

SOUTH AFRICAN SUGAR INDUSTRYAGRONOMISTS' ASSOCIATION

Code: Salinity/Pongola

Cat.No.: 1213 Project No.8127

TITLE: RECLAMATION OF A NON-SALINE SODIC SOIL - KOSTER'S FARMParticulars of project

This crop : Plant
Site : Koster's farm, Pongola
Region : E. Transvaal
Soil system : Komatipoort
Soil series : Bonheim
Design : Observation plots
Variety : NCo 376
Fertilizer : N P K
 105 - -

Soil analysis: before planting

pH	ppm				
	P	K	Ca	Mg	Na
8,4	43	355	7990	1970	620

Age: 12,0 m Dates: 7/9/79-23/9/80Rainfall: 583 mmIrrigation: 860 mmObjectives:

1. To determine whether installation of drains and the application of soil ameliorants to a non-saline sodic soil would improve soil conditions sufficiently to permit the re-establishment of sugarcane.
2. If it were possible to correct the problem how long would it take?

Procedure:-

1. The soil. The soil at the proposed site was comprehensively sampled and shown to be a fairly uniform heavy black clay of the Bonheim series overlying a dark brown clay to depth. Though the EC was not sufficiently high to affect cane growth, the very high pH and sodium levels had adversely affected the soil physical condition causing it to be very prone to waterlogging.
2. Drains. Two lateral drains 150 m long and 19m apart formed the upper and lower plot boundaries. They were installed at depth of 1,3 m in August 1977. 50 mm PVC smooth drainage pipe was laid with a sand envelope some 60 cm thick, and the trenches backfilled with excavated soil, then consolidated with the rear wheels of a front end loader. The PVC pipes led into a collector drain at one end of the plots and two inspection boxes were installed.

3. Soil sampling. Prior to application of treatments in October 1977 samples were taken at four points on a diagonal across each plot. Samples were taken at depths of 0-15, 15-30, 30-60 and 60-90 cm. Similar sampling was carried out in January, March, June 1978 and in February and September 1979.
4. Allocation of treatments. The experiment area was divided into ten plots each 15 m x 19 m, which were allocated various ameliorative treatments.
5. Treatments
 - 5.1 C = Control (drainage only) - 2 plots
G = Gypsum at 26 t/ha - 2 plots
FC = Filtercake at 350 t/ha
G + FC = Gypsum + filtercake at above rates
S = Sulphur at 6 t/ha
H₂SO₄ = Sulphuric acid at 17 t/ha - 2 plots
 $\frac{1}{2}$ H₂SO₄ = Sulphuric acid at half above rate.
 - 5.2 Treatment application: Gypsum and sulphur were applied by hand whilst concentrated H₂SO₄ was sprayed onto the soil using a plastic watering can. Each block was divided into 12 equal areas to facilitate even distribution. Filtercake was applied by shovelling it from the rear of a tractor drawn trailer. The applied gypsum, sulphur and filtercake were incorporated to a depth of 18 cm by two passes of a disc harrow. This was done between lateral drains in order to avoid turning on the neighbouring blocks. The control and H₂SO₄ treated blocks were not ploughed.

One of the H₂SO₄ treated plots, the $\frac{1}{2}$ H₂SO₄ and gypsum + FC plots were mole ploughed to a depth of 45 cm at 2 metre intervals during September 1978.
6. Irrigation. A single irrigation line down the centre of the plots was installed in November 1977 and irrigation commenced in December 1977. The sprinklers were spaced 18 m apart on the rising lateral. Some 3 000 mm of irrigation water plus rainfall were received at the site prior to planting in September 1979, during which time the growth of grasses and broadcast weeds improved markedly.
7. Planting. In early September 1979 the site was ridged out and planted with variety NCo 376 in 1,33 m rows. Germination was surprisingly good despite the heavy soil. A TAM of 90 mm was used in the profit and loss account. A net amount of 40 mm irrigation water was applied on a minimum cycle time of 10 days but only when the deficit reached 54 mm. Crop growth measurements at 5 months indicated there had been a response to amelioration with gypsum and sulphuric acid. Leaf analysis showed adequacy of fertilizer.

8. Results

8.1 Yield and crop characteristics

Treatment	tc/ha	Ers %	t ers/ha	Stalk popn x 10 ⁻³ /ha	Stalk length cm
Control (2)	108	11,8	12,7	110	240
H ₂ SO ₄ (2)	110	11,8	13,1	113	247
Gypsum (2)	111	11,8	13,1	105	248
Filtercake (1)	108	12,2	13,1	120	235
Gypsum + FC (1)	94	12,4	11,6	109	237
Sulphur (1)	105	12,1	12,6	110	242
½ H ₂ SO ₄ (1)	106	11,9	12,6	108	241
Mean (10)	107	11,9	12,8	110	242

