatments and reflected the effects on both cane yield and quality. The difference in sucrose yield between 150 and 300kg K ha^{-1}, although not significant, was substantial (1 T Suc ha^{-1}) suggesting that 150 kg K ha^{-1} was suboptimal. This result is contrary to last season's finding.

5.3.4 Leaf Analysis

Potassium treatments significantly increased uptake of K and reduced uptake of Ca and Mg (Table 2). There were significant responses to applied K in this trial despite the fact that leaf K levels in the control plots were above the new threshold levels of 0.85 and 0.95 % for November and December respectively. This suggests that the new threshold levels may underestimate the critical concentration of K.

It is interesting to note that in November leaf K associated with the intermediate rate of K was on the level of the old F.A.S. threshold of 1.05 % while leaf K at the high rate of K was above this level. As the response to K application at the high rate was better than at the intermediate rate, the results of the November leaf sample suggest that the old threshold is closer to the critical concentration than the new threshold.

5.3.5 Discussion

Sucrose yield responses to Potassium occurred despite the fact that the soil K level in the control was above F.A.S. threshold for these soils (150 ppm). Factors which could account for the inadequacy of F.A.S. soil K threshold include the absence, in this shallow soil, of subsoil K reserves and the high degree of Ca and Mg saturation levels relative to K. $\left(\frac{Ca + Mg}{K} > 20\right)$

It is possible also that adjustment of the threshold is needed only in the case of winter harvested cane. This would be to compensate for the lower K uptake in spring, a characteristic of cane growing on a winter cycle. The fact that the response of the high rate of K application was better than at the intermediate level indicates that the soil K threshold is equal or larger than 282 ppm. (See page 1: soil test level of K_2 before fertilization.)

6. CONCLUSIONS

* Results of this trial have shown that optimum sucrose yields occur at approximately 160 - 180 kg N/ha on this old ratoon on a 'S' set soil. This is higher than the rate of 140 kg N/ha currently recommended for older ratoons on these soils and may result from the timing of application. Fertilizer is usually applied as a single application when both the soil type (shallow) and the seasonal cycle (winter) may require split applications. This will be investigated next year.

* Sucrose yield responded to Potassium application and the optimum rate was between 150 and 300 kg K ha^{-1}.

* F.A.S. soil K threshold was found to be inadequate and evidence pointed to critical levels of approximate 280 ppm.

* The new F.A.S. leaf K threshold for winter cut cane was found to be less accurate than the old threshold and its validity was questioned.

* This trial is being continued and is now in its 12th ratoon.

PCH/AGK/fjs
21 May 1991

APPENDIX 1

Fig.1: Responses of Cane Yield and Sucrose Yield to Rates of Nitrogen (means of 4 crops, 8R - 11R)

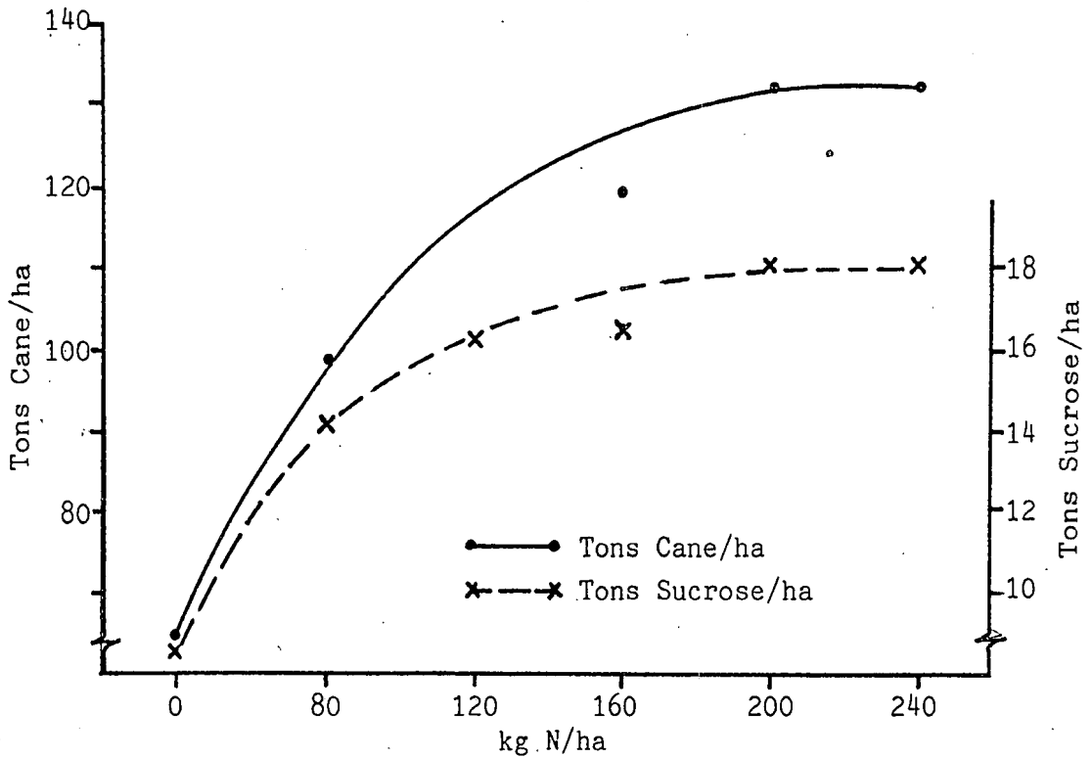


Table 1: Responses to Additional Amounts of Nitrogen

Response	Rates of N (kg/ha)				
	0-80	80-120	120-160	160-200	200-240
Tons Cane/ha	34	18	10*	5	-
%	52	18	8	4	-
Tons Sucrose/ha	4.8	2.1	0.9*	0.8	-
%	51	15	6	5	-

* Using values from curves in fig.1

SOUTH AFRICAN SUGAR INDUSTRY

AGRONOMISTS' ASSOCIATION

EXPERIMENT RESULTS

CODE: NK16/86/Sw UBO Som

CAT.NO.: 1650

TITLE: LEVELS OF NITROGEN AND POTASSIUM FOR RATOON CANE ON A SOMERLING SERIES SOIL

1. PARTICULARS OF PROJECT

This crop	:	10th Ratoon	Soil Analysis : Date 26/7/1988			
Site	:	Ubombo Ranches Field Speculation 4	pH	OM%	Clay%	PDI
			6.77	-	> 30	0.35
Region	:	Northern Irrigated (Swaziland)	ppm			
Soil Set/Series:		S/Somerling	P	Ca	Mg	K0 185 K1 252 K2 293
Design	:	6 x 3 factorial	27	2608	800	
Variety	:	NCo376	Age : 12 months Dates : 5/7/88 - 5/7/89			
Fertiliser	:	See treatments	Rainfall : 494 mm Irrigation : 736 mm Total : 1230 mm			

2. OBJECTIVES

2.1 To determine the optimum levels of nitrogen and potassium for ratoon cane on a Somerling series soil.

2.2 To confirm results to earlier N K trials on similar shallow 'S' set soils.

2.3 To test the availability of exchangeable potassium.

3. TREATMENTS

N (Kg/Ha)		K (Kg/Ha)
N0 = Nil	N3 = 160	K0 = Nil
N1 = 80	N4 = 200	K1 = 150
N2 = 120	N5 = 240	K2 = 300

Notes on Treatments

* Nitrogen as urea (46% N) was applied as a single dressing 8 weeks after harvesting.
* Potassium as KCl (50%) was top-dressed 8 weeks after harvesting.
* Phosphate as single supers (10.5 % P) at the rate of 40 kg P/Ha was top dressed 8 weeks after harvesting.
* All fertilisers were applied by hand over the cane row.

4. RESULTS

4.2 Harvest Data

Table 1: Cane Yield, Sucrose % Cane and Sucrose Yield

Treatment	Tons Cane/Ha	Sucrose % Cane	Tons Sucrose/Ha
N0 0kg N/ha	61	13.8	8.4
N1 80kg N/ha	92	14.1	13.0
N2 120kg N/ha	110	14.1	15.5
N3 160kg N/ha	116	13.7	15.9
N4 200kg N/ha	127	13.6	17.2
N5 240kg N/ha	131	13.7	17.9
LSD N Means (0.05)*	9	0.6	1.1
(0.01)**	12	0.8	1.5
Significance	**	NS	**
K0 0kg K/ha	100	13.7	13.6
K1 150kg K/ha	108	13.9	15.0
K2 300kg K/ha	110	13.8	15.2
LSD K Means (0.05)*	6	0.4	0.8
(0.01)**	8	0.6	1.1
Significance	**	NS	**
Trial Mean	106	13.8	14.6
S.E.	7.1	0.5	0.9
CV%	6.7	3.4	6.4
N * K Interaction	*	NS	*

4.2 Foliar Analysis

Table 2: Third Leaf Analysis (% dm) at 3.8 (October) and 4.5 (November) Months of Age

Treatment	N		P		K		Ca		Mg		S	
	3.8 m	4.5 m	3.8 m	4.5 m	3.8 m	4.5m	3.8 m	4.5 m	3.8 m	4.5 m	3.8 m	4.5 m
N0 - 0kg N/ha	1.75[M]	1.59[D]	0.22	0.19	0.98[M]	0.87[D]	0.28	0.28	0.15	0.16	0.15	0.14
N1 - 80kg N/ha	2.17	1.65[D]	0.22	0.15[D]	1.10	0.84[D]	0.27	0.32	0.17	0.19	0.17	0.14
N2 - 120kg N/ha	2.37	1.76[M]	0.23	0.15[D]	1.11	0.88[D]	0.29	0.32	0.18	0.20	0.17	0.14
N3 - 160kg N/ha	2.40	1.82	0.22	0.15[D]	1.10	0.84[D]	0.28	0.32	0.19	0.23	0.18	0.15
N4 - 200kg N/ha	2.47	1.82	0.23	0.15[D]	1.09	0.80[D]	0.30	0.35	0.19	0.23	0.18	0.15
N5 - 240kg N/ha	2.52	1.32	0.22	0.15[D]	1.15	0.92[D]	0.29	0.33	0.18	0.22	0.18	0.15
LSD Means 0.05*	0.14	0.13	0.016	0.018	0.11	0.088	0.028	0.030	0.018	0.023	0.006	0.011
0.01**	0.20	0.17	0.022	0.025	0.15	0.12	0.039	0.041	0.025	0.032	0.009	0.016
Significance	**	**	NS	**	NS	NS	NS	**	**	**	**	*
K0 - 0kg K/ha	2.23	1.81	0.22	0.16[D]	0.85[D]	0.75[D]	0.32	0.36	0.20	0.24	0.18	0.15
K1 - 150kg K/ha	2.32	1.77[M]	0.23	0.16[D]	1.19	0.90[D]	0.27	0.31	0.17	0.20	0.17	0.15
K2 - 300kg K/ha	2.29	1.76[M]	0.22	0.15[D]	1.22	0.92[D]	0.26	0.30	0.16	0.18	0.17	0.14
LSD Means 0.05*	0.10	0.091	0.011	0.013	0.079	0.062	0.020	0.021	0.013	0.017	0.004	0.008
0.01**	0.14	0.12	0.015	0.018	0.11	0.084	0.028	0.029	0.018	0.023	0.006	0.011
Significance	NS	NS	NS	NS	**	**	*	**	**	**	**	*
Mean	2.28	1.78	0.23	0.16	1.09	0.86	0.23	0.32	0.18	0.21	0.17	0.15
SE	0.12	0.11	0.013	0.015	0.091	0.072	0.023	0.024	0.015	0.019	0.005	0.009
CV %	5.2	6.0	5.8	5.6	8.4	8.3	8.2	7.6	8.5	9.4	3.0	6.4

D: Deficient
M: Marginal

Fig 1: Yield of Cane as a Function of N Application Rates and at Three Levels of K Addition

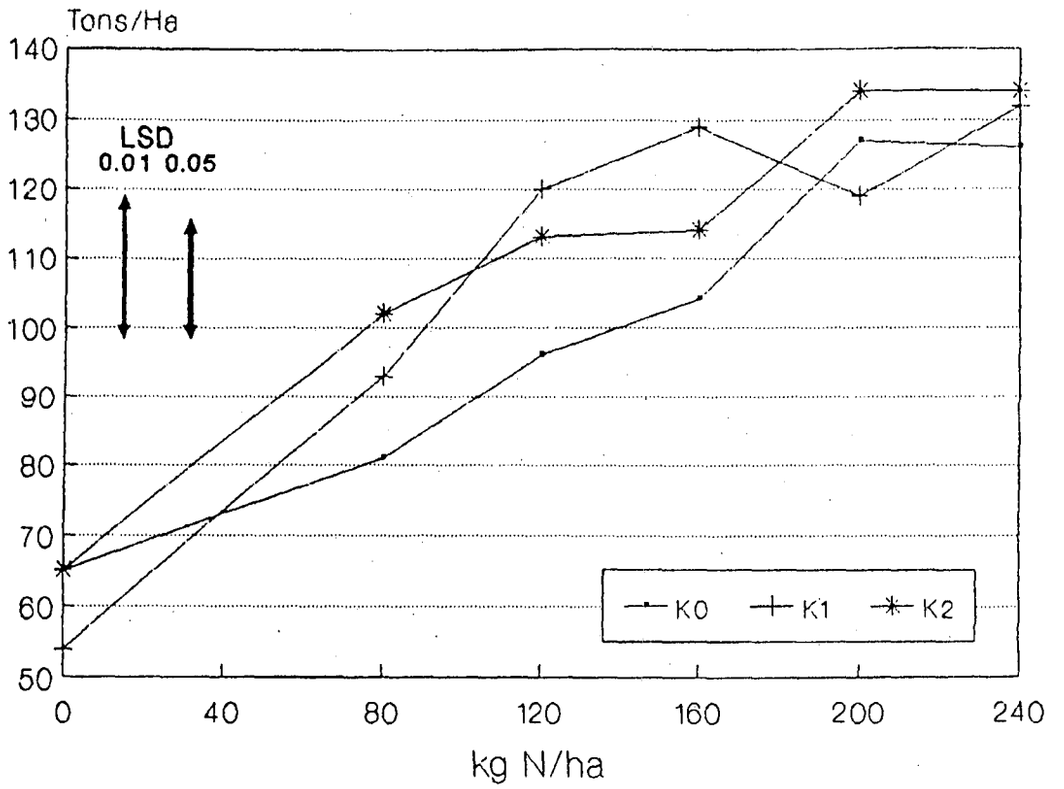
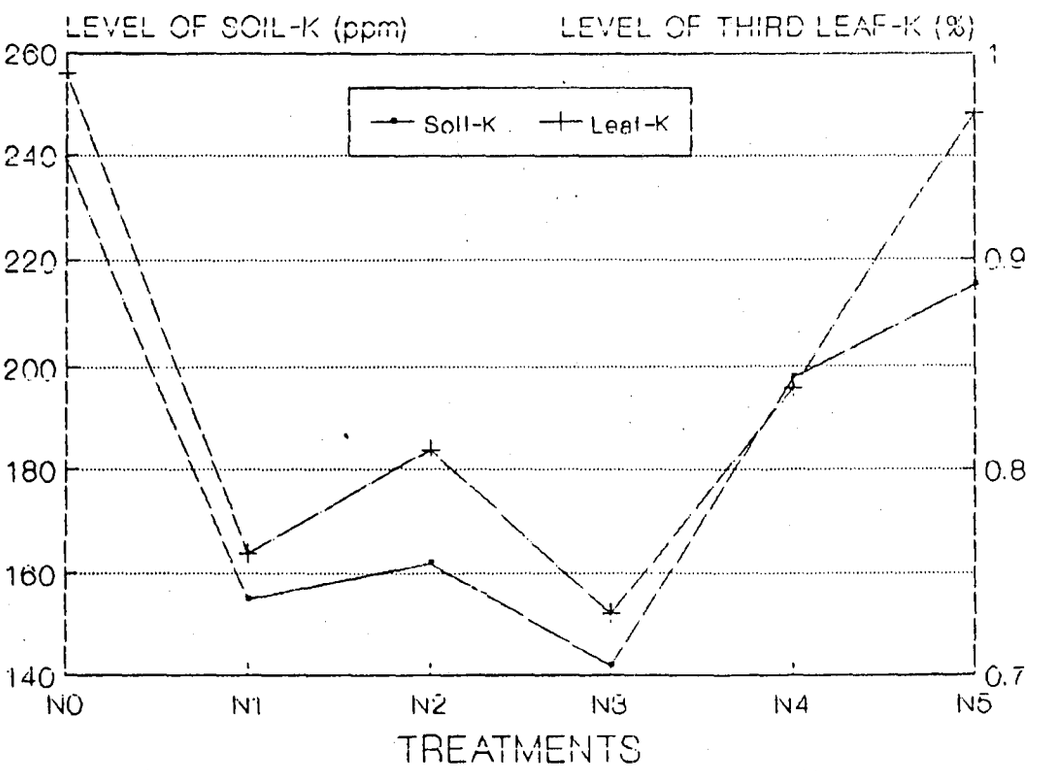


