PROEFSTATION VOOR TUINBOUW ONDER GLAS, NAALDWIJK

The pH change over time in three different sources of rockwool

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Introduction

In the Netherlands rockwool is used commercially to grow a variety of vegetable and floricultural crops. Cymbidium orchids grown in rockwool often become chlorotic in the first few weeks of growth due primarily the calcium oxide present in the rockwool which causes a slightly alkaline reaction and rise in pH(Sonneveld, 1980, Verwer, 1980). The chemical composition of rockwool is presented in table 1.

Table 1. The chemical composition of rockwool (Verwer, 1980)

Si02	47%	Mg0	10%
Al203	14%	Mn0	1%
Ti03	1%	Na20	2%
Fo03	8%	K20	1%
Ca0	16%		

The rockwool commonly used in the Netherlands is produced by the Rockwool Lapidus Co. and sold under the trade name Grodan. It is sold either as prefabricated cubes and slabs or in granulate form. The granulate form is produced by factories in Denmark and the Netherlands by different manufacuring processes. The Danish granulate is the byproduct of the prefabricated cubes and slabs and contains a higher level of phenolic resin. The Dutch product is directly manufactured and contains larger particles then the Danish product.
The objective of this experiment was to study the pH and chemical composition change in rockwool of three different sources over a period of time.

Materials and Methods

Three types of rockwool were used in the experiment; cubes of 20 x 20 x 15 cm which were covered with a black plastic, and the Dutch and Danish granulate which was added to plastic containers of 20x17 cm. There was 325 g of each type of rockwool used. A small hole was punched in the bottom of the cubes and plastic containers to allow the leachate to escape from the bottom. The cubes and containers were set on a glasshouse bench on small circular trays for collection of the leachate. The tops of the containers were covered with black plastic to prevent algae growth on the rockwool.
One nutrient solution was used at pH levels of 4.5 and 6.5 consisting of 60 g calcium nitrate and 50 g Nutriflora-T per 50 liters of water. The pH values were regulated by use of the nitric acid or potassium hydroxyde. The nutrient solution was added to the rockwool surface daily in 500 ml increments. After 1600 ml were added the rockwool became saturated and leachate was obtained. Further nutrient solution was added daily, first in increments of 150 ml for 7 day period, later in 200 mm increments for a 5 day period, and finally in 300 ml increments for 21 days giving a total of 8350 ml of solution per container. The pH and EC of the leachate were measured approximately every 2 days. The measurings were terminated when the pH began to stabilize. At this time the solution was extracted by pressure from the rockwool and collected for analysis by routine laboratory procedures.
The experiment was a factorial design with 3 replications.

Results and Discussion

Figure 1 shows the pH values for the rockwool over time. All the rockwool treatments show a decrease in pH over time with the granulate forms having a more rapid change in the beginning of the experiment. The cube rockwool pHvalues were lower than the granulate throughout most of the experiment. One explanation for this is that the rockwool cube fibers are not broken during manufacturing as with the granulate and therefore less alkaline reaction occurs (Verwer , 1980). The coefficients of variation between replications for the analysis of variance are presented in the table 2.

Table 2. The coefficient of variation for the pH and EC values of rockwool.

	coefficient of variation	
treatment	pH	EC
Cube 4.5	2.2	1.8
Cube 6.5	1.8	3.3
Dutch 4.5	4.8	1.5
Dutch 6.5	4.1	1.9
Danish 4.5	3.8	1.9
Danish 6.5	2.3	3.2

The values were low for all the treatments.
At the beginning of the experiment the granulate forms of rockwool had a large increase in pH indicating that calcium in the rockwool was being dissolved. At the end of the experiment the pH levels of the Dutch and Danish granulate forms gave similar values indicating that an equilibrium of pH was achieved.
Figure 2 shows the EC values of the rockwool over time. The EC values were stable for the first part of the experiment and then rose slightly until the conclusion of the experiment. On the days between 7/25 and 7/28 there was a drop in EC which is believed to be due to a malfunction in the EC meter. The values were similar for each treatment throughout most of the experiment. The corresponding coefficient of variation values for the EC are given in table 2. The values of each treatment were low.
The composition, EC and pH values of the different sources of the rockwool and nutrient solutions used are presented in tables 3 and 4.