8.2 Soil analyses

Treatment	Soil depth cm	pH		EC se (MS/m)		SAR	
		18/10/77	25/9/79	18/10/77	25/9/79	18/10/77	25/9/79
Control	0-15	9,1	8,5	114	106	12,3	8,1
	15-30	9,1	8,8	127	128	14,7	11,6
	30-60	9,1	9,3	167	146	18,9	18,8
	60-90	9,1	9,5	151	171	23,0	22,1
Gypsum	0-15	9,1	8,4	105	67	12,3	3,1
	15-30	9,1	8,5	127	83	12,7	6,2
	30-60	9,0	9,0	178	119	20,8	15,6
	60-90	9,2	9,4	173	126	23,6	20,0
H ₂ SO ₄	0-15	9,0	8,3	142	81	13,8	4,3
	15-30	9,0	8,5	161	112	15,1	7,7
	30-60	9,0	9,0	194	155	21,2	17,2
	60-90	9,2	9,4	156	158	23,7	21,3
Filtercake	0-15	8,8	8,4	179	70	14,5	4,5
	15-30	8,8	8,6	138	95	11,6	8,8
	30-60	8,8	8,9	280	139	17,7	14,0
	60-90	8,9	9,4	355	212	22,6	17,4
Gypsum + FC	0-15	8,8	8,3	167	102	14,1	3,6
	15-30	8,7	8,4	229	160	16,7	6,8
	30-60	8,8	8,8	328	273	21,6	14,5
	60-90	8,9	9,0	362	336	20,3	18,7
Sulphur	0-15	9,2	8,2	112	145	13,6	4,1
	15-30	9,2	8,3	143	210	15,2	9,3
	30-60	9,4	9,1	145	203	20,7	20,6
	60-90	9,6	9,4	98	135	19,8	20,3
½ H ₂ SO ₄	0-15	9,1	8,4	116	92	11,4	5,4
	15-30	9,2	8,6	113	106	12,3	8,1
	30-60	9,3	9,1	155	138	20,1	17,2
	60-90	9,2	9,5	174	176	24,7	21,4

18/10/77 drains installed. 25/9/79 at planting.

9. Comments

9.1 The results demonstrate clearly that subsurface pipe drainage is the factor primarily responsible for bringing the land back into full production in less than two years. The importance of adequate irrigation water to leach the soil prior to re-planting has also been demonstrated.

- 9.2 There is no indication that gypsum, sulphuric acid or any of the other treatments have significantly increased cane yield over that of control. The lowest yield was on the gypsum plus filtercake plot which overall had a somewhat higher level of salinity than that of any other plot.
- 9.3 Chemical amelioration has affected mainly the upper 30 cm of soil and below this the soil is still extremely sodic. With adequate drainage and irrigation however, this depth is sufficient to grow a good crop of cane, even though the average SAR value at planting on the control plot in the 0-30 cm depth was 9.9.
- 9.4 It was hoped that mole drainage would facilitate rapid drainage of the top-soil and therefore speed up gypsum dissolution and salt removal. The height of the water table has been monitored in all plots and data obtained so far indicate that the additional mole drainage has resulted in no practical advantage.
- 9.5 The trial will continue into the first ratoon.

RAW/SN
12 January, 1981

SOUTH AFRICAN SUGAR INDUSTRY

AGRONOMISTS' ASSOCIATION

Code: Salinity/Pongola

Cat. No.: 1213

Project No.: 8127

TITLE: Reclamation of a non-saline sodic soil - Koster's Farm

1. Particulars of project

This crop : First ratoon
Site : Koster's farm, Pongola
Region : Eastern Transvaal
Soil system : Komatipoort
Soil series : Bonheim
Design : Observation plots
Variety : NCo 376
Fertilizer : N P K

Soil analysis:

Age: 12 months Dates: 23/09/1980
16/09/1981
Rainfall: 764 mm
Irrigation: 560 mm

2. Objective

To determine whether installation of drains and the application of soil ameliorants to a non-saline sodic soil would improve soil conditions sufficiently to permit the re-establishment of sugarcane.

3. Treatments

C = Control (drainage only) - 2 plots
G = Gypsum at 26 t/ha - 2 plots
FC = Filtercake at 350 t/ha
G + FC = Gypsum + filtercake at above rate
S = Sulphur at 6 t/ha
H₂SO₄ = Sulphuric acid at 17 t/ha - 2 plots
 $\frac{1}{2}$ H₂SO₄ = Sulphuric acid at half above rate.

4. Results

Table 1 Yield and crop characteristics

Treatment	Tons cane /ha	Ers %	ters /ha	Stalk popu. $\times 10^{-3}$ /ha	Stalk length (m)	Sucrose t/ha
Control (2)	108	10,7	11,5	135	265	13,5
H ₂ SO ₄ (2)	107	11,2	11,9	125	264	13,7
Gypsum (2)	116	11,0	12,7	126	258	14,8
Filtercake (1)	114	9,7	11,1	139	269	13,4
Gypsum + FC (1)	109	10,8	11,8	141	277	13,7
Sulphur (1)	106	11,8	12,4	137	265	14,3
$\frac{1}{2}$ H ₂ SO ₄ (1)	102	11,2	11,4	138	285	13,2
Mean (10)	109	10,9	11,9	133	267	13,8

(Table 2 See page four)

5. Soil analyses

Table 2 summarises the changes in pH, EC and SAR that have occurred in the various treatments between 18 October 1977 and 3 September 1981.