Fig 2: Level of Soil Test-K and Third Leaf-K at 3.8 Months in K0 Plot as a Function of N Treatments



5. COMMENTS

5.1 General

* Cane yield at this site was on average lower than that for the last two seasons although the highest yield was 131 T Cane/ha. It was noted that the CV's were particularly low in this trial.

* The interaction between N and K was significant with respect to yield of Cane and Sucrose (Table 1). This means that the effect of N or K on responses cannot be examined separately and the combined response to the different levels of N and K treatments are shown in Figure 1.

5.2 Nitrogen

5.2.1 Harvest data

* Optimum cane yields were achieved at 120 kg N/ha in the K 1 treatments and at 200 kg/ha in the K0 and K2 treatments.

* Quality was not significantly affected by the N treatments.

* Sucrose yield therefore followed the same trend as cane yield.

* In previous seasons, cane yield showed a trend to respond up to the highest rate of N application but optimum response was also achieved at 120 kg N/ha.

5.2.2 Foliar Analysis

* At 4.5 months of age plots which had received either no N or low rates of N showed levels of N in third leaf to be deficient.

* Deficiencies in P and K, irrespective of N treatments, became widespread at 4.5 months of age (Table 2).

* Mg and S uptake were enhanced by increasing rates of N.

5.3 Potassium

5.3.1 Harvest data

* Cane yield tended to respond to potash application, especially in the medium range of N rates (N1 to N3). (See Figure 1). This is because the K0 plots that received these medium rates have low soil-K status as shown in Figure 2.

* 300 kg K/ha did not give a significantly better response than 150 kg K/ha.

* Quality was not influenced by K treatment.

* Sucrose yield followed the same trend as cane yield and optimum yield was also achieved at the rate of 150 kg K/ha.

5.3.2 Foliar Analysis

* Third leaf K content reflected correctly the increasing rates of the potash treatments at both sampling times.

* K uptake in the K0 plots closely followed the level of soil-K as shown in Figure 2. The good relationship probably reflects the fact that in this shallow soil there are no K reserves at depth which could confound the effect of K uptake in the sampling layer.

* In Figure 2 it can be seen that the potassium content of third leaf at 3.8 months were all deficient, particularly when associated with the N1, N2 and N3 treatments. As the response to potash was significant precisely at those levels of N (Figure 1), it can be gathered that the levels of soil test-K becomes critical at about 180 ppm.

* High levels of K suppress Ca and Mg uptake.

5.4 Summary

* The yield response to N treatment varied with the level of K and optimum yields were recorded at 120 kg N/ha.

* Yield responded to potash and the optimum rate was 150 kg K/ha.

* Leaf samples taken in the first months of growth showed that the K content of the control cane was markedly below threshold despite of the soil K level of 185 ppm.

* Fertilizer topdressings were applied in early September in this trial and it is likely that the responses to N and K may have been influenced by the unusually cool, overcast and wet conditions that were experienced during October (i.e. 170 mm rainfall, cf. LTM of $\pm$ 60 mm).

* The results of this trial indicate that the FAS soil-K threshold may be inadequate in preventing K deficiency under conditions of excessive moisture.

* This trial has been continued into its 11th ratoon.

PCH/aw
14 May 1990

SOUTH AFRICAN SUGAR INDUSTRY

AGRONOMISTS' ASSOCIATION

EXPERIMENT RESULTS

CODE: NK16/86/Sw UBO Som

CAT.NO.: 1650

TITLE: LEVELS OF NITROGEN AND POTASSIUM FOR RATOON CANE ON A SOMERLING SERIES SOIL

1. PARTICULARS OF PROJECT

This crop	:	12th Ratoon
Site	:	Ubombo Ranches Field Speculation 4
Region	:	Northern Irrigated (Swaziland)
Soil Set/Series	:	S/Somerling
Design	:	6 x 3 factorial 2 replications
Variety	:	NCo376
Fertiliser	:	N&P: See treatments P: 20 kg ha^{-1}

Soil Analysis : Date 15/02/1991

pH	OM %	Clay %	Silt %	Sand %
7.2	2.8	34	14	55

ppm

P		K	Ca	Mg	(Ca+Mg)/K
32	K_0	154	2538	916	22
	K_1	324	2619	901	11
	K_2	361	2457	920	9

CEC : 21.7 meq/100 g soil

KDI : 0.82

Age : 12.25 months

Dates : 17/07/90 - 23/07/91

Rainfall : 528 mm

Irrigation: 725 mm

Total : 1253 mm

2. OBJECTIVES

2.1 To determine the optimum levels of Nitrogen and Potassium for ratoon cane on a Somerling series soil.

2.2 To confirm results to earlier N*K trials on similar shallow 'S' set soils.

2.3 To test the availability of exchangeable Potassium.

3. TREATMENTS

N (Kg ha^{-1})		K (Kg ha^{-1})
N_0 = Nil	N_3 = 160	K_0 = Nil
N_1 = 80	N_4 = 200	K_1 = 150
N_2 = 120	N_5 = 240	K_2 = 300

Notes on Treatments

* Nitrogen was applied in the form of Urea (46% N) and application was split. 40% of the treatment rate was top-dressed on 06/08/1990, 3 weeks after harvest while the balance was top-dressed on 19/10/1990, 3 months after harvest. All Nitrogen was banded on the cane row.

* Potassium as KCl (50% K) was surface broadcast as a single dressing on 03/08/1990, 2.5 weeks after harvest.

* Phosphate as single supers (10.5% P) at the rate of 20 kg P ha^{-1} was surface broadcast on 20/08/1990, 4.5 weeks after harvest.

4. RESULTS

4.1 Soil Analysis

Table 1: K, Ca, Mg status of the soil profile - February 1991

Depth (cm)	K_0 K	Ca	Mg	(Ca+Mg)/K	K_1 K	Ca	Mg	(Ca+Mg)/K	K_2 K	Ca	Mg	(Ca+Mg)/K
	ppm				ppm				ppm			
0-15	179(24)	2350(114)	919(38)	18	452	2673	983	8	331	2395	898	10
20-30	109(15)	2640 (52)	743(31)	31	145	2640	772	23	164	3075	762	23
40-50	83(13)	3057(159)	775(38)	46	89	2845	684	40	94	3185	842	43

( ) Standard error
Samples taken in 4 plots in control and 2 plots in each of K_1 and K_2.

Table 2: Properties of the soil profile - February 1991

Depth (cm)	pH	Clay %	OM %	CEC meq/100g soil	TCEC meq/100g clay	KDI
0-15	7.03 (0.15)	34.01 (1.43)	2.77 (0.19)	21.46 (0.59)	63.10	0.82 (0.07)
20-30	6.81 (0.03)	37.28 (1.82)	2.40 (0.14)	21.28 (0.33)	57.08	0.74 (0.06)
40-50	6.93 (0.03)	37.99 (2.94)	1.80 (0.22)	22.61 (0.56)	59.52	0.72 (0.05)

( ) Standard error
Note: Samples taken from 4 control plots

4.2 Harvest Data

Table 3: Cane Yield, Sucrose % Cane and Sucrose Yield

Treatment	Tons Cane/Ha	Sucrose % Cane	Tons Sucrose/Ha
N_0 0kg N ha^{-1}	43	14.76	6.3
N_1 80kg "	73	14.56	10.6
N_2 120kg "	87	14.18	12.3
N_3 160kg "	105	14.34	14.9
N_4 200kg "	113	13.96	15.7
N_5 240kg "	116	13.94	16.1
LSD N Means (0.05)	13	0.76	1.9
(0.01)	18	1.04	2.5
Significance	**	NS	**
K_0 0kg K ha^{-1}	82	14.23	11.6
K_1 150kg "	91	14.17	12.8
K_2 300kg "	94	14.48	13.5
LSD K Means (0.05)	9	0.54	1.3
(0.01)	12	0.74	1.8
Significance	*	NS	*
N * K Interaction	**	NS	**
Trial Mean	89	14.29	12.7
S.E.	10.5	0.62	1.5
CV%	12	4.4	12.1

Figure 1: Cane yield responses to Nitrogen and Potassium

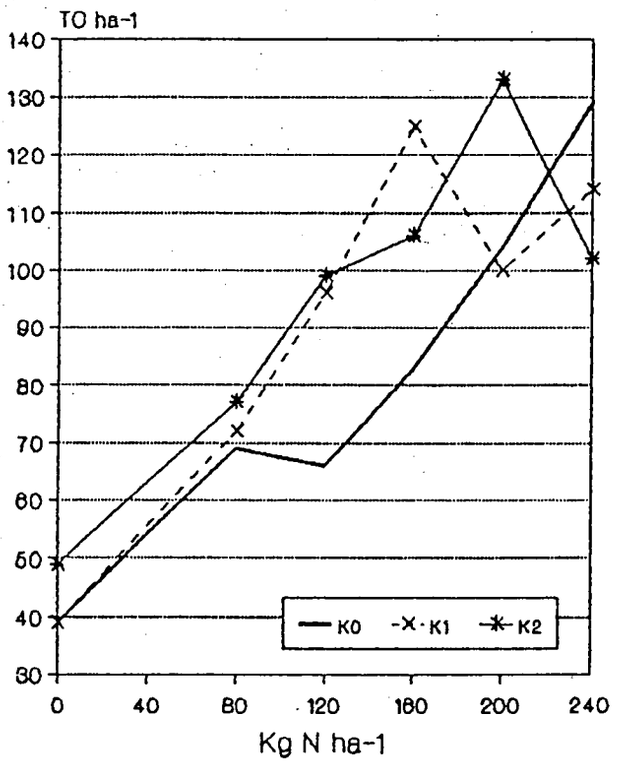
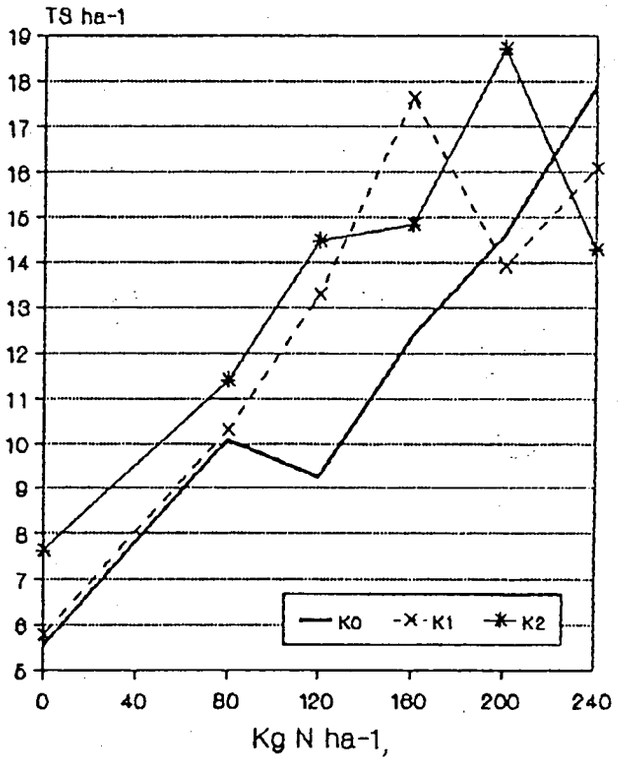


Figure 2: Sucrose yield reponses to Nitrogen and Potassium



4.3 Leaf Analysis

Table 4: Third Leaf Analysis (% dm) at 3.0 months in October

Treatments		N	P	K	S	Ca	Mg	Zn(ppm)
N_o 0 kg N/ha		1.43^D	0.20	0.97	0.16	0.29	0.17	14.8
N_1 80 kg "		1.42^D	0.22	0.96	0.16	0.31	0.19	15.5
N_2 120 kg "		1.48^D	0.20	0.96	0.16	0.33	0.21	16.5
N_3 160 kg "		1.67^D	0.20	0.96	0.17	0.35	0.23	15.5
N_4 200 kg "		1.69^D	0.19	0.98	0.16	0.34	0.23	14.5
N_5 240 kg "		1.72^D	0.20	1.03	0.17	0.36	0.23	15.7
LSD N	0.05	0.18	0.020	0.081	0.011	0.042	0.019	2.3
	0.01	0.26	0.027	0.11	0.015	0.058	0.026	3.2
Significance		**	NS	NS	NS	*	**	NS
K_o 0 kg K/ha		1.47	0.21	0.87	0.17	0.36	0.23	14.7
K_1 150 kg K/ha		1.58	0.20	1.00	0.16	0.32	0.20	16.2
K_2 300 kg K/ha		1.65	0.20	1.07	0.16	0.31	0.20	15.4
LSD K	0.05	0.13	0.014	0.057	0.008	0.030	0.013	1.6
	0.01	0.18	0.019	0.078	0.011	0.041	0.018	2.3
Significance		*	NS	**	*	**	**	NS
Interaction		NS	NS	*	NS	NS	**	NS
Mean		1.57	0.20	0.98	0.16	0.33	0.21	15.4
S.E. One Plot		0.15	0.016	0.066	0.010	0.035	0.015	1.9
CV %		9.9	7.9	6.8	5.7	10.5	7.5	12.4

