SOUTH AFRICAN SUGAR INDUSTRY

AGRONOMISTS' ASSOCIATION

Code: A/Soil/81P
Cat. No.: 1315

TITLE: Soil amendment with Hydrogel and glassfibre wool

A. Field evaluation

1. Particulars of the project

This crop	:	Plant
Site	:	La Mercy
Region	:	Coastal
Soil system	:	Umzinto Coast/ Lowlands
Soil form/series	:	Swartland
Plot Size	:	3 Rows x 1,4x5,0= 21m²
Design	:	Latin Square x 3 Reps
Variety	:	NCo 376
Fertilizer / Ameliorants	:	N 207 - P 37 - K 218

Soil analysis: Date: 14/1/81

pH	O.M.%	Clay %
5,45	1,6	26

ppm

P	K	Ca	Mg	Zn	Al
21	102	1031	> 220	1,2	-

Age: 15,2 Mths Dates: 25/2/81-1/6/82
Rainfall: 1190mm L.T.M.: 1275mm
Irrigation: Nil

Rainfall

Rainfall in (mm)

Mth	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	TOTAL
Mth.	1	35	11	139	19	21	159	107	74	157	45	139	94	102	69	18	1 190
L.T.M.	28	127	76	49	35	28	38	62	109	114	114	125	118	127	76	49	1 275

L.T.M. = Long term mean

Description of soil

Dark grey brown structureless sandy clay loam (orthic), about 250 mm thick overlying a very dark blocky clay with clay skins (pedocutanic)

2. Objective

To measure, in a small field experiment, the effect on cane growth and yield of placing Hydrogel and layers of glassfibre wool in the planting furrow in a sandy clay loam at the La Mercy farm.

3. Motivation

Hydrogel is a soil amendment which is reported to increase the water holding capacity of soils by up to 50%. If the T.A.M. of many of the soils in the cane growing areas could be increased by even 10%, at a reasonable cost, the improvement in rainfall efficiency and consequently yield, would be substantial.

In a small observation trial at La Mercy last year there appeared to be a considerable response to layers of fibreglass placed in the planting furrow.

4. Treatments

1. Control - untreated

2. Hydrogel (Viterra 2) at 300g/m of cane row

3. Fibreglass wool at 300g/m of cane row

Notes on treatments:

Furrows were drawn in moist soil, fertilizer (Saaifos) and then seed setts placed in the furrows and thereafter the Hydrogel or Fibreglass wool were placed over the setts before covering with soil.

5. Results

The trial was harvested at 15,2 months and yielded as follows:

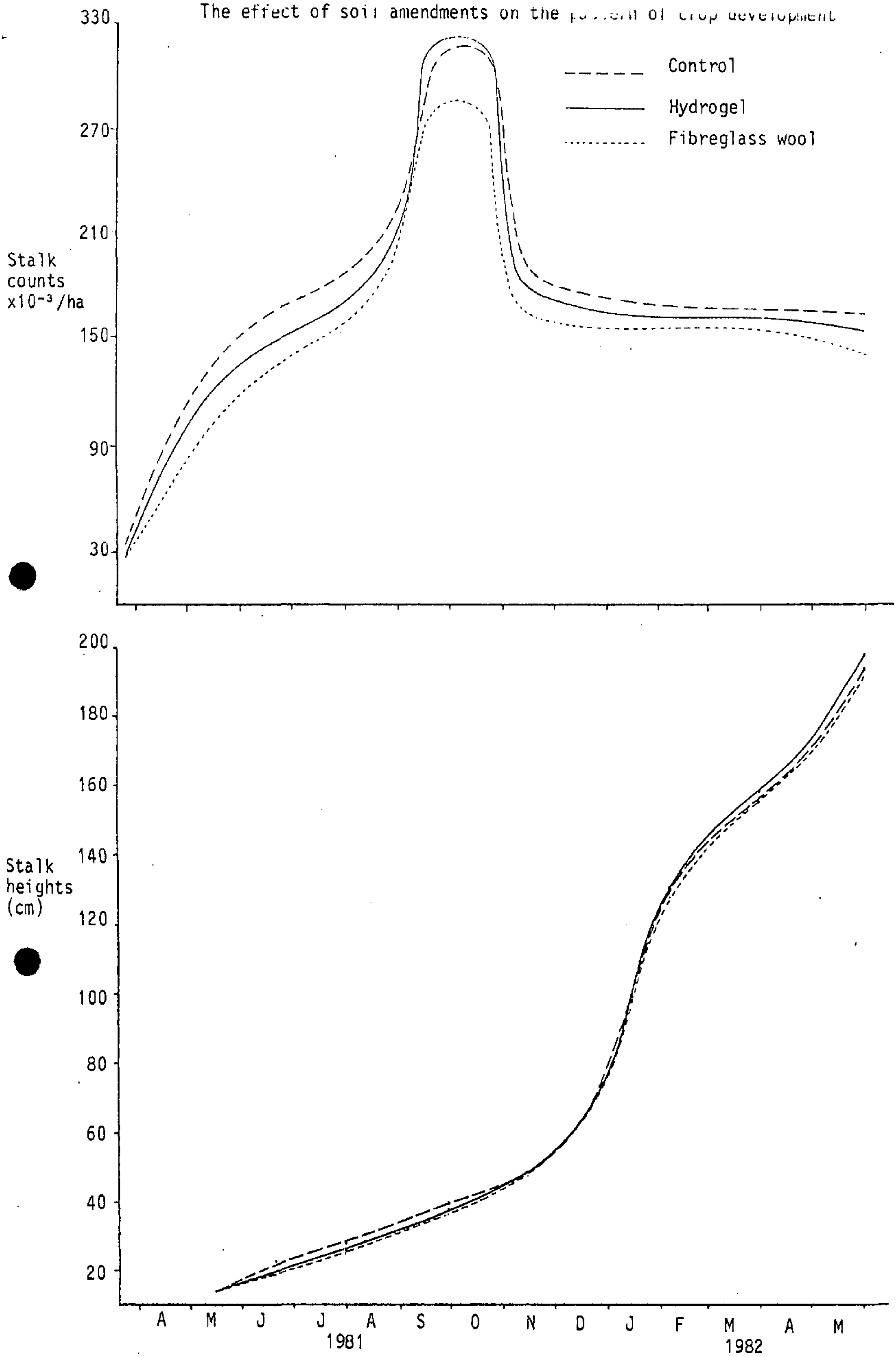
5.1 Yields

	cane t/h	sucrose % cane	sucrose t/ha	stalk pop thd/ha	stalk length m
Control	134	11,9	16,0	155	1,93
Hydrogel	127	12,2	15,5	145	1,97
Fibreglass	125	11,7	14,5	139	1,91
Mean	129	11,9	15,3	146	1,94
C.V. %	3,8	4,5	6,6	2,9	2,6
L.S.D.(0,05)	16,9	1,27	3,6	15,1	0,18

5.2 Growth measurements

Germination was unaffected by treatment and the effects on crop growth were hardly discernable as illustrated in the graphs that follow.

The effect of soil amendments on the pattern of crop development



6. Comments

- The lack of response to either amendment was disappointing. As usual there were a number of dry periods during crop development so the lack of response to amendments was not attributable to rainfall.

- A criticism of the techniques used might be that the Hydrogel was not incorporated into the soil.

B. Evaluation in a pot trial

1. Particulars of the project

1.1	Site	: Glasshouse Mount Edgecombe
1.2	Soil system	: Umzinto Coast Lowland
1.3	Soil form/series	: Fernwood / Fernwood
1.4	Pot size	: height 357 mm, diameter 355 mm
1.5	Design	: six replications
1.6	Variety	: NCo 376
1.7	Fertilizer	: adequate nutrients applied at intervals to all pots

Description of soil

A deep grey medium sand with 7% clay, and 4% silt.