6. Comments

- 6.1 The yield results from the first ratoon were similar to those obtained from the plant crop although the mean tons Ers/ha was down slightly, from 12,8 t/ha to 11,9 t/ha.
- 6.2 Soil pH values have shown little change in the past year. The pH value of 8,6 for all plots at the 0-30 cm soil depth is still very high.
- 6.3 A slight decline in EC was recorded in all but the gypsum treated plots, this being mainly confined to the 0-15 cm depth. However a marked decline in EC was noted on the filtercake and filtercake + gypsum treatments throughout the profile, and in the sulphur treated plot to a depth of 60 cm.
- The profiles of all plots are now non-saline, with the exception of the gypsum + filtercake plot which still shows slight salinity at depth. Over the course of this trial, there has been a definite lowering of salt content in all plots. This reduction can be attributed to an overall improvement in drainage.
- 6.4 There has been a slight reduction in SAR values in most plots over the past year. SAR remained unchanged however in the gypsum and H₂SO₄ treated plots, but there was a significant reduction in values throughout the profile in the filtercake only plot.

Average SAR values for the 0-30 cm depth in all plots are now well below the accepted SAR hazard limit of + 10 for this Bonheim series soil. Below the 30 cm depth however, SAR values are still high and the very marked decline in values recorded between 1977 and 1979 has now levelled off.

MJC/VJ
22 January 1982

Table 2 The effect of a range of ameliorative treatments on soil pH, EC and SAR values at Koster's farm between 16/10/77 and 30/09/81

Treatment	Depth	pH				ECse (MS/m)				SAR			
		18/10/77	25/09/79	8/10/80	30/09/81	18/10/77	25/09/79	8/10/80	30/09/81	18/10/77	25/09/79	8/10/80	30/09/81
Control	0-15	9,1	8,5	8,7	8,6	114	106	71	69	12,3	8,1	6,1	4,4
	15-30	9,1	8,8	8,8	8,8	127	128	105	106	14,7	11,6	10,5	10,6
	30-60	9,1	9,3	9,1	9,2	167	146	134	125	18,9	18,8	15,7	15,5
	60-90	9,1	9,5	9,2	9,4	151	171	152	145	23,0	22,1	18,4	17,7
Gypsum	0-15	9,1	8,4	8,6	8,5	105	67	57	58	12,3	3,1	2,4	2,6
	15-30	9,1	8,5	8,5	8,7	127	83	78	81	12,7	6,2	5,0	7,3
	30-60	9,0	9,0	9,1	9,1	178	119	108	121	20,8	15,6	11,6	14,3
	60-90	9,2	9,4	9,5	9,5	173	126	126	123	23,6	20,0	15,6	16,4
H ₂ SO ₄	0-15	9,0	8,3	8,5	8,5	142	81	67	57	13,8	4,3	3,4	3,1
	15-30	9,0	8,5	8,6	8,7	161	112	98	95	15,1	7,7	7,9	8,5
	30-60	9,0	9,0	9,2	9,2	194	155	126	129	21,2	17,2	13,3	15,1
	60-90	9,2	9,4	9,4	9,5	156	158	148	136	23,7	21,3	17,7	16,6
Filtercake	0-15	8,8	8,4	8,4	8,4	179	70	89	61	14,5	4,5	5,4	1,9
	15-30	8,8	8,6	8,5	8,5	138	95	123	77	11,6	8,8	10,4	6,0
	30-60	8,8	8,9	8,9	8,8	280	139	181	110	17,7	14,0	16,0	10,2
	60-90	8,9	9,4	9,1	8,8	355	212	210	140	22,6	17,4	18,9	14,8
Gypsum + FC	0-15	8,8	8,3	8,3	8,4	167	102	98	76	14,1	3,6	5,7	3,8
	15-30	8,7	8,4	8,4	8,6	229	160	152	139	16,7	6,8	10,4	9,6
	30-60	8,8	8,8	8,8	8,7	328	273	277	215	21,6	14,5	15,4	15,0
	60-90	8,9	9,0	8,8	8,7	362	336	326	302	20,3	18,7	19,5	17,1
Sulphur	0-15	9,2	8,2	8,4	8,4	112	145	150	88	13,6	4,1	5,1	4,0
	15-30	9,2	8,3	8,6	8,7	143	210	228	152	15,2	9,3	13,5	11,9
	30-60	9,4	9,1	9,2	9,4	145	203	209	182	20,7	20,6	21,0	18,3
	60-90	9,6	9,4	9,3	9,5	98	135	154	165	19,8	20,3	18,2	21,5
½ H ₂ SO ₄	0-15	9,1	8,4	8,5	8,6	116	92	68	62	11,4	5,4	4,2	3,5
	15-30	9,2	8,6	8,6	8,9	113	106	112	111	12,3	8,1	9,2	9,8
	30-60	9,3	9,1	9,1	9,0	155	138	175	163	20,1	17,2	18,2	17,3
	60-90	9,2	9,5	9,2	9,4	174	176	179	174	24,7	21,4	18,0	19,4