D: Deficient

Table 5: The effect of N * K on third leaf content of K(%dm)

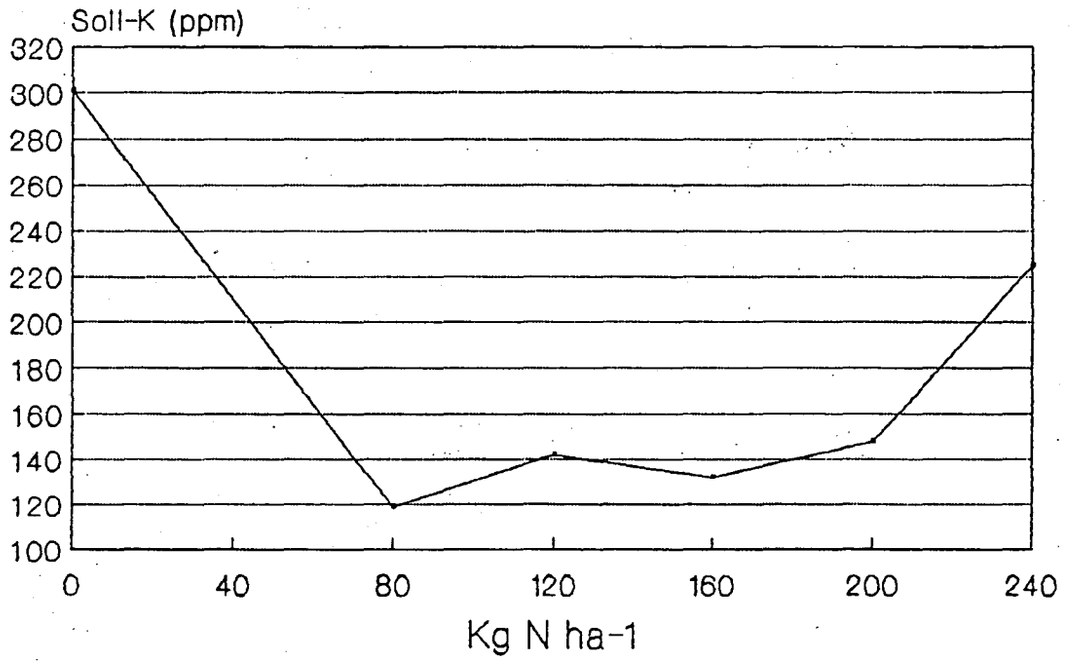
Treatments	N_o	N_1	N_2	N_3	N_4	N_5
K_o	1.01	0.83	0.88	0.76	0.85	0.90
K_1	0.93	1.05	0.98	1.02	0.97	1.02
K_2	0.97	1.01	1.03	1.10	1.10	1.18

Table 6: Third Leaf Analysis (% dm) at 5.0 months in December

Treatments		N	P	K	Ca	Mg
N_0	0 kg N/ha	1.65[D]	0.23	0.91	0.28	0.15
N_1	80 kg "	1.68[D]	0.23	1.00	0.27	0.16
N_2	120 kg "	1.74	0.23	1.01	0.28	0.18
N_3	160 kg "	1.80	0.24	1.15	0.27	0.18
N_4	200 kg "	1.75	0.22	1.12	0.27	0.18
N_5	240 kg "	1.82	0.23	1.17	0.27	0.20
LSD N	0.05	0.14	0.013	0.11	0.038	0.023
	0.01	0.17	0.018	0.15	0.053	0.031
Significance		NS	NS	**	NS	**
K_0	0 kg K/ha	1.73	0.23	0.94	0.29	0.20
K_1	150 kg K/ha	1.74	0.23	1.06	0.29	0.17
K_2	300 kg K/ha	1.75	0.23	1.19	0.25	0.16
LSD K	0.05	0.090	0.009	0.077	0.027	0.016
	0.01	0.12	0.013	0.11	0.037	0.022
Significance		NS	NS	**	**	**
Interaction		NS	NS	*	*	*
Mean		1.74	0.23	1.06	0.28	0.18
S.E. One Plot		0.11	0.010	0.089	0.026	0.020
CV %		6.1	4.2	8.4	9.2	11.0

D: Deficient

Figure 3: Variation in soil-K levels in K_0 treatments



5. COMMENTS

5.1 General

Cane yield in this shallow 'S' set was lower this season than in the two previous seasons.

Past results have shown the N requirement of this old ratoon to be higher than the currently recommended rate of 140 kg N ha^{-1} for 'S' set soils. One of the reasons for this discrepancy was thought to be the method of N application which consisted of a single top-dressing. As a result, N application was split this season.

The interaction between N and K was significant with respect to yield of cane and sucrose (Table 1). The effects of N or K could therefore not be examined separately and the responses to the different levels of N and K treatments are shown in Figure 1.

5.2 Soil Analysis

Method of potassium fertilizer application in this ratoon was changed from top-dressing on the cane row to broadcasting. Soil sampling method was also changed and consisted of 40 cores taken from each plot at a ratio of 15 on the row to 24 interow (ie. 1:1.5 instead of 1:8). In the subsoil, samples consisted of 20 cores taken at a ratio of 8 on row to 12 interow (1:1.5). The samples were taken in February ±6 months after fertilization.

K status in the control was above FAS threshold for soils containing between 30 and 40 clay %. The value of the (Ca + Mg)/K ratio was high, however, indicating that the availability of K might be limited by the relatively high content of Ca and Mg and responses to K application are likely.

K status of the control at depth was below threshold, (Ca + Mg)/K ratio increased and KDI decreased indicating decreasing availability of K reserves with depth (Table 1 and 2).

The effects of K treatments on the soil-K status were most apparent in the topsoil. The decrease in soil-K between topsoil and the 20-30 cm horizon was sharp in all treatments (Table 1). This and the fact that cumulated additions of K, over the last 5 years, induced only moderate differences in K status at depth between treatments indicates that leaching of K is slow. Hence, surface application of K to this soil is likely to remain positionally unavailable to the bulk of the root system.

5.3 Nitrogen

5.3.1 Cane Yield

Maximum cane yield appeared to vary with K application. The effects were not consistent, however, and maximum yield was achieved at 240 kg N ha^{-1}, 200 kg N ha^{-1} and 160 kg N ha^{-1} in the K_0, K_2 and K_1 treatments respectively (Fig. 1). The magnitude of the maximum yields obtained were similar for all levels of K.

5.3.2 Cane Quality

Increasing the rate N decreased sucrose content. The difference between N_0, N_4 and N_5 was significant.

5.3.3 Sucrose Yield

Sucrose yield reflected cane yield (Fig. 2) and maximum yields were achieved at 240 kg N ha^{-1}, 200 and 160 kg N ha^{-1} in the K_0, K_2 and K_1 treatments respectively.

5.4 Potassium

5.4.1 Cane Yield

Cane yield responded to K application in the medium range of N rates (N_2 to N_4 in Fig. 1). This is because the K_0 plots that received these medium rates have low-K status (Fig 3).

The higher rate of K was only better than the intermediate rate in the N_4 treatment.

5.4.2 Cane Quality

The effect of K on cane quality was variable and non significant.

5.4.3 Sucrose Yield

Sucrose yield followed the same trend as cane yield and the intermediate rate (150 kg K h^{-1}) appeared optimum.

5.5 Leaf Analysis

N-leaf content at 3.0 months of age was below threshold in all N treatments, suggesting that the second application should have been applied earlier. This deficiency in the early stage of growth could account for the low yield observed this season. By December, however, the deficiencies had been alleviated in most treatments.

Increasing the rate of N increased the uptake of K, Ca and Mg.

Leaf-K content in the control in October and December was similar to the new FAS threshold. Leaf-K in October and December associated with the intermediate rate of K was between the new and the old FAS threshold, while that of the high rate was above the old threshold. Since the response to K was better at the high rate than at the intermediate rate, these results suggest that the old threshold is closer to the critical concentration than the new threshold.

The interaction between K and N was significant and table 5 shows that increasing the rate of N stimulated the uptake of K in the K_2 treatment. K addition increased the uptake of N significantly while Ca and Mg uptake were decreased.

6. CONCLUSIONS

* N application was split this season but the timing of the 2nd application appeared to have been incorrect and may have affected the results.

* The optimum rate of N this season was found to be dependent on the soil K status. The lowest rate of N at which maximum sucrose yield was achieved was 160 kg N ha^{-1} (at the intermediate level of K:150 kg K ha^{-1}).

* The rates of N which were optimum in this trial were higher than the currently recommended 140 kg N ha^{-1}. This may have resulted from the incorrect timing of the 2nd application of N.

* Sucrose yield responded to potash application and the optimum rate was between 150 kg ha^{-1} and 300 kg K ha^{-1}.

* Result of this trial confirmed the inaccurancy of both the soil and the new leaf-K threshold for winter cut cane and suggest that the old leaf-K threshold was adequate.

* Subsoil sampling showed K reserves at depth to be low and indications are that leaching of K in this soil has been slow. It is suspected that surface application of K fertilizer is ineffective as a method of supplying K to the bulk of the root system.

* This trial is being continued and is now in its 13 ratoon.

PCH/fkd
24.02.92

SOUTH AFRICAN SUGAR INDUSTRY
AGRONOMISTS' ASSOCIATION

EXPERIMENT RESULTS

CODE: NK16/86/Sw UBO Som
CAT No: 1650

TITLE: LEVELS OF NITROGEN AND POTASSIUM FOR RATOON CANE ON A SOMERLING SERIES SOIL

1. PARTICULARS OF PROJECT

This crop	:	13th Ratoon	
Site	:	Ubombo Ranches Field Speculation 4	
Region	:	Northern Irrigated (Swaziland)	
Soil Set/Series:		S/Somerling	
Design	:	6 * 3 factorial 2 replications	
Variety	:	NCo376	
Fertilizer	:	N&K: See treatments P = 0	

Soil Analysis : Date 26/06/1992

pH	OM %	Clay %	Silt %	Sand %
7.07	2.8	34	14	55

ppm					
P		K	Ca	Mg	(Ca+Mg)/K
22	K_0	133	2583	826	27
	K_1	208	2548	974	18
	K_2	256	2368	853	14

CEC : 21.7 meq/100 g soil
KDI : 0.62

Age : 11.8 months
Dates : 23/07/91 - 16/07/92

Rainfall : 376 mm
Irrigation: 1183 mm
Total : 1559 mm

2. OBJECTIVES

2.1 To determine the optimum levels of Nitrogen and Potassium for ratoon cane on a Somerling series soil.

2.2 To confirm results to earlier N*K trials on similar shallow 'S' set soils.

2.3 To test the availability of exchangeable Potassium.

3. TREATMENTS

NK (Kg ha^{-1})		K (Kg ha^{-1})
N_0 = Nil	N_3 = 160	K_0 = Nil
N_1 = 80	N_4 = 200	K_1 = 150
N_2 = 120	N_5 = 240	K_2 = 300

Notes on Treatments

* Nitrogen as Urea (46% N) was applied by banding on the cane row on 29/08/91, 1.2 months after harvest.

* Potassium as KCl (50% K) was broadcast and incorporated in the interrow to a depth of ± 20 cm with an alubuster on 20/08/91, a month after harvest.

Notes on soil sampling

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

Subsoil: 20 cores were taken in four selected plots of the control and two of the 300 kg K ha^{-1} treatment 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 (ppm) of the soil profile - June 1992

Depth (cm)	Control				300 kg K ha^{-1}			
	K	Ca	Mg	(Ca+Mg)/K	K	Ca	Mg	(Ca+Mg)/K
0 - 15	105	2955	749	35	108	2604	735	31
20 - 30	93	2922	717	39	142	2612	768	24
40 - 50	85	3365	805	49	91	3450	922	48

Table 2: K, Ca and Mg status (ppm) of the topsoil - June 1992*

Treatments	K	Ca	Mg	(Ca+Mg)/K
N_0 0 kg N/ha	219	2845	844	19
N_1 80 kg "	159	2430	800	22
N_2 120 kg "	225	2454	814	18
N_3 160 kg "	210	2252	1058	19
N_4 200 kg "	187	2645	925	23
N_5 240 kg "	193	2373	865	17
LSD N (0.05)	75	603	342	6.5
SED ±	35.6	285.9	162	3.1
Significance	NS	NS	NS	NS
K_0 0 kg K/ha	133	2583	826	27
K_1 150 kg K/ha	208	2548	974	18
K_2 300 kg K/ha	256	2368	853	14
LSD K (0.05)	53	426	242	5
SED ±	25.2	202.1	114.6	2.2
Significance	**	NS	NS	**
Interaction	NS	NS	NS	NS
Mean	199	2500	884	20
CV%	31.0	19.8	31.7	27.2

* Note: at end of 13th ratoon

4.2 Leaf Analysis

Table 2: Third leaf Analysis (%dm) at various ages

Treatments	November (4.1 months)					December (4.6 months)					January (6.0 months)				
	N	P	K	Ca	Mg	N	P	K	Ca	Mg	N	P	K	Ca	Mg
N_0 0 kg N/ha	1.67	0.23	0.93	0.32	0.17	1.39	0.22	1.07	0.29	0.24	1.26	0.20	0.97	0.30	0.16
N_1 80 " "	1.69	0.23	0.98	0.27	0.21	1.44	0.22	1.02	0.28	0.24	1.23	0.21	1.00	0.29	0.19
N_2 120 " "	1.70	0.22	0.99	0.32	0.21	1.47	0.20	1.13	0.25	0.25	1.33	0.20	1.03	0.27	0.18
N_3 160 " "	1.89	0.23	1.04	0.30	0.25	1.58	0.21	1.15	0.29	0.28	1.30	0.20	1.07	0.30	0.21
N_4 200 " "	1.85	0.22	0.94	0.30	0.22	1.64	0.20	1.15	0.29	0.27	1.38	0.20	1.15	0.29	0.21
N_5 240 " "	2.01	0.23	1.05	0.33	0.24	1.79	0.21	1.25	0.31	0.30	1.41	0.20	1.12	0.30	0.21
LSD N (0.05)	0.12	0.01	0.09	0.07	0.04	0.12	0.02	0.09	0.09	0.05	0.12	0.01	0.10	0.07	0.04
SED ±	0.05	0.01	0.04	0.03	0.02	0.06	0.01	0.04	0.04	0.03	0.06	0.004	0.05	0.03	0.02
Significance	**	NS	NS	NS	*	**	NS	**	NS	NS	NS	NS	**	NS	**
K_0 0 kg K/ha	1.82	0.23	0.86	0.32	0.25	1.59	0.22	0.01	0.27	0.29	1.32	0.20	0.99	0.32	0.21
K_1 150 " "	1.82	0.22	1.03	0.32	0.21	1.51	0.20	1.16	0.32	0.26	1.34	0.21	1.10	0.28	0.18
K_3 300 " "	1.76	0.23	1.07	0.28	0.19	1.54	0.21	1.21	0.27	0.24	1.29	0.20	1.07	0.27	0.18
LSD K (0.05)	0.08	0.01	0.07	0.05	0.03	0.09	0.02	0.07	0.06	0.04	0.09	0.01	0.07	0.05	0.03
SED ±	0.04	0.004	0.03	0.02	0.01	0.04	0.01	0.03	0.03	0.02	0.04	0.003	0.03	0.02	0.01
Significance	NS	NS	**	NS	**	NS	NS	**	NS	*	NS	NS	*	NS	*
Interaction N * K	NS	NS	*	NS	*	NS	NS	NS	NS	NS	NS	NS	**	NS	*
Mean	1.80	0.23	0.99	0.31	0.22	1.55	0.21	1.13	0.28	0.26	1.32	0.20	1.06	0.29	0.19
CV%	5.2	4.6	7.9	19.0	15.4	6.4	9.4	7.1	24.9	16.3	7.7	4.3	7.8	18.4	13.1