2. Objectives

To determine during a drying cycle:

2.1 if stress symptoms are delayed in cane growing in treated soil compared with cane growing in untreated soil

2.2 the difference in mass of water held in the treated and untreated soils at the time the cane in the untreated soil starts to wilt

3. Treatments

- Soil was taken at a depth of 0 to 200 mm from area 2, adjacent to trial site F9L/79, at La Mercy; it was air-dried for some days. Each drum then received 17,30kg air-dry soil (18.3.81)

- Hydrogel at 3kg/m³ soil - 52 g/drum of soil was thoroughly mixed into each 17,30kg soil before the soil was placed into the drum.

- Fibreglass wool at 1,5kg/m³ - 28 g/drum of soil was mixed as well as possible and then placed into the drums

- Control drums also received 17,30kg air dry soil but no amendments

4. Effect of amendments on mass of drums

The soil in all drums was saturated with water (24.3.81), left to drain and then weighed over a period of 10 days.

Mean weight per drum, days after saturating soil

	1 25/3	3 27/3	8 1/4	10 3/4	Mean
Control	21,95	21,67	21,70	21,67	21,75
Hydrogel	24,80	24,80	25,30	25,27	25,04
Fibreglass	22,62	21,85	22,02	21,87	22,09

Mean mass of moisture held at field capacity

(mass in table above less 17,30kg air dry soil

less mass of drums

Control	21,75 - 17,30 - 2,70	=	4450 gms
Hydrogel	25,04 - 17,30 - 2,70	=	7740 gms
Fibreglass	22,09 - 17,30 - 2,70	=	4790 gms

5. Experiment procedure

Two pre-germinated single-eyed setts of NCo 376 were planted into each drum (8.4.81). Once establised one of the plants was cut back and the regrowth treated with Roundup, leaving the best grown plant in each drum (2.6.81).

All drums were kept in the open alongside the glasshouse, watered as required and nutrients applied mainly in the form of 5.1.5 (42). By November 1981 the water requirements per drum were about 600 ml/day, increasing to 750 ml/day by December, and to 1 ℓ by January 1982.

On 15th and 16th February 1982, 10 months after planting, all drums received their final watering to field capacity, were weighed once there was no further leaching, the drums were placed under cover of the glasshouse and the drying cycle started.

Drums were weighed at various intervals after the 16.2.82 and up to 22.2.82 when the final weighings were done and the plants cut back, weighed and dry matter determined.

6. Results

6.1 Treatment effects on evapotranspiration

A summary of the Et losses from the cane in each treatment towards the end of the experiment when the sugarcane was progressively stressed is given in the table that follows.

Evapotranspiration losses over the seven day stress period

Date/ Time	Control			Hydrogel (± 0,2%)			Glass Fibre (± 0,1%)		
	Mean mass of pot (kg)	Change in mass - or water loss (kg)	Cumulative water loss (kg)	Mean mass of pot (kg)	Change in mass - or water loss (kg)	Cumulative water loss (kg)	Mean mass of pot (kg)	Change in mass - or water loss (kg)	Cumulative water loss (kg)
16/2/82	26,30			27,89			26,50		
18/2/82 8.15	24,52	1,78	1,78	26,03	1,86	1,86	24,69	1,83	1,83
18/2/82 12.15	24,11	0,41	2,19	25,51	0,52	2,38	24,27	0,40	2,23
18/2/82 15.30	23,86	0,23	2,44	25,13	0,38	2,76	24,01	0,26	2,49
19/2/82 7.50	23,59	0,27	2,71	24,81	0,32	3,08	23,75	0,26	2,75
19/2/82 16.00	23,21	0,38	3,09	24,29	0,52	3,60	23,36	0,39	3,14
22/2/82 8.05	22,60	0,61	3,70	23,44	0,85	4,45	22,78	0,58	3,72

It can be seen that cane grown in Hydrogel treated soil used the most water (20% more than control), whereas cane grown in the glass fibre and control drums used about the same amount. This indicates that the Hydrogel treated soil contained more plant available water held at high matric potential than did the other soils, and that under the same evaporative conditions the evapotranspiration rate was maintained for a longer time.