Table 3. The composition of macronutrients (mmol/l), pH and EC (mS/cm 25° C) of the extraction solution form the rockwool sources and nutrient solutions (stand 4.5 and stand 6.5) used.

Sample	NH4+	K+	Na+	Ca++	Mg++	NO3-	Cl-	SO4--	HCO3-	P	EC	pH
Cube 4.5	0.2	9.3	0.9	6.3	1.8	16.8	0.5	3.9	0.2	1.47	2.38	5.36
Cube 6.5	0.2	10.2	0.9	6.3	1.8	17.4	0.5	3.9	0.1	1.59	2.50	5.45
Danish 4.5	0.1	9.3	0.9	6.0	1.8	17.1	0.5	3.9	0.3	1.08	2.41	5.52
Danish 6.5	0.2	9.9	1.2	6.0	1.8	17.1	0.3	3.9	0.2	1.17	2.46	6.05
Dutch 4.5	0.2	9.3	1.2	6.3	1.8	16.8	0.5	3.6	0.2	1.23	2.40	5.80
Dutch 6.5	0.0	9.6	0.9	6.3	1.8	16.8	0.5	3.6	0.2	1.11	2.40	6.27
Stand 4.5	0.1	9.0	1.8	5.1	1.5	14.1	0.5	3.6	0.3	1.65	2.19	5.11
Stand 6.5	0.1	9.6	0.9	5.4	1.2	14.4	0.5	3.9	0.2	1.77	2.25	5.17

Table 4. The composition of micronutrient (μmol/l) of the extracted solution from the rockwool sources and nutrient solutions (stand. 4.5 and stand. 6.5) used.

	Fe	Mn	Zn	B	Cu
Cube 4.5	8.7	24.4	5.4	44	0.82
Cube 6.5	9.6	23.1	5.3	44	0.78
Danish 4.5	11.3	19.9	2.9	43	1.09
Danish 6.5	8.3	11.8	3.2	43	0.59
Dutch 4.5	9.8	20.5	3.1	45	0.85
Dutch 6.5	8.8	15.5	3.2	43	0.63
Stand. 4.5	12.9	25.0	6.5	42	0.65
Stand. 6.5	10.4	25.5	6.2	42	0.50

There were higher concentrations of calcium and magnesium in the extract of all types of rockwool than in the nutrient solutions indicating that these elements were being supplied by the rockwool. The EC values were also higher in the rockwool sources. The NO3-N content was higher in the rockwool solution, but the explanation for this is unknown since rockwool contains no No3-N. The levels of manganese and zinc were lower in the rockwool than in the nutrient solution indicating that these elements may be absorbed by the rockwool. The pH value for the 6.5 pH nutrient solutions changed at the conclusion of the experiment to a value of 5.5. The explanation for this is unknown, but the solution used throughout the experiment had a pH of approximately 6.5.

Summary and conclusions

The pH in the Dutch and Danish granulate was initially high for both pH levels of nutrient solution indicating that an alkaline reaction was occuring. Approximately 3 weeks were required to bring the pH to 6.0. The Dutch and Danish forms of rockwool gave similar results even though their manufacturing processes are different. The rockwool cubes gave only a slight rise in pH from the 6.5 pH nutrient solution and a slightly greater increase resulted with the 4.5 pH nutrient solution. The fibers are not broken in the manufacturing of the rockwool cubes and this may make the cubes less prone than the granulate rockwool to an alkaline reaction.