Table 3: The effect of N * K on third leaf content of K (%dm) in November and January

Treatment	November (4.1 months)						January (6.0 months)					
	N_0	N_1	N_2	N_3	N_4	N_5	N_0	N_1	N_2	N_3	N_4	N_5
K_0	0.95	0.88	0.82	0.80	0.83	0.92	0.95	0.97	0.92	0.85	1.04	1.23
K_1	0.90	0.95	1.14	1.17	0.98	1.08	0.93	1.11	1.14	1.23	1.22	0.98
K_3	0.93	1.12	1.00	1.16	1.03	1.16	1.02	0.93	1.02	1.12	1.19	1.17
LSD N * K (0.05) = 0.16							LSD N * K (0.05) = 0.18					

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

Treatment	Tons cane/ha	Suc % cane	Tons suc/ha
N_0 0kg N/ha	46	14.43	6.6
N_1 80kg "	78	15.07	11.7
N_2 120kg "	93	14.92	13.9
N_3 160kg "	107	14.45	15.4
N_4 200kg "	117	14.59	17.1
N_5 240kg "	125	14.34	17.9
LSD N (0.05)	17	0.37	2.5
SED ±	8.2	0.18	1.2
Significance	**	**	**
K_0 0kg K/ha	90	14.42	12.9
K_1 150kg "	95	14.81	14.0
K_2 300kg "	98	14.66	14.3
LSD K (0.05)	12	0.26	1.7
SED ±	5.8	0.13	0.8
Significance	NS	*	NS
Interaction N * K	NS	NS	NS
Mean	94	14.63	13.8
CV%	15.2	2.1	14.7

5. COMMENTS

5.1 General

There was no statistically significant interaction between N and K in either the soil or the harvest data, (table 2 & 4). As result of this, the influence of N and K cane be examined separately.

5.2 Soil Analysis

K levels measured in the control plots of the K treatments at the end of this 13th ratoon were slightly lower than the FAS threshold of 150 ppm (34% clay). It was therefore expected that K applications would increase yields (table 1). K levels in the treatments were increased significantly (P=0.05), and reflected the amounts of K applied to the soil. Soil K content of the lower levels of the soil was increased by the incorporation of K. Ca+Mg/K ratios were greater than the level of 16 (proposed for winter cut cane) except for the 300 kg K/ha treatment, indicating that the application of higher rates of K could check the surpressing effect of excessive amounts of Ca and Mg on the uptake of K (table 2). High CV's were observed, indicating high variability in the nutrient status of the soil.

5.3 Leaf Analysis

Leaf analysis in November, December and January revealed that leaf N was deficient in November (treatments N0 - N2), December and January (treatments N0 - N5). N levels were significantly (P=0.05) increased by treatments in November and December (treatments N3 - N5), although increases in December were not sufficient to reach threshold levels (1.8% dm).

Leaf K level in the K control was below the old (1.05% dm), but above the new threshold level in November. In December, leaf K levels were above both the new (0.95% dm), and the old (1.05% dm) threshold levels. Leaf levels were significantly (P=0.05) increased by the application of K in November and January, and by applications of N in December and January. Leaf Mg values were significantly (P=0.05) increased by applications of N and K in November and December (table 2). The interaction between N and K in November and January on the uptake of K and Mg was statistically significant.

5.4 Harvest Data

Cane yield was significantly (P=0.05) improved by applications of N up to 240 kg N/ha. Cane quality was significantly affected by N treatment although the effects were difficult to interpret. Applications of 80 and 120 kg N/ha increased sucrose % cane while the other treatments had no apparent effect. Application of N increased sucrose yields and reflected the effects on cane yield. The highest sucrose yield was reached at 240 kg N/ha and the incremental increase in sucrose yield/ha was as follows:

0-80 (kg N/ha)	80-120	120-160	160-200	200-240
5.1	2.2	1.5	1.7	0.8

Applications of K increased cane yields, cane quality and sucrose yields although the responses were generally not statistically significant. It should be noted that soil K levels have always been variable at this site and this will have contributed to the relatively high CV's recorded.

6. CONCLUSIONS

* N was once again applied as a single application in this trial and low leaf N values in December and January indicated that a split application may have been more appropriate.

* Under these circumstances, sucrose yields increased linearly up to 240 kg N/ha. In the past, optimum sucrose yields have been reached at 160 - 180 kg N/ha on this old ratoon. Current recommendations under these conditions are 140 kg N/ha and this year's results continue to suggest that this recommendation should be increased.

* Applications of K increased cane and sucrose yields although the response was not statistically significant. The soil K level of the control was below the current threshold of 150 ppm. Leaf K levels of the control were consistently below the old threshold value of 1.05 % dm but were above the new interim value of 0.85 for November and 0.95% dm for December

* The incorporation of K in the interrow this year did not appear to improve the response to K application although soil analysis indicated that K levels had been improved at depth.

AJD/DMZ/vnm
15.02.93

SOUTH AFRICAN SUGAR INDUSTRY AGRONOMIST'S ASSOCIATION

CODE: NK16/86/Sw/Ubo 'S'
CAT NO : 1650

LEVELS OF NITROGEN FOR RATOON CANE ON AN 'S' SET SOIL

1. PARTICULARS OF PROJECT

This crop	:	18th Ratoon
Trial crop	:	12th
Site	:	Ubombo Ranches LTD
Field	:	Speculation 4
Region	:	Northern Irrigated (Swd)
Soil Set	:	'S' Somerling
Design	:	Randomised blocks 6 replications
Variety	:	NCo376
Fertilizer kg/ha	:	N P K Treatment 0 0

Soil Analysis: July 1996

pH	OM %	Clay %	Silt %	Sand %
7.4	2.8	34	14	42

ppm

P	K	Ca	Mg	(Ca+Mg)/K
24	226	2826	1060	13.5

Initial CEC : 29 meq/100g soil

KDI : 0.62

Date : 18/7/96-22/7/97
Age : 12.1 months

Rainfall : 570 mm
Irrigation : 800 mm (Overhead)
Total : 1370 mm

2. OBJECTIVES

2.1 To determine the optimum rate of N for ratoon cane on an 'S' set soil under irrigated conditions.

2.2 To confirm results of earlier N trials on similar shallow 'S' set soils.

2.3 To validate current leaf N threshold values.

3. TREATMENTS

3.1 Potassium was not applied in this crop and rates given below are residual. Nitrogen (Urea, 46 % N) was applied on the cane row 3.7 weeks after harvest. Application rates were as follows:

Nitrogen		Potassium*	
Treatment	kg/ha	Treatment	kg/ha
N0	0	K0	0
N1	80	K1	150
N2	120	K2	300
N3	160	* No K treatments applied after 16th ratoon.	
N4	200		
N5	240		

4. FERTILIZERS AND SOIL SAMPLING

4.1 Phosphorus and potassium were not applied in this crop (18th ratoon). However, in the 17th ratoon, potassium had been applied to individual plots that were below threshold, according to standard Swaziland Sugar Association (SSA) fertilizer recommendations. These were 40% of the K0 treatment plots and 25% of the K1 treatment plots. Soil K levels in all the K2 treatment plots were above threshold. The purpose of the exercise was to start the process of equalizing soil K levels among treatments in order to nullify residual rates of K as a factor in the trial design.

4.2 Soil samples for the analysis of phosphorus, potassium, calcium and magnesium were taken in July, before fertilizer application. 30 cores were taken in each plot at a ratio of 6 on row to 24 inter-row (i.e. 1:4).

5. RESULTS AND DISCUSSION

5.1 Soil Analysis

Differences in the levels of P, K, Ca and Mg among nitrogen treatments were not statistically significant (Table 1). However, the level of K in treatment N2 (120 kg N/ha) was below the SSA threshold of 175 ppm for winter cut cane (Soil 30-40% clay).

Residual levels of K did not differ significantly among former K treatments, which may be an effect of the corrective rates of K applied in the 17th ratoon. The levels of soil K in the control and both residual treatments were well above threshold (Appendix 1). However, the coefficient of variation (CV) for the analysis of soil K in this trial was particularly high (>50%), and these results should be viewed with caution.

Table 1: P, K, Ca and Mg status (ppm) of the topsoil before fertilization - July 1996

Treatment	Ppm					
(kg N/ha)	P	K	Ca	Mg	Ca+Mg	(Ca+Mg)/K
N0 – 0	19	281	2985	1025	4009	11.9
N1 – 80	20	243	3070	1017	4087	10.9
N2 – 120	31	156	2795	1127	3922	17.9
N3 – 160	29	211	2394	1022	3417	17.9
N4 – 200	23	199	2798	1134	3932	14.1
N5 – 240	22	267	2914	1035	3949	8.6
Mean	24	226	2826	1060	3886	13.5
LSD(0.05)	NS	NS	NS	NS	NS	NS
CV%	47.1	53.0	20.8	11.4	16.2	56.2

5.2 Leaf Analysis

Results from leaf samples taken in October, November and December indicate that levels of phosphorus, calcium and magnesium were satisfactory and above their respective Fertilizer Advisory Service (FAS) thresholds. Furthermore, nitrogen application had no statistically significant effect on the uptake of these nutrients (Table 2).

Leaf nitrogen levels of the control (N0) were marginally lower than the FAS threshold of 1.8% dm in October and December, but above this threshold in November (Table 2). In October, leaf N levels reflected nitrogen application rates above 80 kg N/ha, although only treatments N4 and N5 (200 and 240kg N/ha) were significantly higher in leaf nitrogen than the control (P=0.05). In November,

leaf N levels were significantly higher than the control (P=0.05) in all treatments higher than N1 (80 kg N/ha). By December, when the crop was 5 months old, nitrogen application had no statistically significant effect on leaf N levels.

Potassium levels were well above the current SSA threshold of 0.85% dm in October, but well below the SSA threshold of 0.90% dm in November (Table 2). In December, levels of leaf K were marginal, with only treatment N4 (200 kg N/ha) exhibiting levels well over the 1.00 % dm threshold. However, differences in levels of K among nitrogen treatments were not significant (Table 2). Again, the high CV (>30%) of leaf K analysis in November should be noted.

Table 2: Third leaf nutrient analyses (%dm) in October, November and December

Treatment (kg N/ha)	N			P			K			Ca			Mg		
	Oct. (3.4m)	Nov. (4.3m)	Dec. (5.0m)	Oct. (3.4m)	Nov. (4.3m)	Dec. (5.0m)	Oct. (3.4m)	Nov. (4.3m)	Dec. (5.0m)	Oct. (3.4m)	Nov. (4.3m)	Dec. (5.0m)	Oct. (3.4m)	Nov. (4.3m)	Dec. (5.0m)
N0 – 0	1.78	1.98	1.79	0.21	0.22	0.24	0.93	0.75	1.01	0.27	0.37	0.28	0.15	0.21	0.17
N1 – 80	1.77	2.02	1.79	0.20	0.22	0.24	0.97	0.73	1.03	0.25	0.38	0.28	0.15	0.28	0.14
N2 – 120	1.82	2.10	1.82	0.21	0.22	0.26	0.97	0.7	0.91	0.30	0.40	0.32	0.14	0.30	0.19
N3 – 160	1.84	2.09	1.79	0.21	0.22	0.24	1.05	0.73	0.93	0.29	0.39	0.29	0.15	0.27	0.18
N4 – 200	1.88	2.10	1.79	0.21	0.22	0.24	1.00	0.74	1.10	0.28	0.38	0.28	0.15	0.29	0.17
N5 – 240	1.89	2.11	1.79	0.21	0.23	0.25	1.16	0.80	1.02	0.26	0.38	0.26	0.15	0.25	0.13
Mean	1.83	2.06	1.79	0.21	0.22	0.24	1.01	0.74	1.00	0.27	0.38	0.29	0.15	0.27	0.16
LSD(0.05)	0.08	0.09	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.04
LSD(0.01)	NS	NS	-	-	-	-	-	-	-	-	-	-	-	-	NS
CV%	3.4	3.4	4.3	5.0	4.1	12.2	12.4	31.3	19.5	12.3	18.7	16.5	10.6	24.2	20.4

Residual levels of potassium had no statistically significant effect on the leaf content of other nutrients, with the exception of Ca in October (Appendix 2). Leaf K levels of the control were above threshold in October, well below threshold in November (note the high CV), and marginally below threshold in December, making yield responses to residual levels of K hard to predict.

5.3 Growth Data

In January, stalk populations were significantly higher in treatments N3 – N5 (160 – 240 kg N/ha) than in the control (P=0.05). Stalk populations were also higher in treated plots than in the control in February and May, although the effect was not statistically significant at this time (Table 3). Nitrogen application significantly increased stalk heights throughout the sampling period (P=0.01). In all months, stalk heights increased with increasing rates of nitrogen application.

Table 3: Growth measurements at various ages

Treatment (kg N/ha)	Stalk population ('000/ha)			Stalk height (cm to TVD)		
	Jan. (5.7 m)	Feb. (7.4 m)	May (10.0 m)	Jan. (5.7 m)	Feb. (7.4 m)	May 10.0 m)
N0 – 0	125	121	110	94	144	191
N1 – 80	131	126	116	115	163	231
N2 – 120	132	122	119	116	169	229
N3 – 160	147	136	121	116	170	240
N4 – 200	142	132	123	125	181	249
N5 – 240	149	136	122	128	185	263
Mean	138	129	119	116	168	234
LSD (0.05)	17.0	NS	NS	13.4	10.0	24.0
LSD (0.01)	NS	-	-	18.0	13.0	33.2
CV %	10.2	9.5	6.3	9.5	4.6	8.5

In February, there was a significant interaction (P=0.05) between the effects of nitrogen application rates and residual levels of potassium on stalk heights (Table 4). In treatments N2 (120 kg N/ha) and N4 (200 kg N/ha), residual K led to significantly taller stalks than where no K had been applied (P=0.05). The tallest cane stalks were observed at the combination rates of 200 kg N/ha (N4) and 300 kg K/ha (K2, residual). These stalks were marginally higher than those produced by the combination of 240 kg N/ha (N5) and 150 kg K/ha (K1, residual).

However, because of the application of K fertilizer to some K0 and K1 plots in the 17th ratoon, the residual levels of K in these treatments may not be a true reflection of the original treatment rates.