The difference in water use between cane in the control and the Hydrogel treated soil became progressively more pronounced as the stress increased.

Comparing the moisture release curves of Hydrogel treated soil and the control, (see results of soil moisture release), this difference in water use is not unexpected as at low tensions the Hydrogel treated soil contained significantly more moisture.

6.2 Cane yields and observations

Some of the yield data are given in the table that follows:

	Control	Hydrogel	Glassfibre
Mass of fresh material (g)	1319	1471	1313
D.M.%	30,3	28,4	30,5
Mass of dry maerial (g)	400	418	400
Mean stalk ht (mm) prior to onset of stress (12.2.82)	662	699	682
Mean stalk count/drum	8,8	8,8	8,8

Cane in the Hydrogel soil was better grown before the onset of stress (see mean stalk height), had a higher mass and was less desiccated at harvest. Despite the heavier crop (and presumably greater leaf area) symptoms of moisture stress were considerably delayed when cane was growing in soil treated with Hydrogel.

Timetable

16.2	: soil at field capacity
17.2	: drying off started
18.2, 8.30	: no stress symptoms
18.2, 12.30	: wilting evident in control drums only
18.2, 15.30	: wilting evident in fibreglass drums as well and very slight in Hydrogel drums.
19.2	: cane in all drums showing stress but less serious in Hydrogel drums
22.2	: final weighing

6.3 The effects of Hydrogel on soil moisture release

A laboratory study was conducted to determine the effect of Hydrogel on the moisture release, bulk density and total pore space characteristics of a Fernwood form soil.

Undisturbed core samples were taken at 0-5 cm depth from each of the untreated and Hydrogel-treated replicates. Matric potential curves were determined over the 7,5 to 1500 kPa range. The bulk density was also determined on these cores and total porosity calculated using a particle density of 2650 kg m^{-3}

The results obtained are given in the table and figures that follows.

Results:

It is evident from a comparison of the available data that Hydrogel has improved the soil's capacity to hold moisture.

The matric suction curves indicate that the greatest improvement was obtained in the low tension range (10 to 100 kPa).

The fairly large proportion of available water left in the Hydrogel treated soil (12,01% at 1500 kPa) is suprising as the manufacturers have indicated that 90% of water held by Hydrogel is in the low tension range. Shrinking with subsequent drying out of the treated soil sample will result in poor contact with the ceramic plate and this may explain the anomalous result.

It is interesting to note that Hydrogel has improved air capacity on average by about 5% whilst bulk density has been reduced by about 30%.