References

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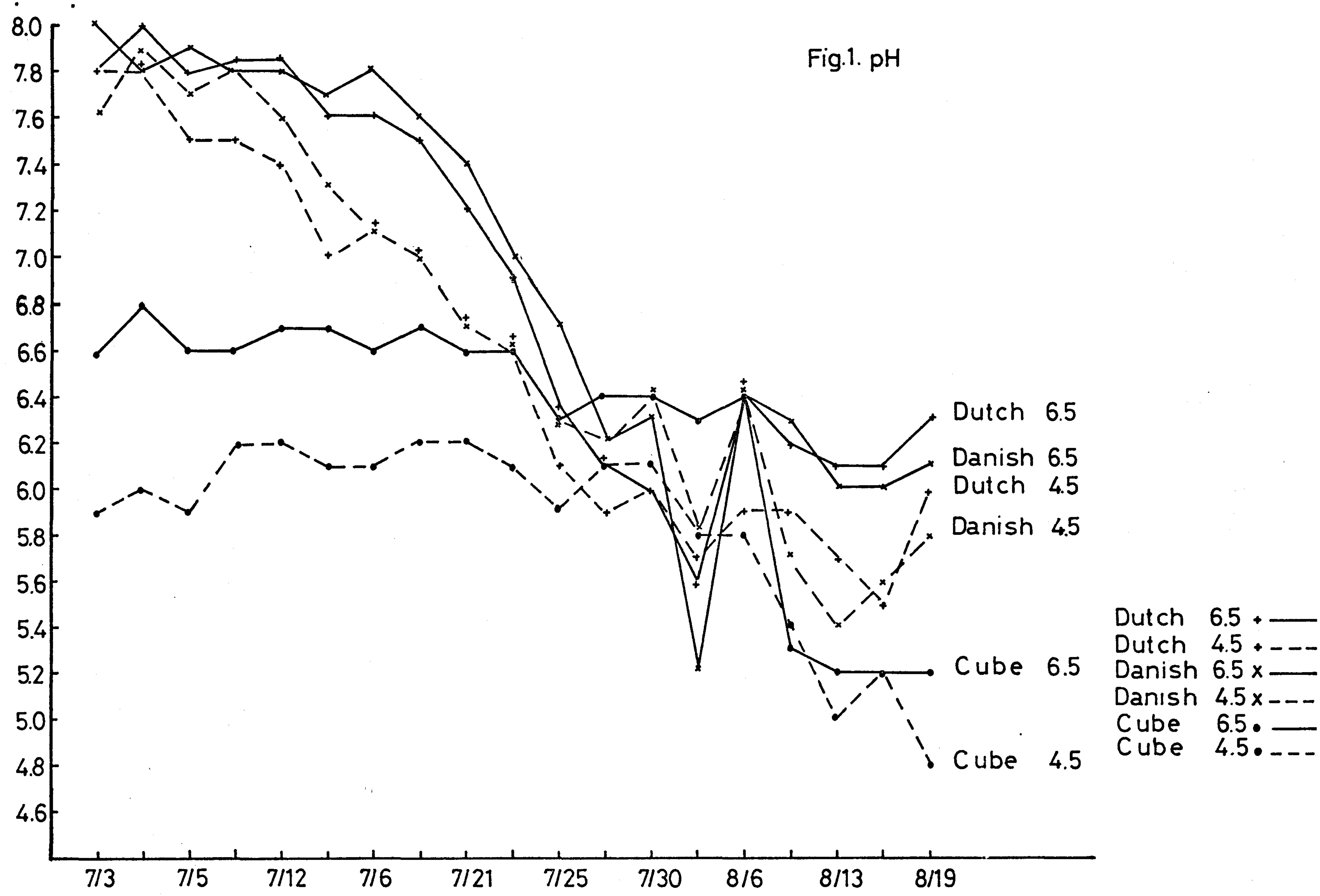
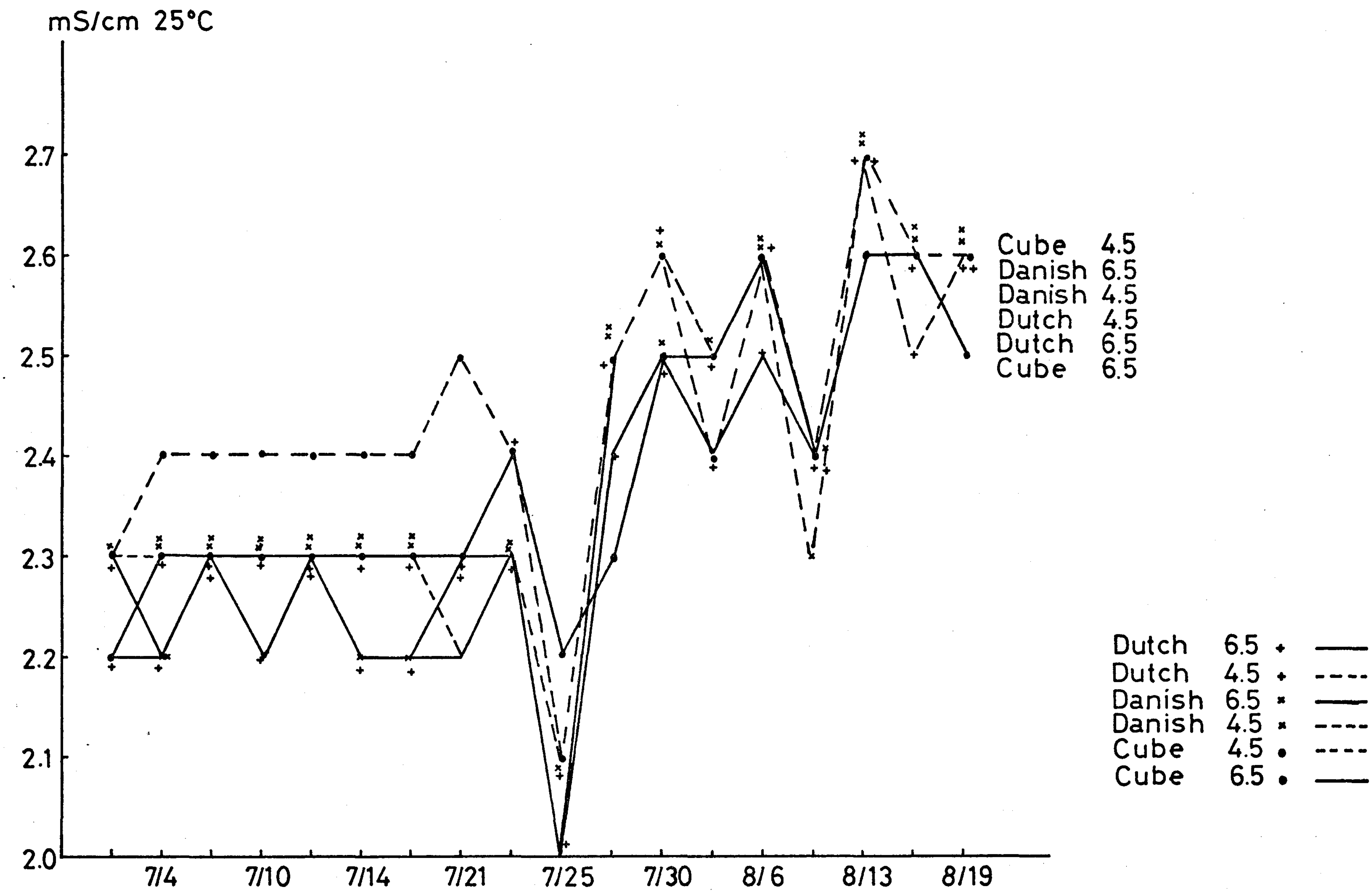


Fig.1. pH
8.0
7.8
7.6
7.4
7.2
7.0
6.8
6.6
6.4
6.2
6.0
5.8
5.6
5.4
5.2
5.0
4.8
4.6
7/3
7/5
7/12
7/6
7/21
7/25
7/30
8/6
8/13
8/19
Dutch 6.5
Danish 6.5
Dutch 4.5
Danish 4.5
Cube 6.5
Cube 4.5
Dutch 6.5 +
Dutch 4.5 +
Danish 6.5 x
Danish 4.5 x
Cube 6.5 •
Cube 4.5 •

fig.2. EC



mS/cm 25°C
2.7
2.6
2.5
2.4
2.3
2.2
2.1
2.0
7/4
7/10
7/14
7/21
7/25
7/30
8/6
8/13
8/19
Cube 4.5
Danish 6.5
Danish 4.5
Dutch 4.5
Dutch 6.5
Cube 6.5
Dutch 6.5
Dutch 4.5
Danish 6.5
Danish 4.5
Cube 4.5
Cube 6.5