Table 4: Effect of rates of N and K on stalk height in February

Treatment (kg N/ha)	Stalk height (cm to TVD)			
	K0 (0kg K/ha)	K1 (150kg K/ha)	K2 (300kg K/ha)	K Mean
N0 – 0	144	153	134	144
N1 – 80	169	161	160	163
N2 – 120	163	182	163	169
N3 – 160	167	166	177	170
N4 – 200	169	179	194	181
N5 – 240	183	193	178	185
Mean	166	172	168	168
Interaction	*			
LSD N rates (0.05)	10			
(0.01)	13			
LSD K rates (0.05)	NS			
LSD Treats (0.05)	16			
(0.01)	NS			
CV %	9.5			

5.4 Harvest Data

The interaction between nitrogen application rates and residual levels of K was significant in terms of cane yield and sucrose yield (Table 5). Residual levels of K produced significantly higher cane yields in treatments N2 (120 kg N/ha) and N4 (200 kg N/ha) (P=0.01). This was reflected in significantly higher sucrose yields (P=0.05) in the same N treatments at corresponding residual K levels.

The highest sucrose yield (22.3 tons sucrose/ha) was realised at 200 kg N/ha (N4) and 300 kg K/ha (K2, residual). Similarly, treatment N5 (240 kg N/ha) produced the highest cane and sucrose yields in the previous K1 treatment (150 kg K/ha, residual). This was also the case in the previous K0 (control) plots. However, where 300 kg K/ha had been applied, the highest cane and sucrose yields were observed in treatment N4 (200 kg N/ha) (P=0.01). Rates of nitrogen and potassium had no statistically significant effect on sucrose % cane.

Table 5: Cane yield, sucrose % cane and sucrose yield

Treatment (kg N/ha)	T cane/ha				Sucrose % cane				T sucrose/ha			
	K0	K1	K2	K Mean	K0	K1	K2	K Mean	K0	K1	K2	K Mean
N0 – 0	80	91	70	81	15.10	14.47	14.05	14.54	12.1	13.2	9.9	11.7
N1 – 80	119	114	106	113	14.39	14.23	14.74	14.45	17.1	16.1	15.6	16.3
N2 – 120	104	130	111	115	14.09	14.53	14.40	14.34	14.6	18.9	16.0	16.5
N3 – 160	128	122	127	126	14.30	13.96	13.69	13.98	18.4	17.1	17.3	17.6
N4 – 200	117	131	153	134	13.87	14.38	14.53	14.26	16.3	18.8	22.3	19.1
N5 – 240	144	157	131	144	14.43	14.20	14.76	14.46	20.8	22.3	19.3	20.8
Mean	115	124	116	119	14.36	14.29	14.36	14.34	16.5	17.7	16.7	17.0
Interaction	**				NS				*			
LSD N rates (0.05)	10				NS				1.8			
(0.01)	14				-				2.4			
LSD K rates (0.05)	7				NS				NS			
(0.01)	NS				-				-			
LSD Treats (0.05)	18				NS				3.0			
(0.01)	24				-				NS			
CV %	7.1				3.7				8.5			

NB: Residual K levels K1 = 150 & K2 = 300 kg K/ha

6 CONCLUSIONS

- Residual levels of K at this site significantly influenced the effect of nitrogen application on cane and sucrose yields. The optimum rate of nitrogen application was 240 kg N/ha where either no K or 150 kg K/ha had been applied as a treatment in the past. Where 300 kg K/ha had been applied in the past, the optimum rate of nitrogen application was 200 kg N/ha. However, due to the corrective application of K to some K0 and K1 plots in the 17th ratoon, residual levels of K in these two treatments are not likely to relate to the original treatment rates.
- The interaction between N application and residual K produced taller stalks, which led to an improvement in cane yields, and increased sucrose yields.
- The current SSA nitrogen fertilizer recommendation for ratoons on S set soils is 160 kg N/ha. The optimum nitrogen rates observed in this trial show that this recommendation might be too low for ratoons of this age.
- Leaf N levels of the control were marginally below the FAS threshold if 1.8 % dm in October and December and the significant yield responses indicate that this threshold may be too low and could be in need of review.
- This trial has been continued and it is now in its 19th ratoon.

DMZ/DB
25/07/98

7. APPENDICES

Appendix 1: P, K, Ca and Mg status (ppm) of the topsoil before fertilization - July 1996

Treatment (kg K/ha)	Ppm					
	P	K	Ca	Mg	Ca+Mg	(Ca+Mg)/K
K0 – 0	28	194	2728	1065	3794	18.5
K1 – 150	21	232	2922	1036	3958	13.0
K2 – 300	23	252	2828	1078	3906	9.1
Mean	24	226	2826	1060	3886	13.5
LSD(0.05)	NS	NS	NS	NS	NS	6.5
LSD(0.01)	-	-	-	-	-	NS
CV%	47.1	53.0	20.8	11.4	16.2	56.2

Appendix 2: Third leaf nutrient analyses (%dm) in October, November, December

Treatment (kg K/ha)	N			P			K			Ca			Mg		
	Oct. (3.4m)	Nov. (4.3m)	Dec. (5.0m)	Oct. (3.4m)	Nov. (4.3m)	Dec. (5.0m)	Oct. (3.4m)	Nov. (4.3m)	Dec. (5.0m)	Oct. (3.4m)	Nov. (4.3m)	Dec. (5.0m)	Oct. (3.4m)	Nov. (4.3m)	Dec. (5.0m)
K0 – 0	1.83	2.10	1.78	0.21	0.22	0.25	0.94	0.64	0.93	0.26	0.42	0.29	0.14	0.29	0.17
K1 – 150	1.84	2.04	1.80	0.21	0.22	0.24	1.05	0.76	1.06	0.27	0.37	0.27	0.15	0.25	0.16
K2 – 300	1.82	2.06	1.80	0.21	0.22	0.25	1.05	0.82	1.02	0.30	0.36	0.29	0.15	0.25	0.15
Mean	1.83	2.06	1.79	0.21	0.22	0.24	1.01	0.74	1.00	0.27	0.38	0.29	0.15	0.27	20.4
LSD(0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.03	NS	NS	NS	NS	NS
LSD(0.01)	-	-	-	-	-	-	-	-	-	NS	-	-	-	-	-
CV%	3.4	3.4	4.3	5.0	4.1	12.2	12.4	31.3	19.5	12.3	18.7	16.5	10.6	24.2	20.4

N1

SOUTH AFRICAN SUGAR AGRONOMIST'S ASSOCIATION

EXPERIMENT RESULT 1999

CAT : 1650

CODE: NK16/86/Sw/Ubo 'S'

LEVELS OF NITROGEN FOR RATOON CANE ON AN 'S' SET SOIL

1. PARTICULARS OF PROJECT

This crop	:	20th Ratoon
Trial crop	:	14th
Site	:	Ubombo Sugar
Field	:	Speculation 4
Region	:	Northern Irrigated (Swd)
Soil Set	:	'S' Somerling
Design	:	Randomised blocks 2 replications
Variety	:	NCo376
Fertilizer kg/ha	:	N P K Treatment 20 -

Soil Analysis: July 1998

pH	OM %	Clay %	Silt %	Sand %
7.1	3.5	34	14	42

ppm

P	K	Ca	Mg	(Ca+Mg)/K
23	202	2382	814	16

Initial CEC	:	29 meq/100g soil
KDI	:	0.62
Date	:	22/7/98 – 21/7/99
Age	:	12.0 months
Rainfall	:	541 mm
Irrigation	:	790 mm (Overhead)
Total	:	1331 mm

2. OBJECTIVES

2.1 To determine the optimum rate of N for ratoon cane on an 'S' set soil under irrigated conditions.

2.2 To confirm results of earlier N trials on similar shallow 'S' set soils.

2.3 To validate current leaf N threshold values.

3. TREATMENTS

3.1 Potassium was not applied as a treatment in this crop and rates referred to below are residual. Nitrogen (Urea, 46 % N) was applied on the cane row 2 weeks after harvest as follows:

Nitrogen		Potassium*	
Treatment	kg/ha	Treatment	kg/ha
N0	0	K0	0
N1	80	K1	150
N2	120	K2	300
N3	160		
N4	200	* no K treatments applied after	
N5	240	16th ratoon	

4. FERTILIZERS AND SOIL SAMPLING

4.1 Phosphorus (Single super-phosphate, 10.5% P) was broadcast on the cane row 1.1 weeks after harvest to give 20 kg P/ha.

4.2 Soil samples for the analysis of P, K, Ca and Mg were taken in June shortly before harvest of the previous crop. 27 cores were taken in each plot at a ratio of 3 on the row to 24 on the inter-row (i.e. 1:8).

5. RESULTS AND DISCUSSION

5.1 Soil Analysis

Analysis of soil samples taken before fertilizer application showed that there were no statistically significant differences in levels of P, K, Ca and Mg among nitrogen treatments, and that levels of all minerals other than K were above their respective thresholds (Table 1). Mean soil K was above threshold, but treatments N3 to N5 (160 – 240 kg N/ha) were deficient to marginal in K.

In the residual K treatments, soil K was significantly higher in the K2 treatment (300 kg K/ha) than in the control (P=0.05) (Appendix 1). This was associated with a higher Mg content in both residual rates of K than in the control (P=0.05).

Table 1: P, K, Ca and Mg status (ppm) of the topsoil before fertilization – July 1998

Treatment	Ppm					
(Kg N/ha)	P	K	Ca	Mg	Ca+Mg	(Ca+Mg)/K
N0 – 0	30	239	2693	803	3495	15.8
N1 – 80	24	241	2052	817	2869	13.0
N2 – 120	21	202	2301	825	3126	16.3
N3 – 160	16	182	2350	821	3171	18.3
N4 – 200	24	177	2357	814	3171	20.3
N5 – 240	24	171	2539	807	3346	20.3
Mean	23	202	2382	814	3196	17.4
LSD(0.05)	NS	NS	NS	NS	NS	NS
CV%	60.2	28.2	19.1	3.9	14.0	33.0

5.2 Leaf Analysis

Results from the analysis of leaf samples taken in November, December and January showed that levels of N, P, Ca and Mg were satisfactory and above their respective thresholds (Table 2). Leaf K levels were below or marginally higher than the thresholds of 0.90 and 1.05 % dm for November and January respectively in most of the nitrogen treatments.

Nitrogen application significantly increased third leaf N content (P=0.01) in November, and this was associated with a significant increase in the uptake of K (P=0.01) and Ca (P=0.05) in December, and also Mg (P=0.01) in January. However, the effect of nitrogen application on N, K, Ca and Mg was significantly influenced by residual K rates (Table 3). N content in November was increased by all rates of nitrogen application in the residual K0 (control) and K1 (150kg K/ha) treatments, while in the residual K2 (300kg K/ha) treatment, the increase was only significant where 160kg N/ha or more was applied.

Table 2: Third leaf nutrient analyses (% dm) in November, December and January

Treatment (Kg N/ha)	N			P			K			Ca			Mg		
	Nov. (3.4m)	Dec. (4.4m)	Jan. (5.5m)	Nov. (3.4m)	Dec. (4.4m)	Jan. (5.5m)	Nov. (3.4m)	Dec. (4.4m)	Jan. (5.5m)	Nov. (3.4m)	Dec. (4.4m)	Jan. (5.5m)	Nov. (3.4m)	Dec. (4.4m)	Jan. (5.5m)
N0 – 0	2.01	1.99	1.91	0.24	0.21	0.25	0.90	1.01	1.08	0.33	0.19	0.29	0.18	0.17	0.18
N1 – 80	2.05	2.03	1.95	0.24	0.20	0.23	0.86	1.02	1.02	0.34	0.19	0.30	0.22	0.16	0.19
N2 – 120	2.07	2.01	1.91	0.25	0.20	0.24	0.94	1.13	1.08	0.36	0.21	0.32	0.23	0.16	0.20
N3 – 160	2.13	2.02	2.00	0.25	0.20	0.24	0.83	1.11	1.08	0.39	0.19	0.29	0.25	0.16	0.21
N4 – 200	2.10	2.05	1.99	0.25	0.20	0.24	0.81	1.12	0.99	0.37	0.22	0.32	0.26	0.18	0.22
N5 – 240	2.10	2.05	1.99	0.23	0.20	0.24	0.87	1.14	1.02	0.37	0.20	0.30	0.23	0.18	0.22
Mean	2.08	2.02	1.96	0.24	0.20	0.24	0.87	1.09	1.04	0.36	0.20	0.30	0.23	0.17	0.20
LSD(0.05)	0.03	NS	NS	NS	NS	NS	NS	0.07	NS	NS	0.02	NS	NS	0.01	0.017
LSD(0.01)	0.04	-	-	-	-	-	-	0.09	-	-	NS	-	-	NS	0.024
CV%	1.3	2.6	4.3	5.9	5.0	4.2	12.0	5.2	6.4	14.5	7.1	12.9	19.8	6.0	7.0

Table 3: Effect of K rates on the response of leaf N, K, Ca and Mg to N rates

Treatment (Kg N/ha)		Nov. (3.4m) Leaf N (%dm)				Dec. (4.4m) Leaf K (% dm)				Dec. (4.4m) Leaf Ca (% dm)				Jan. (5.5m) Leaf Mg (% dm)			
		K0	K1	K2	K Mean	K0	K1	K2	K Mean	K0	K1	K2	K Mean	K0	K1	K2	K Mean
N0 – 0		2.01	2.00	2.02	2.01	1.02	0.97	1.05	1.01	0.21	0.19	0.18	0.19	0.180	0.185	0.180	0.182
N1 – 80		2.08	2.07	2.01	2.05	0.96	1.04	1.06	1.02	0.19	0.21	0.17	0.19	0.200	0.205	0.160	0.188
N2 – 120		2.13	2.09	2.01	2.07	1.05	1.19	1.15	1.13	0.25	0.19	0.20	0.21	0.240	0.170	0.180	0.197
N3 – 160		2.14	2.12	2.12	2.13	0.95	1.23	1.15	1.11	0.19	0.19	0.18	0.19	0.250	0.185	0.185	0.207
N4 – 200		2.11	2.06	2.13	2.10	1.16	1.01	1.20	1.12	0.20	0.24	0.21	0.22	0.235	0.215	0.200	0.217
N5 – 240		2.09	2.11	2.11	2.10	1.11	1.12	1.20	1.14	0.20	0.20	0.20	0.20	0.210	0.235	0.215	0.220
Mean		2.09	2.07	2.06	2.08	1.04	1.09	1.13	1.09	0.21	0.20	0.19	0.20	0.219	0.199	0.187	0.202
Interaction			*				**				*				**		
LSD N rates	(0.05)		0.03				0.07				0.02				0.017		
	(0.01)		0.04				0.09				NS				0.024		
LSD K rates	(0.05)		0.09				0.05				0.01				0.012		
	(0.01)		0.12				0.07				NS				0.017		
LSD Treat.	(0.05)		0.06				0.12				0.03				0.030		
	(0.01)		NS				0.16				NS				0.041		
CV %			1.3				5.2				7.1				7.0		

K0 = 0kg K/ha, K1 = 150 kg K/ha, K2 = 300 kg K/ha

Third leaf K content in December was significantly increased by nitrogen application rates of 200kg N/ha in the residual K0 (P=0.05), 120kg N/ha and 160kg N/ha in the residual K1 (P=0.01) and 200 kg N/ha and 240 kg N/ha in the residual K2 (P=0.05). The increase in Ca content was significant only where 120 kg N/ha was applied in the residual K0 (P=0.05) and where 200 kg N/ha was applied in residual K1 and K2. Mg uptake in January was significantly increased by N rates of 120kg N/ha or more in the residual K0, but was only significant at higher N rates in residual treatments K1 and K2.