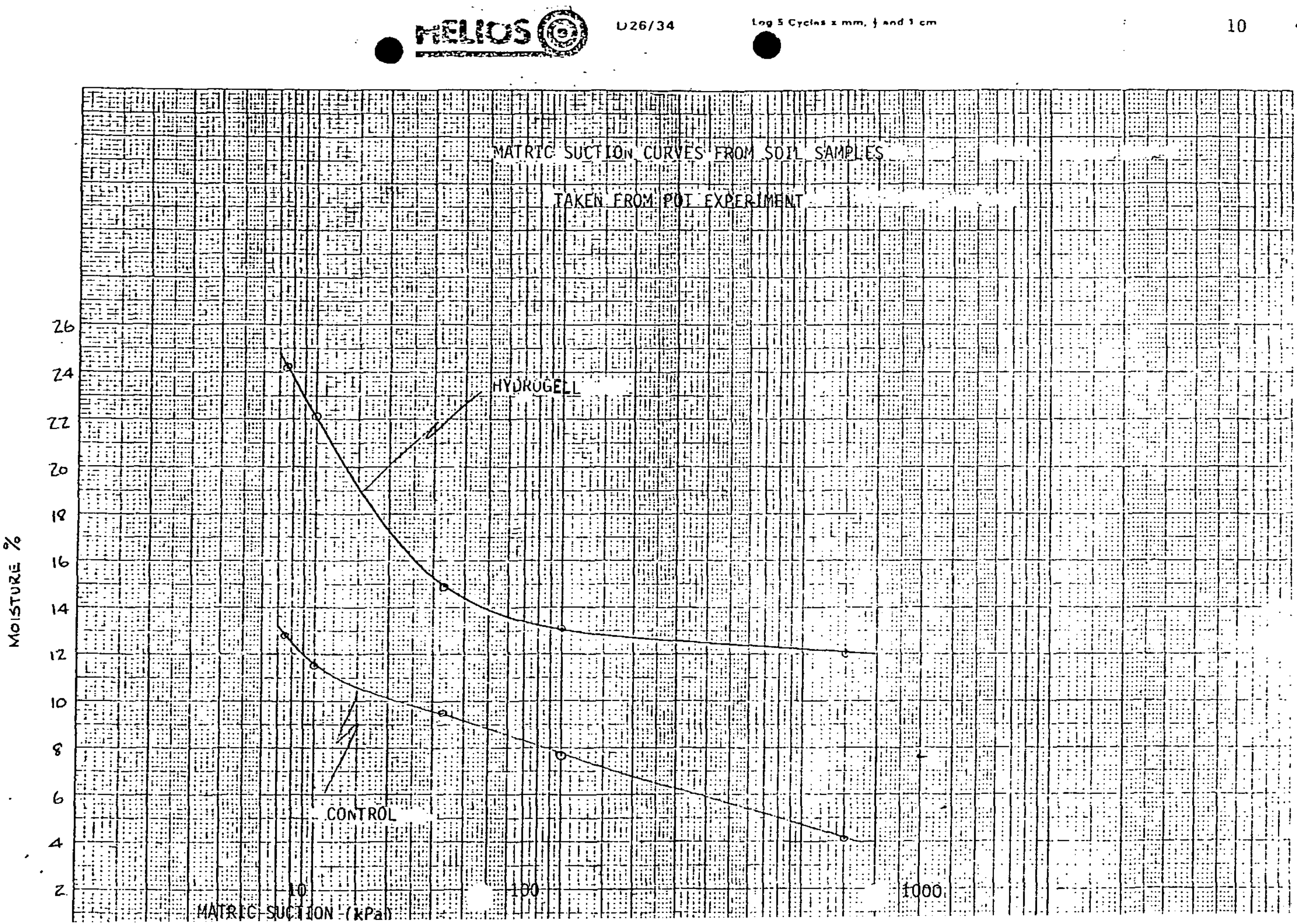
As the soils had perhaps not settled sufficiently at the time of sampling, results may have differed had samples been taken later.

7. General comments

- It is clear that Hydrogel (at 0,3% by mass) had a substantial effect on soil characteristics and plant growth whereas the effect of fibreglass wool (at 0,16% by mass) was negligible.
- Hydrogel increased the quantity of water lost through E_t by 20%, delayed the onset of wilting by about 24 hours, increased water holding capacity over a wide range of soil tensions, improved air capacity of the soil by 5%, reduced bulk density by 30% and increased yield by 12% (fresh material) and 5% (d.m.)

- The well-known constraints in extrapolating data obtained from pots to field conditions are acknowledged but nevertheless, the results are very encouraging and worth persuing in the field in soils with a low TAM and with cheaper material if such is available.