Residual rates of potassium significantly increased third leaf K content throughout the sampling period (P=0.01), leading to a significant reduction in the uptake of Ca in December and Mg in both December and January (P=0.05) (Appendix 2).

5.3 Growth Data

Nitrogen application significantly increased stalk populations in March (P=0.01) and July (P=0.05) in this trial (Table 4). On both occasions, stalk populations were similar among N application treatments and significantly higher than the control.

Table 4: Growth measurements at various ages

Treatment (Kg K/ha)	Stalk population ('000/ha)					Stalk height (cm to TVD)				
	Jan. (5.5m)	Jan. (6.2m)	Mar. (8.1m)	Apr. (8.8m)	Jul. (11.3m)	Jan. (5.5m)	Jan. (6.2m)	Mar. (8.1m)	Apr. (8.8m)	Jul. (11.3m)
N0 – 0	128	109	93	108	92	76	102	164	182	214
N1 – 80	140	121	108	120	106	101	126	194	212	238
N2 – 120	135	121	110	121	108	110	136	211	229	259
N3 – 160	142	120	113	122	104	111	138	213	231	256
N4 – 200	139	125	114	103	112	114	137	211	231	262
N5 – 240	140	123	107	99	109	119	144	221	245	274
Mean	137	120	108	112	105	105	130	202	222	250
LSD (0.05)	NS	NS	9	NS	11	8	11	16	17	17
LSD (0.01)	-	-	13	-	NS	11	15	22	23	23
CV %	6.3	7.7	7.2	29.9	8.8	6.2	6.8	6.4	6.3	5.5

All nitrogen application rates significantly increased stalk height (P=0.01), with the greatest increases in height occurring at the highest rates of application. Treatment N5 (240kg N/ha) had the tallest stalks throughout the period of measurement, while treatment N1 (80kg N/ha) had the shortest stalks of all treatments other than control on most sampling occasions.

5.4 Harvest Data

Nitrogen application significantly increased cane yield (P=0.01), sucrose % cane (P=0.05) and sucrose yield (P=0.01) in this trial (Table 5). All rates of nitrogen produced significantly higher cane yields than the control (P=0.01). Treatment N5 (240kg N/ha) produced significantly higher cane (P=0.01) and sucrose yields (P=0.05) than the other application rates, while treatment N1 (80kg N/ha) produced significantly lower cane and sucrose yields than all treatments other than the control (P=0.05).

Table 5: Cane yield, sucrose % cane and sucrose yield

Treatment (Kg N/ha)	T cane/ha				Sucrose % cane				T suc/ha			
	K0	K1	K2	K Mean	K0	K1	K2	K Mean	K0	K1	K2	K Mean
N0 – 0	56	54	66	59	15.60	16.29	15.70	15.86	8.7	8.9	10.3	9.3
N1 – 80	87	91	91	90	16.08	16.71	16.55	16.45	13.9	15.2	15.1	14.8
N2 – 120	95	104	106	102	16.18	16.21	17.40	16.59	15.3	16.9	18.4	16.9
N3 – 160	95	111	107	104	16.46	16.79	16.83	16.69	15.6	18.7	17.9	17.4
N4 – 200	117	88	108	104	15.64	16.16	16.75	16.18	18.2	14.2	18.1	16.8
N5 – 240	121	109	133	121	15.34	16.49	16.35	16.06	18.6	17.9	21.7	19.4
Mean	95	93	102	97	15.88	16.44	16.59	16.31	15.1	15.3	16.9	15.8
Interaction	NS				NS				NS			
LSD N rates (0.05)	11				0.54				1.7			
(0.01)	15				NS				2.3			
LSD K rates (0.05)	NS				0.38				1.2			
(0.01)	-				0.52				1.6			
LSD Treat. (0.05)	NS				NS				NS			
CV %	9.3				2.7				8.8			

K0 = 0kg K/ha, K1 = 150 kg K/ha, K2 = 300 kg K/ha

There were no statistically significant differences in cane and sucrose yield among application rates of 120, 160 and 200 kg N/ha. Application rates between 80 and 160 kg N/ha were all significantly higher in sucrose % cane than the control (P=0.05).

Sucrose % cane was significantly higher in both residual K treatments than in the control, while sucrose yield was significantly increased by the residual K2 treatment (P=0.01).

6 CONCLUSIONS

- The optimum nitrogen application rate in this trial was 240kg N/ha, which is 80kg more than the current recommendation for this soil. This confirms the results of previous crops at this site and indicates that SSA nitrogen recommendations should be adapted to account for aging ratoons on shallow 'S' set soils.
- The high sucrose yield produced by 240 kg N/ha was the result of a high cane yield, produced by increases in stalk height and population in response to nitrogen application. Sucrose % cane was higher at lower rates of N application.
- Leaf N levels of the control were above threshold in November, December and January. Significant responses to N application indicate that these thresholds may be too low. However, K was limiting to yield in most treatments during this crop, and these results should be viewed with caution.
- This trial has been terminated.

DMZ/DB/avm
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7. APPENDICES

Appendix 1: P, K, Ca and Mg status (ppm) of the topsoil before fertilization – July 1998

Treatment (Kg N/ha)	Ppm					
	P	K	Ca	Mg	Ca+Mg	(Ca+Mg)/K
K0 – 0	30	164	2471	792	3263	20.9
K1 – 150	22	202	2372	827	3198	17.2
K2 – 300	18	241	2303	824	3128	14.0
Mean	23	202	2382	814	3196	17.4
LSD(0.05)	NS	49	NS	28	NS	4.9
LSD(0.01)	-	NS	-	NS	-	NS
CV%	60.2	28.2	19.1	3.9	14.0	33.0

Appendix 2: Third leaf nutrient analyses (% dm) in November, December and January

Treatment (Kg N/ha)	N			P			K			Ca			Mg		
	Nov. (3.4m)	Dec. (4.4m)	Jan. (5.5m)	Nov. (3.4m)	Dec. (4.4m)	Jan. (5.5m)	Nov. (3.4m)	Dec. (4.4m)	Jan. (5.5m)	Nov. (3.4m)	Dec. (4.4m)	Jan. (5.5m)	Nov. (3.4m)	Dec. (4.4m)	Jan. (5.5m)
K0 – 0	2.09	2.04	1.95	0.25	0.20	0.24	0.77	1.04	0.95	0.37	0.21	0.31	0.25	0.17	0.22
K1 – 150	2.07	2.02	1.95	0.24	0.20	0.24	0.87	1.09	1.06	0.36	0.20	0.31	0.22	0.17	0.20
K2 – 300	2.06	2.02	1.97	0.24	0.20	0.24	0.96	1.13	1.12	0.35	0.19	0.29	0.21	0.16	0.19
Mean	2.08	2.02	1.96	0.24	0.20	0.24	0.87	1.09	1.04	0.36	0.20	0.30	0.23	0.17	0.20
LSD(0.05)	NS	NS	NS	NS	NS	NS	0.09	0.05	0.06	NS	0.01	NS	NS	0.01	0.01
LSD(0.01)	-	-	-	-	-	-	0.12	0.07	0.08	-	NS	-	-	NS	0.02
CV%	1.3	2.6	4.3	5.9	5.0	4.2	12.0	5.2	6.4	14.5	7.1	12.9	19.8	6.0	7.0

SOUTH AFRICAN SUGAR INDUSTRY AGRONOMISTS' ASSOCIATION

Cat. No.: 1650

CODE: **NK16/86/Sw/Ubo 'S'**

TITLE: LEVELS OF NITROGEN AND POTASSIUM FOR RATOON CANE ON A 'S' SET SOIL

1. PARTICULARS OF PROJECT

This crop	: 14th Ratoon	Soil Analysis: Date 19/03/93				
Site	: Ubombo Ranches Field Speculation 4	pH	OM%	Clay %	KDI	
		7.1	2.8	34	0.62	
Region	: Northern Irrigated (Swaziland)	ppm (control)				
		P	K	Ca	Mg	(Ca+Mg)/K
		36	170	3078	1019	54
Soil Set/Series	: 'S'/(Somerling)					
		CEC	: 21.7 meq/100g soil			
Design	: 6 * 3 factorial 2 replications	Dates	: 16/07/92 - 20/07/93			
		Age	: 12.1 months			
Variety	: NCo376					
		Rainfall	: 679 mm			
Fertilizer	: N & K P	Irrigation	: 650 mm (overhead)			
Total (kg/ha)	:See treatments 40	Total	:1329 mm			

2. OBJECTIVES

2.1 To determine the optimum levels of Nitrogen and Potassium for ratoon cane on a 'S' set soil.

2.2 To confirm results of earlier N*K trials on similar shallow 'S' set soils.

2.3 To test the availability of exchangeable Potassium.

3. TREATMENTS

3.1 Notes on Treatments

Nitrogen		Potassium	
Treatment	(kg/ha)	Treatment	(kg/ha)
N0	Nil	K0	Nil
N1	80	K1	150
N2	120	K2	300
N3	160		
N4	200		
N5	240		

Nitrogen (Urea, 46% N), Potassium (KCl, 50% K) and Phosphorus (Superphosphate 10.5 % P) were applied 1.7 weeks after harvest. Nitrogen was banded on the cane row while K and P were broadcast.

3.2 Notes of Soil Sampling

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

Subsoil: 20 cores were taken from 3 selected plots of the control and the 300 kg K/ha treatment at a ratio of 8 on row to 12 interrow (i.e. 1:1.5).

4. RESULTS

4.1 Soil Analysis

Table 1: K, Ca and Mg status (ppm) of the topsoil - March 1993

Treatments	K	Ca	Mg	(Ca+Mg)/K
K0	170	3078	1019	54
K1	361	3023	951	13
K2	507	2719	954	8
LSD (0.05)	131	408	82	50
SE Diff. ±	62.2	193.3	39.0	23.9
Significance	**	NS	NS	NS
Mean	346	2940	974	25
CV %	44.0	16.1	9.8	23.4

Table 2: K, Ca and Mg status (ppm) of the soil profile - February 1993

Depth	Control				300 kg K/ha			
(cm)	K	Ca	Mg	(Ca+Mg)/K	K	Ca	Mg	(Ca+Mg)/K
0 - 15	113	2635	715	30	193	2635	744	18
20 - 30	111	2648	691	30	119	3018	782	32
40 - 50	81	3045	727	47	110	2900	824	34

4.2 Leaf Analysis

Table 3: Third leaf analysis (% dm) at various ages

	November (4.3 months)					December (5.0 months)					January (6.9 months)				
Treatment	N	P	K	Ca	Mg	N	P	K	Ca	Mg	N	P	K	Ca	Mg
N0	1.56	0.22	1.09	0.24	0.16	1.47	0.20	0.90	0.27	0.15	1.35	0.27	1.03	0.25	0.14
N1	1.57	0.21	0.93	0.27	0.19	1.52	0.20	0.99	0.27	0.19	1.38	0.23	1.08	0.24	0.16
N2	1.62	0.20	0.96	0.28	0.21	1.50	0.20	1.05	0.24	0.21	1.43	0.24	1.15	0.23	0.17
N3	1.70	0.21	1.08	0.28	0.23	1.54	0.19	1.16	0.26	0.18	1.42	0.22	1.24	0.23	0.18
N4	1.74	0.20	1.02	0.26	0.23	1.55	0.20	1.12	0.25	0.20	1.42	0.24	1.28	0.23	0.18
N5	1.78	0.21	1.21	0.26	0.22	1.62	0.20	1.27	0.26	0.20	1.47	0.26	1.30	0.22	0.18
LSD N (0.05)	0.12	0.02	0.22	0.05	0.04	0.12	0.01	0.12	0.08	0.04	0.15	0.04	0.13	0.04	0.02
SE Diff. ±	0.05	0.01	0.11	0.03	0.02	0.05	0.01	0.06	0.04	0.02	0.07	0.02	0.06	0.02	0.01
Significance	**	NS	NS	NS	**	NS	NS	**	NS	*	NS	*	**	NS	*
K0	1.69	0.22	0.95	0.30	0.25	1.53	0.20	0.99	0.29	0.20	1.42	0.26	1.09	0.25	0.19
K1	1.68	0.20	1.09	0.25	0.19	1.53	0.20	1.12	0.25	0.19	1.37	0.24	1.20	0.22	0.16
K2	1.62	0.21	1.11	0.24	0.18	1.53	0.20	1.14	0.23	0.18	1.44	0.23	1.24	0.23	0.16
LSD K (0.05)	0.08	0.01	0.16	0.04	0.03	0.08	0.01	0.09	0.05	0.03	0.11	0.03	0.09	0.03	0.01
SE Diff. ±	0.04	0.01	0.08	0.02	0.01	0.04	0.00	0.04	0.03	0.01	0.05	0.01	0.04	0.01	0.01
Significance	NS	NS	NS	**	**	NS	NS	**	NS	NS	NS	NS	*	NS	**
Interaction N*K	NS	NS	NS	NS	**	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Mean	1.66	0.21	1.05	0.26	0.21	1.53	0.20	1.08	0.26	0.19	1.41	0.24	1.18	0.23	0.17
CV %	5.9	7.0	17.7	14.9	12.1	6.1	5.0	9.5	24.2	15.9	8.6	11.7	9.5	13.7	10.6

4.3 Growth analysis

Table 5: Growth measurements in February and May

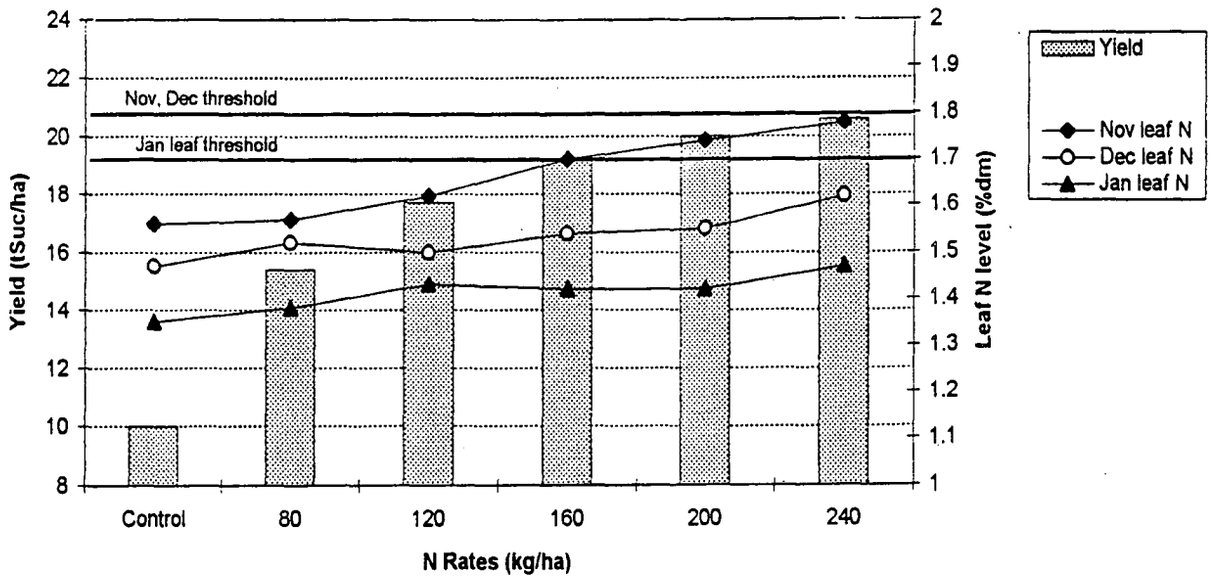
Treatment	Stalk height (cm to TVD)		Stalk population (* 1000/ha)	
	Feb (6.6 mths)	May (10 mths)	Feb (6.6 mths)	May (10 mths)
N0	127	222	146	96
N1	152	258	151	106
N2	159	265	148	105
N3	169	263	173	119
N4	170	275	164	111
N5	165	274	168	116
Significance	**	**	NS	NS
K0	151	253	153	107
K1	157	262	167	110
K2	163	264	155	109
Significance	NS	NS	NS	NS
Mean	157	259	158	109
Interaction N * K	NS	NS	NS	NS

4.3 Harvest Data

Table 6: Cane yield, sucrose % cane and sucrose yield

Treatment	TCane/ha	Suc % Cane	TSuc/ha
N0	68	14.66	10.0
N1	102	15.10	15.4
N2	116	15.30	17.7
N3	128	15.09	19.2
N4	133	15.04	20.0
N5	141	14.64	20.6
LSD N (0.05)	16	0.54	2.4
SE Diff. ±	7.7	0.26	1.1
Significance	**	NS	**
K0	106	14.92	15.8
K1	119	15.06	17.9
K2	119	14.93	17.8
LSD K (0.05)	11	0.38	1.7
SE Diff. ±	5.4	0.18	0.8
Significance	*	NS	*
Interaction N * K	NS	NS	NS
Mean	115	14.97	17.2
CV %	11.6	3.0	11.5

Figure 1: N Rates vs. Sucrose yield and leaf N levels in November, December and January



5. COMMENTS

5.1 General

There was no statistically significant interaction between N and K in this trial with respect to harvest data. The effects of N and K have therefore been reviewed independently.

5.2 Soil Analysis

Soil K levels of the control treatment were above the recommended FAS threshold level of 150 ppm (soil 30-40% clay) before fertilization. No yield response to K application was therefore expected. Soil K levels of treatments previously receiving K were well above that of the control and reflected the rates that were applied. Although the Ca+Mg/K ratio of the control treatment was high, applications of K had reduced this ratio in the other treatments and no limitations to the uptake of K were expected where K had been applied (table 1).

Potassium levels in the deeper layers of the soil have been increased by previous applications of K. Ca and Mg levels however, increased more sharply than K levels and as a result the Ca+Mg/K ratio increased with depth (table 2).

Differences in K levels of control treatments of samples taken for the whole trial and those taken for depth analysis might be attributed to variability in the site (CV = 44.0) and different methods of soil sampling.

5.3 Leaf Analysis

Nitrogen

Leaf levels of Nitrogen were unusually low in this trial and were according to current thresholds (Nov. and Dec. =1.80 %dm, Jan. =1.70 %dm) deficient throughout the sampling period in all treatments. Leaf N levels were increased by applications of N and but levels decreased from November to January (table 3, figure1).

Third leaf nutrient analysis in November, December and January showed leaf P, Ca and Mg to be satisfactory and above the respective thresholds. Applications of N increased K uptake in December and January, but reduced the uptake of P in January (table 3).

Potassium

Leaf K levels of the control treatments were above the current threshold levels (Nov. = 0.85, Dec. and Jan. = 0.95 %dm) and a response to K applications was not expected. Leaf K levels were increased by applications of K and reflected the different rates applied. Third leaf K levels increased from November to January, reflecting the important influence of season on the uptake of K. Leaf Ca and Mg levels were reduced by applications of K in November and December (table 3).

Nitrogen * Potassium

Rates of N and K had a combined effect on leaf levels of Mg in this trial. Leaf Mg levels were generally increased by increasing rates of N but were also reduced by increasing rates of K (table 4).

5.4 Growth measurements

Stalk heights and populations were improved by applications of both N and K in this trial. Increases in stalk height closely reflected the different N as well as K rates applied, but increases in stalk population were variable and not as consistent.

5.5 Harvest Data

Cane yields as well as sucrose yields were significantly (P = 0.01) increased by applications of N at this site and the highest yields were obtained from the 240 kg N/ha treatment (N5). Sucrose content was decreased by N applications higher than 120 kg N/ha (table 6, figure1).

Cane as well as sucrose yields were significantly (P = 0.05) improved by the application of Potassium. There were no differences between the different rates of K applied (table 6).

6. CONCLUSIONS

- The highest sucrose yield in this trial was obtained from the 240 kg N/ha treatment which for the third consecutive year indicates that the recommended application of 140 kg N/ha for this soil type should be increased where good irrigation management sustains high yields.

- Although responses obtained from this trial indicate that the current soil K threshold of 150 ppm K for this soil is too low, soil K levels were very variable and this result should be viewed with caution.

- Responses obtained from this trial do not support currently recommended leaf K thresholds and suggest that these thresholds need to be increased.

- This trial has been continued and it is now in its 15th ratoon.

DMZ/AJD/fkn
24.11.93

SOUTH AFRICAN SUGAR INDUSTRY AGRONOMISTS' ASSOCIATION

CAT. NO.: 1650

CODE: NK16/86/Sw/Ubo 'S'

TITLE: LEVELS OF NITROGEN AND POTASSIUM FOR RATOON CANE ON A 'S' SET SOIL

1. PARTICULARS OF PROJECT

This crop	: 15th Ratoon			
Site	: Ubombo Ranches Field Speculation 4			
Region	: Northern Irrigated (Swaziland)			
Soil Set/Series	: 'S'/(Somerling)			
Design	: 6 * 3 factorial 2 replications			
Variety	: NCo376			
Fertilizer	: N & K	P		
Total (kg/ha)	:See Treatment	20		

Soil analysis: August 1993

pH	OM%	Clay %	KDI
7.1	2.8	34	0.62

ppm (control)

P	K	Mg	Ca	(Ca+Mg)/K
60	161	1190	3135	27

CEC : 21.7 meq/100g soil

Dates : 20/07/93 - 20/07/94
Age : 12 months

Rainfall : 366 mm
Irrigation : 800 mm (overhead)
Total : 1166 mm

2. OBJECTIVES

2.1 To determine the optimum levels of Nitrogen and Potassium for ratoon cane on 'S' set soil.

2.2 To confirm results of earlier N * K trials on similar shallow S set soils.

2.3 To test the availability of exchangeable Potassium.

3. TREATMENTS

3.1 Notes on Treatments

Nitrogen		Potassium	
Treatment	(kg/ha)	Treatment	(kg/ha)
N0	0	K0	0
N1	80	K1	150
N2	120	K2	300
N3	160		
N4	200		
N5	240		

Nitrogen (Urea, 46% N) was banded on the cane row and Potassium (KCl, 50% K) was broadcast, 2 weeks after harvest.

3.2 Notes on Soil Sampling

Soil samples were taken before fertilization in August.

Topsoil: 40 cores were taken from **each plot** at a ratio of 16 on row to 24 interrow (i.e. 1:1.5)

Subsoil: 20 cores were taken from **3 selected plots** of the control and 300kg K/ha treatment at a ratio of 8 on row to 12 interrow (i.e. 1:1.5)

4. RESULTS

4.1 Soil Analysis

Table 1: K, Ca and Mg Status (ppm) of the topsoil - August 1993

Treatment	K	Ca	Mg	(Ca + Mg)/K
K0 - 0	161	3135	1190	26.9
K1 - 150	268	3028	1088	15.4
K2 - 300	365	2929	1094	11.0
LSD (0.05)	61	362	126	-
SED ±	29.1	171.7	59.9	-
Significance	**	NS	NS	-
Mean	265	3031	1124	17.76
CV%	27.0	13.9	13.1	-

Table 2: K, C, and Mg status (ppm) of the soil profile - July 1993

Depth	K0 - Control				K2 - 300kg K/ha			
(cm)	K	Ca	Mg	(Ca + Mg)/K	K	Ca	Mg	(Ca + Mg)/K
0 - 15	104	2963	1253	41	242	3363	1336	19
20 - 30	98	3167	1167	44	327	3277	1401	14
40 - 50	96	3927	1217	54	182	3370	1019	24

4.2 Leaf Analysis

Table 3: Third leaf analysis (% dm) at various ages

Treatment	November (4.1 months)					December (4.8 months)					January (5.8 months)				
(Kg K/ha)	N	P	K	Ca	Mg	N	P	K	Ca	Mg	N	P	K	Ca	Mg
N0 - 0	1.77	0.27	0.99	0.32	0.16	1.66	0.26	1.05	0.29	0.15	1.51	0.31	1.07	0.26	0.15
N1 - 80	1.76	0.26	0.97	0.31	0.23	1.69	0.28	1.07	0.28	0.20	1.46	0.30	1.16	0.27	0.17
N2 - 120	1.80	0.23	1.07	0.33	0.23	1.76	0.27	1.14	0.28	0.21	1.46	0.30	1.23	0.26	0.17
N3 - 160	1.89	0.25	1.03	0.30	0.22	1.89	0.28	1.19	0.32	0.21	1.52	0.30	1.15	0.28	0.21
N4 - 200	1.89	0.24	1.00	0.30	0.25	1.91	0.27	1.11	0.28	0.22	1.53	0.31	1.21	0.28	0.22
N5 - 240	1.97	0.24	0.98	0.35	0.28	1.98	0.28	1.30	0.29	0.23	1.66	0.30	1.38	0.24	0.20
LSD N (0.05)	0.11	0.02	0.12	0.04	0.08	0.13	0.02	0.19	0.05	0.04	0.09	0.02	0.22	0.05	0.04
SE Diff. ±	0.05	0.01	0.05	0.02	0.04	0.06	0.01	0.09	0.03	0.02	0.04	0.01	0.10	0.03	0.02
Significance	**	*	NS	*	NS	**	NS	NS	NS	NS	**	NS	NS	NS	**
K0 - 0	1.87	0.25	0.77	0.34	0.27	1.86	0.27	0.94	0.31	0.25	1.58	0.31	1.09	0.26	0.23
K1 - 150	1.84	0.25	1.07	0.33	0.22	1.79	0.27	1.16	0.30	0.18	1.51	0.30	1.26	0.27	0.17
K2 - 300	1.83	0.25	1.18	0.29	0.19	1.80	0.27	1.32	0.25	0.17	1.49	0.30	1.26	0.26	0.16
LSD K (0.05)	0.08	0.01	0.08	0.03	0.05	0.09	0.01	0.13	0.04	0.03	0.07	0.02	0.15	0.04	0.03
SE Diff. ±	0.04	0.01	0.04	0.01	0.03	0.04	0.01	0.06	0.02	0.01	0.03	0.01	0.07	0.02	0.01
Significance	NS	NS	**	**	*	NS	NS	**	*	**	*	NS	*	NS	**
Interaction N*K	NS	NS	NS	**	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Mean	1.84	0.25	1.01	0.32	0.23	1.82	0.27	1.14	0.29	0.20	1.52	0.30	1.20	0.26	0.19
CV%	4.7	6.5	9.6	8.2	27.0	6.1	5.1	13.6	15.9	18.8	5.1	6.2	15.0	16.8	16.1

4.3 Growth Data

Table 4: Growth Measurements at various ages

Treatment	Stalk height (cm to TVD)				Stalk population (*1000/ha)			
	Jan (6.1m)	Mar (7.5m)	May (10.2m)	Jul (11.5m)	Jan (6.1m)	Mar (7.5m)	May (10.2m)	Jul (11.5m)
N0 - 0	99	137	185	194	136	119	94	96
N1 - 80	118	161	216	221	129	125	113	108
N2 - 120	128	177	233	245	137	134	114	112
N3 - 160	124	176	248	254	149	141	115	112
N4 - 200	131	184	244	268	138	134	118	117
N5 - 240	134	193	260	268	161	144	124	121
K0 - 0	122	168	234	238	141	131	112	110
K1 - 150	123	172	233	245	141	134	113	111
K2 - 300	122	173	227	242	142	135	114	112
Mean	122	171	231	242	142	133	113	111

4.4 Harvest Data

Table 5: Cane yield, Sucrose % cane and Sucrose yield

Treatment	TCane/ha	Suc % Cane	TSuc/ha
N0 - 0	65	13.48	8.7
N1 - 80	97	13.40	13.0
N2 - 120	117	13.48	15.8
N3 - 160	120	13.30	16.0
N4 - 200	132	13.63	18.1
N5 - 240	144	13.15	18.9
LSD N (0.05)	13	0.54	2.0
SE Diff. ±	6.4	0.26	1.0
Significance	**	NS	**
K0 - 0	109	12.95	14.0
K1 - 150	114	13.65	15.6
K2 - 300	114	13.63	15.6
LSD K (0.05)	10	0.38	1.4
SE Diff. ±	4.5	0.18	0.7
Significance	NS	**	NS
Interaction N*K	NS	NS	NS
Mean	112	13.41	15.1
CV%	9.8	3.3	11.1

5. COMMENTS

5.1 General

The interaction between N and K with respect to yield data was not statistically significant and the effects of N and K can therefore be reviewed separately.

5.2 Soil Analysis

Soil K levels of the control treatment were above the FAS threshold of 150 ppm (soil 30 - 40% clay) before fertilization and a response to K applications was not

expected (table 1). Soil K levels of treatments receiving K were well above the threshold and corresponded with K rates applied in previous crops. Soil Ca and Mg levels were high before fertilization but the (Ca + Mg)/K ratio was significantly lowered in treatments that had previously received K applications. Soil analysis results were variable (CV = 27%) and caution should be applied when these results are used to interpret yield responses.
Sampling at depth showed that K levels of the lower soil layers had been greatly increased by high applications of K over the years and significant amounts of K had leached from the topsoil to the lower soil layers (table 2).

5.3 Leaf Analysis

Leaf levels of P, Ca and Mg were satisfactory and above their respective thresholds during November to January (table 3).