PKM/IS
15 November 1982


HELIOS
D26/34
Log 5 Cycles x mm, ½ and 1 cm
MATRIC SUCTION CURVES FROM SOIL SAMPLES
TAKEN FROM POT EXPERIMENT
HYDROGELL
CONTROL
MOISTURE %
26
24
22
20
18
16
14
12
10
8
6
4
2
10
100
1000
MATRIC SUCTION (kPa)

DATA FOR MOISTURE RETENTION CHARACTERISTICS

* Figures not included in the mean

Lab No.	Source of Sample	Moisture % (Gravimetric) 7,5 kPa	10,0 kPa	33 kPa	100 kPa	400 kPa	800 kPa	1500 kPa	Bulk density kg/m^3	AMC[1] mm/m (10,0 - 1500 kPa)	AMC[1] mm/m (10,0 - 100 kPa)	Total[2] porosity (% by vol)	Air filled porosity at 10,0 kPa (% by vol)
1132	Control 1	12,74	11,63	9,71	8,07			3,70	1457	116	52	45,0	28,06
1133	" 2	12,92	12,98*	9,61	8,14			3,87	1444	132*	70*	45,5	26,76*
1134	" 3	12,28	11,14	9,59	7,45			7,48*	1458	53*	54	45,0	28,75
1135	" 4	12,89	11,31	9,30	7,86			4,70	1459	96	50	44,9	28,40
1136	" 5	12,96	11,54	9,27	7,60			4,30	1485	108	59	44,0	26,87
1137	" 6	13,17	11,69	9,21	7,30			3,78	1400	111	61	47,2	30,84
	Average	12,83	11,46	9,45	7,74			4,07	1451	108	55	45,3	28,6
1138	Hydrogel 7	24,55	22,70	14,65	12,82			11,78	1101	120	109	58,5	33,50
1139	" 8	21,91	19,79	11,83	10,14		?	10,98*	1137	100*	110	57,1	34,61
1140	" 9	24,16	22,17	17,19	14,89			16,77*	1111	60*	81	58,1	33,47
1141	" 10	26,36	23,29	16,39	13,98			13,07	1080	110	101	59,2	34,04
1142	" 11	23,93	21,62	12,77	11,63			9,96	1101	128	110	58,5	34,70
1143	" 12	24,38	22,92	16,32	14,94			13,21	1101	107	88	58,5	33,26
	Average	24,22	22,08	14,86	13,07			12,01	1105	116	100	58,3	33,9

1 AMC = Available moisture capacity

2 Calculated from the relationship: $\text{total porosity} = 100\left[1 - \frac{\text{bulk density}}{\text{particle density}}\right]$

DATA FOR MOISTURE RETENTION CHARACTERISTICS

Lab No.	Source of Sample	Moisture % (Volumetric)							Bulk density kg/m^3	AMC[1] mm/m (10,0 - 1500 kPa)	AMC[1] mm/m (10,0 - 100 kPa)	Total[2] porosity (% by vol)	Air filled porosity at 10,0 kPa (% by vol)
		7,5 kPa	10,0 kPa	33 kPa	100 kPa	400 kPa	800 kPa	1500 kPa					
1132	Control 1	18.55	16.94	14.15	11.76			5,39					
1133	" 2	18,65	18,74*	13,87	11,75			5,59					
1134	" 3	17,90	16,25	13,98	10,87			10,91*					
1135	" 4	18.81	16,50	13,57	11,47			6,86					
1136	" 5	19,24	17,13	13,77	11,28			6,38					
1137	" 6	18,44	16,36	12,89	10,22			5,29					
		18,60	16,64	13,71	11,23			5,90					
1138	Hydrogel 7	27,03	25,00	16,13	14,11			12,97					
1139	" 8	24,90	22,49	13,45	11,52		?	12,48*					
1140	" 9	26,84	24,63	19,10	16,55			18,63*					
1141	" 10	28,47	25,16	17,70	15,10			14,11					
1142	" 11	26,35	23,80	14,06	12,80			10,96					
1143	" 12	26,85	22,24	17,98	16,46			14,55					
		26,74	24,39	16,40	14.42			13,15					

1 AMC = Available moisture capacity

2 Calculated from the relationship: $\text{total porosity} = 100\left[1 - \frac{\text{bulk density}}{\text{particle density}}\right]$