Nitrogen
Leaf N levels in the control treatment were below the FAS thresholds in all months sampled (1.8% dm for November and December and 1.7%dm for January). Leaf N levels were equal to or below the threshold in treatments N1 and N2 in November and December and deficient in all treatments in January at 6 months of age (table 3). Levels were however, increased above the threshold by applications of N in treatments N3 - N5 in November and December.
N treatments had no statistically significant effect on the uptake of K in November and December but significantly reduced the uptake of P in November and generally increased Mg content in January.

Potassium
Leaf K levels in the control treatment were below the FAS thresholds of 0.85% dm in November and 0.95% dm in December but increased to above the threshold in January (table 3). Applications of K significantly improved leaf K content and reduced the uptake of Mg in all three months sampled. The uptake of Ca (November and December) and N (January) were also reduced by applications of K .

5.4 Growth Data

Stalk heights and stalk populations were generally improved by applications of Nitrogen in all months sampled (table 4)
The effect of K applications on stalk height were variable but stalk populations were marginally increased.

5.5 Harvest Data

Nitrogen
Nitrogen application significantly improved (P = 0.01) cane yield but had no statistically significant effect on cane quality. Sucrose yields were significantly (P=0.01) increased by increased N rates, but differences between N2 and N3 and also between N4 and N5 were relatively small (table 5).
The highest cane and sucrose yields were obtained from the 240 kg N/ha treatment (N5).

Potassium

Cane as well as sucrose yields were improved by applications of potassium although increases were not quite statistically significant. Cane quality was significantly increased by increased rates of N (P=0.01) but no differences between the different rates were observed (table 5).

6. CONCLUSIONS

- For the fourth consecutive year the highest sucrose yield in this trial was obtained from the 240 kg N/ha treatment. This indicates that the application recommended on this soil type (140 kg N/ha) might not be sufficient to sustain high yields in older ratoons.

- Soil K levels of the control were above the FAS threshold in this trial and a response was not expected. Sucrose yield responses were however almost significant, indicating that the threshold for this soil could possibly be higher than the current 150 ppm K. While this result supports that of the previous crop, variability in soil analysis was high and results should be viewed with caution.

- This trial has been continued to further observe N requirements of older ratoons and it is now in its 16th ratoon.

DMZ/AJD/ppd
24.01.95

SOUTH AFRICAN SUGAR INDUSTRY

AGRONOMIST'S ASSOCIATION.

EXPERIMENT RESULT 1995

CODE: NK16/86/Sw/Ubo 'S'
CAT : 1650

TITLE: LEVELS OF NITROGEN AND POTASSIUM FOR RATOON CANE ON A 'S' SET SOIL

1. PARTICULARS OF PROJECT

This crop	: 16th Ratoon	Soil analysis: August 1994	
Site	: Ubombo Ranches Field Speculation 4	pH 6.8	OM% 2.8
Region	: Northern Irrigated (Swaziland)		
Soil Set/Series	: 'S'/(Somerling)		
Design	: 6 * 3 factorial 2 replications		
Variety	: NCo376		
Fertilizer	: N & K	P	
Total (kg/ha)	:See Treatment	-	

Clay %	KDI
34	0.62

ppm (control)

P	K	Ca	Mg	(Ca+Mg)/K
57	184	3443	957	24

CEC : 21.7 meq/100g soil

Dates : 20/07/94 - 19/07/95
Age : 12.months

Rainfall : 406 mm
Irrigation : 864 mm (overhead)
Total : 1270 mm

2. OBJECTIVES

2.1 To determine the optimum levels of Nitrogen and Potassium for ratoon cane on 'S' set soil.

2.2 To confirm results of earlier N * K trials on similar shallow 'S' set soils.

2.3 To test the availability of exchangeable Potassium.

3. TREATMENTS

3.1 Notes on Treatments

Nitrogen		Potassium	
Treatment	(kg/ha)	Treatment	(kg/ha)
N0	0	K0	0
N1	80	K1	150
N2	120	K2	300
N3	160		
N4	200		
N5	240		

Nitrogen (Urea, 46% N) and Potassium (KCl, 50% K) were applied 2 weeks after harvest. Nitrogen was banded on the cane row while K was broadcast.

3.2 Notes on Soil Sampling

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

4. RESULTS

4.1 Soil Analysis

Table 1: P, K, Ca and Mg status (ppm) of the topsoil - August 1994

Treatment	P	K	Ca	Mg	(Ca + Mg)/K
K0	57	184	3443	957	24
K1	56	369	3188	934	11
K2	51	557	2741	889	7
LSD (0.05)	17	100	498	59	5
SED ±	8.1	47.2	235.9	27.8	2.2
Significance	NS	**	*	NS	**
Mean	55	370	3124	927	15
CV%	36.3	31.2	18.5	7.3	35.9

4.2 Leaf Analysis

Table 2: Third leaf analysis (% dm) at various ages

Treatment	N			P			K		
	Nov. (3.7 m)	Dec. (4.5 m)	Jan (5.7 m)	Nov. (3.7 m)	Dec. (4.5 m)	Jan (5.7 m)	Nov. (3.7 m)	Dec. (4.5 m)	Jan (5.7 m)
N0	1.81	1.67	1.36	0.32	0.27	0.27	1.18	1.08	0.98
N1	1.80	1.56	1.35	0.27	0.22	0.23	1.06	1.10	0.95
N2	1.87	1.64	1.40	0.26	0.22	0.23	1.12	1.12	1.04
N3	1.95	1.77	1.43	0.26	0.23	0.24	1.15	1.17	1.06
N4	1.91	1.74	1.40	0.27	0.23	0.23	1.14	1.19	1.10
N5	2.02	1.89	1.48	0.26	0.22	0.23	1.16	1.32	1.12
LSD N (0.05)	0.13	0.17	0.14	0.02	0.02	0.04	0.18	0.14	0.10
SE Diff. ±	0.06	0.08	0.07	0.01	0.01	0.02	0.08	0.07	0.05
Significance	*	*	NS	**	**	NS	NS	*	*
K0	1.93	1.74	1.45	0.28	0.24	0.25	1.00	1.03	0.95
K1	1.88	1.67	1.31	0.27	0.22	0.23	1.11	1.19	1.04
K2	1.87	1.73	1.45	0.27	0.23	0.23	1.30	1.28	1.13
LSD K (0.05)	0.09	0.12	0.10	0.02	0.01	0.03	0.12	0.10	0.07
SE Diff. ±	0.04	0.06	0.05	0.01	0.01	0.01	0.06	0.05	0.03
Significance	NS	NS	*	NS	**	NS	**	**	**
Interaction N*K	NS	NS	NS	NS	NS	NS	NS	NS	*
Mean	1.89	1.71	1.40	0.27	0.23	0.24	1.14	1.17	1.04
CV%	5.5	8.1	8.2	6.9	5.9	10.5	12.8	9.8	8.1

4.3 Growth Data

Table 3: Growth Measurements at various ages

Treatment	Stalk height (cm to TVD)			Stalk population (*1000/ha)		
	Jan. (6m)	May (10m)	July (12m)	Jan. (6m)	May (10m)	July (12m)
N0	101	188	206	139	116	102
N1	121	206	227	139	124	119
N2	124	229	245	141	123	117
N3	140	242	250	136	128	121
N4	137	237	254	147	122	120
N5	136	247	245	143	132	123
K0	121	218	235	142	123	113
K1	126	228	240	139	121	118
K2	132	228	238	141	129	119
Mean	126*	225*	238*	141	124	117

* Significant (P=0.05)

4.4 Harvest Data

Table 4: Cane yield, Sucrose % cane and Sucrose yield

Treatment	T cane/ha	Suc % cane	T suc/ha
N0	65	14.20	9.2
N1	98	15.02	14.7
N2	104	14.94	15.6
N3	111	14.81	16.5
N4	123	14.59	17.8
N5	128	14.87	19.0
LSD N (0.05)	13	0.66	1.8
SE Difference ±	5.9	0.31	0.8
Significance	**	NS	**
K0	97	14.74	14.4
K1	107	14.74	15.9
K2	110	14.73	16.1
LSD K (0.05)	9	0.47	1.2
SE Difference ±	4.2	0.22	0.6
Significance	*	NS	*
Interaction N*K	NS	NS	NS
Mean	105	14.74	15.5
CV%	9.8	3.7	9.3

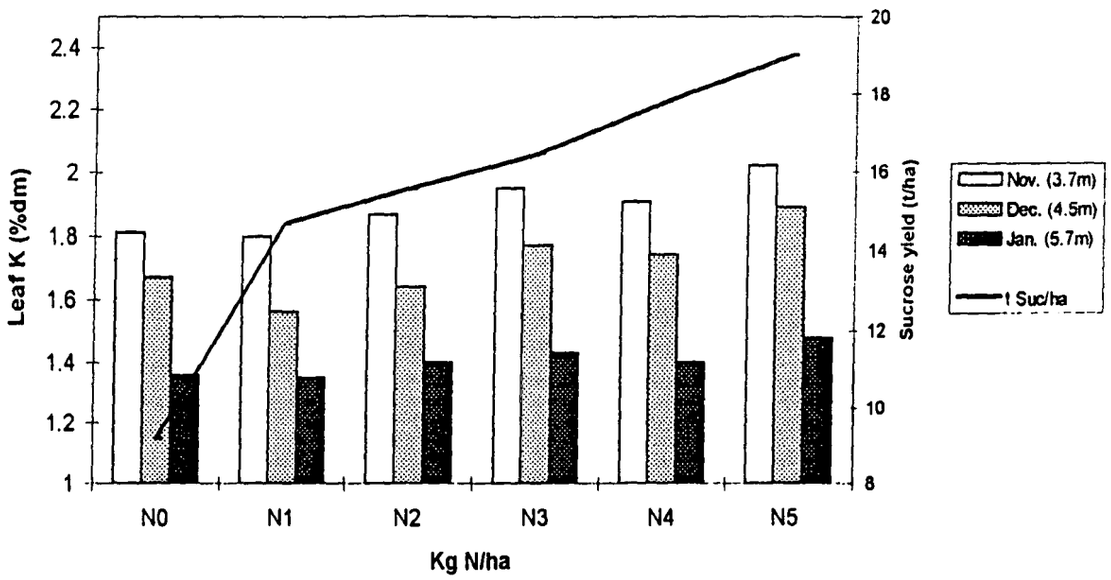


Figure 1: Leaf N levels at different months vs. Sucrose yield

5. COMMENTS

5.1 - Soil Analysis

Soil K levels of the control treatment were slightly above the threshold value of 175 ppm (soil = 30 - 40% clay, winter cut). Responses to applied K were therefore not expected. K levels in treatments receiving K were very high before fertilisation. (table 1).

As was observed in previous crops in this trial, CV's for soil analyses were quite high. However, the reason for this phenomenon could not be found. (Ca + Mg)/K ratios were low in this trial, as a result of high K levels in the soil.

5.2 Leaf Analysis

Third leaf nutrient analysis between November and January showed that leaf levels of P, Ca and Mg were satisfactory and above their respective thresholds (table 2, appendix 1).

Nitrogen

Leaf N levels of the control were satisfactory in November, but below the threshold value in December and January. Although N treatments >80kg N/ha significantly improved leaf N content in all months sampled, N treatments (except N5) were below the respective threshold values in December (1.8 %dm) and January (1.7 %dm) (table 2).

N applications significantly reduced the uptake of P in November and December while levels of Mg (November and December) and K (December and January) were improved in treatments receiving N.

Potassium

K levels of the control treatment were above the current threshold values in November (0.90 %dm) and in December (1.00 %dm), but below the threshold value for January (1.05 %dm) (table 2). In all months sampled, third leaf K content was significantly improved by rates of applied K and increases corresponded with the different rates applied.

Applications of K significantly (P=0.05) reduced the uptake of Ca and Mg in all months sampled (appendix 1).

5.3 Growth Data

Stalk heights were significantly improved by applications of N (P = 0.05) from 6 months of age up to harvest (table 3). Stalk populations were also improved by N treatments but responses were variable and did not necessarily correspond with the rates that were applied.

Stalk heights were generally improved (NS) by K treatments. Stalk populations were improved by K treatments (NS) in May and July.

5.4 Harvest Data

General

There were no statistically significant interactions between N and K treatments and yield results can be reviewed independently.

Nitrogen

Treatments of applied N linearly improved (P = 0.01) both cane and sucrose yield, but had no statistically significant effect on cane quality (table 4). Increases in cane and sucrose yields corresponded with increasing rates that were applied and the highest yields were obtained from the N5 treatment.

Potassium

Cane and sucrose yields were significantly increased (P = 0.05) by rates of applied K despite the fact that soil K levels of treatments receiving K were well above threshold before fertilization (table 4). No statistically significant differences in cane and sucrose yield were observed between treatments receiving K which indicates that the K1 treatment probably supplied sufficient K to meet the demands of the crop. K rates had no apparent effect on cane quality.

6. CONCLUSIONS

- The best yield of cane and sucrose were observed at the highest rate of 240kg N/ha for the 5th consecutive year. This confirms that the recommended rate of 140kg N/ha for this soil is too low to sustain high yields in older ratoons.

- The fact that significant responses to K were observed despite the high soil and leaf K levels that were observed indicates that the recently increased soil K threshold level of 175 ppm as well as leaf K threshold values for November and December may still be too low.

- The responses that were obtained confirm that the current leaf K thresholds for the months November to January may be too low.

- This trial has been continued as an N trial only to further monitor the responses of older ratoons to N application and corrective applications of K have been done to equalize soil K levels. The trial is now in its 17th ratoon.

DMZ/AJD/ppd
22/01/1996

Appendix 1: Leaf Ca and Mg levels at different months

Treatment	Ca (%dm)			Mg (%dm)		
	Nov. (3.7 m)	Dec. (4.5 m)	Jan (5.7 m)	Nov. (3.7 m)	Dec. (4.5 m)	Jan (5.7 m)
N0	0.37	0.32	0.28	0.23	0.19	0.14
N1	0.44	0.31	0.31	0.28	0.20	0.15
N2	0.44	0.30	0.31	0.30	0.20	0.15
N3	0.39	0.27	0.26	0.31	0.25	0.16
N4	0.42	0.31	0.30	0.32	0.24	0.16
N5	0.39	0.28	0.28	0.29	0.24	0.17
LSD N (0.05)	0.08	0.05	0.05	0.05	0.04	0.02
SE Diff. ±	0.04	0.03	0.03	0.03	0.02	0.01
Significance	NS	NS	NS	**	**	NS
K0	0.44	0.34	0.31	0.36	0.26	0.17
K1	0.43	0.28	0.28	0.27	0.20	0.14
K2	0.36	0.27	0.28	0.24	0.19	0.14
LSD K (0.05)	0.05	0.04	0.04	0.04	0.03	0.02
SE Diff. ±	0.03	0.02	0.02	0.02	0.01	0.01
Significance	*	**	NS	**	**	**
Interaction N*K	NS	NS	NS	NS	*	NS
Mean	0.41	0.30	0.29	0.29	0.22	0.15
CV%	15.2	15.4	15.6	13.7	11.8	12.3